Let's Smile

Osstem intends to improve the quality of implants continuously, activate the global AIC operation, and expand its global production and sales thus solidifying its status as a world-class implant maker by pursuing differentiated marketing strategies.

OSSTEM IMPLANT

2013 OSSTEM IMPLANT SYSTEM

1st edition published at 1th April 2006

2nd edition published at 14th Feb 2013

Published by Choi, Kyoo-ok

Edited by Kim, Young-kyun, Kim, Ki-Seong, Kim, Se-woung, Park, Hwee-Woong
Oh, Young-Hak, Lee, Dae-Hee, CHO, Yong-Seok

Publisher : Osstem Implant Co., Ltd.

Registration No. 2005-5

Address : 8th floor, World Meridian 2, 426-5 Gasan-dong, Geumcheon-gu,
Seoul, Korea

Telephone : 82-2-2016-7000

Fax : 82-2-2016-7001

Web-site : http://www.osstem.com

E-mail : master@osstem.com

Manufactured by adfarm Communication

Printed by Grabic Co., Ltd. 031-901-2982

Price : 100,000 Won

CEO's MESSAGE

I am very happy to publish revised edition of 2013 OSSTEM IMPLANT SYSTEM.

OSSTEM IMPLANT CEO

Choi, Kyoo-Ok (DDS, Ph.D.)

Korea's dental implant studies were introduced considerably later than in Europe or America.
However, thanks to Korea's high standard of dentistry, dentists' academic fervor, and increase in the general public' s interest for oral health has developed academics and industry, resulting in a rapid popularization of implants. Not only do all universities perform implant operations, but also over 80% of private clinics. Korea's implant clinic has been growing and developing into a world-class level.

Osstem Implant has been spearheading such trend of growth and evolution, providing clinical operation methods and clinical technical intelligence to AIC workshops, regional research societies, as well as various conferences. By publishing general introduction to OSSTEM IMPLANT SYSTEM in 2005 and five general introductions to OSSTEM IMPLANT SYSTEM in 2006, Osstem Implant has been contributing to the improvement of clinical operation methods and the development of academics.

It has been 7 years since the publication of total five general introductions to OSSTEM IMPLANT SYSTEM, and Osstem Implant has been striving for the clinical development of implants by continual research and development, development of new technology, and provision of more convenient, safe, and durable products to both dentists and patients for quality improvement.

Basing on years of cases with new concepts of operative methods applied, in addition to the release of such new technology and products, a revised edition of OSSTEM IMPLANT SYSTEM has been published.

This revision, published after 7 years, bear different significance from first edition of general introduction of 2005 and from 5 particulars released in 2006 when implant was being popularized.

This revised edition is not a mere update from OSSTEM IMPLANT SYSTEM, but an upgrade revision, which exhibits enhanced convenience in operation and long term clinical results by applying improved Osstem implant' s design and new products with improved surface treatment. Moreover, it is a guideline organized to show operative methods of experienced clinicians, so that clinicians can utilize state of the art surgical tools and equipment

The revised edition consists of "Variety, Design, and Surface Treatment of Osstem Implant", "Implant Operation", "Implant Prosthesis", "Surgical preparation and instrument management", "Clinical cases", "Related Articles" and etcetera. Because it includes detailed accounts of real clinical application processes based on Osstem Implant's product' s technical understanding, it is expected to provide immediate and realistic clinical guidelines to private clinicians.

To the hard work of those who helped greatly to publish this book with liberal clinical verifications and researches: Prof. Kim young-Kyun, Dr. Oh Young-Hak, Dr. Cho Yong-Seok, Dr. Lee Dae-Hee, Dr. Kim Ki-Seong, Dr. Park Hwee-Woong, Dr. Kim Se-Woung, I give special thanks. Moreover, I thank the AIC directors and the dentists in the country who have provided valuable clinical cases and numerous feedbacks.

I give thanks to my fellow dentists and admire their passion and dedication that helped Osstem implant achieve global excellence.

This book is a product of Osstem implant's development, as well as a determination to lead the international dental community as a representative of Korea. Through unrelenting effort and research, we promise to return with even better products and technology.

Thank you.

Editor's note

Editor in Chief

Kim, Young-Kyun

Since Osstem's first development of domestic implant in 1992, the first patent for dental implant in Korea was obtained in 1995 through continuous research. It was released as AVANA since 1997, and I began to cautiously use domestic implants. However, I was hesitant as I had a vague sense of mistrust and discomfort regarding domestic products. Nevertheless, after confirming the excellent initial osseointegration and functional maintenance after prosthesis treatment, I started to actively use domestic implants. Since then, the company name changed to Osstem Implant, and surface treatment was continuously developed and products of various designs were released. Moreover, numerous scholars reported on the fundamental and clinical research results, and as both domestic and international academic journals recently publish Osstem Implant related journals, intermediate to long term stability has been confirmed.

General introduction to OSSTEM IMPLANT published in 2005 was acclaimed as the first book in which a company has organized its implants. In 2006, revised introduction in Korean, Taiwanese, and English was published, and itemized discussions of operation, prosthesis, prosthetic lab-work, and esthetic implant have also been published, providing valuable resources not only to the implant community but also to the dentists.

The material published in 2013 records in detail the history of Osstem Implant, types and characteristics of fixtures, surgical instruments and procedures, and discusses in depth the concept of basic implant prothodontics, occlusion, and impression taking. Successful clinical cases from domestic scholars who used Osstem Implants are introduced, and Osstem Implant related international academic articles have also been included. This teaching material, I believe, is not merely limited to Osstem Implant system, but could aid in the fundamental understanding of implantology as well as assist the clinicians who use the products of other companies.

I sincerely thank the editors and Osstem Implant faculties who have spent a year editing and collecting resources, as well as the dentists who have provided numerous clinical data. Moreover, I thank the Adfarm Communication executives and staff who have showed devoted support in providing this book.

Jan. 2013 Kim, Young-Kyun, Editor in Chief

Editorial Board

CEO

CEO
Choi, Kyoo-Ok

Osstem Implant Co., Ltd.

- DDS, College of Dentistry, Seoul National University, Seoul, Korea
- MS, Dankook University , Major: Orthodontics, Seoul, Korea
- Ph.D, College of Medicine, Korea University, Seoul, Korea

- CEO and President, Osstem Implant Co., Ltd., Seoul, Korea
- The Director of a Apsun Dental Clinic
- Adjunct Professor, Korea Medical University
- Vice President of Korea Venture Business Association.
- Director of Korea Medium Industries Association
- Director of Kosdaq Association

Editor in Chief

Kim, Young-Kyun
D.D.S., PhD

Seoul National University Bundang Hospital

- 1980 - 1986 Seoul National University, College of Dentistry. D.D.S.
- 1986 - 1989 Intern, Resident, Depart of Oral and Maxillofacial Surgery, Section of Dentistry, Seoul National University Hospital
- 1989 - 1992 Military Dental Officer
- 1987 - 1994 Seoul National University Graduate Course. MSD. PhD.
- 1992 -1 997 Full-time Lecturer, Assistant Professor, Dept. of Oral and Maxillofacial Surgery, College of Dentistry, Chosun University
- 1997 - 2003 Chairman, Dept. of Oral and Maxillary Surgery, Section of Dentistry, Bundang Jesaeng General Hospital
- 2003 ~ Now Associate Professor, Chairman, Dept. of Oral and Maxillofacial Surgery, Section of Dentistry, Seoul National University Bundang Hospital
  Associate Professor, School of Dentistry, Seoul National University
- 2011 ~ Now Editor-in-Chief, J Korean Assoc Oral Maxillofac Surg
- Published articles: 447 articles including "Development of a novel bone grafting material using autogenous teeth" International articles 〈SCI(e)〉: 51 articles including "Development of a novel bone grafting material using autogenous teeth"
- Writing textbooks: publishing 54 books including "bone graft and implant vol. 1, 2, 3."

Editors

CHO, Yong-Seok
DDS, MSD, PhD

Apsun Dental Hospital

- Graduated in 1989 from the Dental Collage of Seoul National University, Korea
- Trained at Dept. of Oral and maxillofacial Surgery, Seoul National University Hospital
- Assistant professor at Chungbuk National University
- Chairman of Dept. of Dentistry, Chungbuk National University Hospital
- Diplomate, Korean board of Oral & maxillofacial Surgery
- Diplomate, Korean Board of Maxillofacial Plastic and Reconstructive Surgery
- Osstem Faculty and Course Director of AIC (Apsun Dental Implant Research and Education Center)
- AO active member
- EAO member
- Ambulatory professor of Seoul National University Dental Collage
- Director of Apsun Dental Hospital

Director
Kim, Ki-Seong

Namsang Dental Clinic

Educational and Professional Training

- 1988 D.D.S. College of Dentistry, Seoul National University
- 1988 - 1991 Internship & Resident, Dept. of Prosthodontics, Seoul National University Dental Hospital
- 1991 M.S.D. Graduate School of Dentistry, Seoul National University
- 2010 Ph.D. Graduate School of Dentistry, Seoul National University
- 2008 - 2012 Clinical Professor, Dept. of Prosthodontics, College of Dentistry, Seoul National University
- Present Director of Namsang Dental Clinic

Organization

Vice President, Korean Academy of Esthetic Dentistry (KAED)
Korean Academy of Prosthodontics
Academy of Osseointegration
Asian Academy of Osseointegration
Seoul Implant Research & Study Group

Director
Kim, Se-Woung

The Wise Dental Clinic

Educational and Professional Training

- Graduated from Kyung Hee University's College of Dentistry
- Interned at the Department of Prosthodontics of Gacheon University Gil Medical Center
- Dentist accredited by the Korean Association of Orthodontists
- Served as general affairs director of the Korean Association of Oral and Maxillofacial Implant - Incheon Branch
- Served as director of the Korea Academy of Aesthetic Dentistry
- Served as clinical advisor on prosthetic dentistry at Gacheon University's Dental Hygiene Department
- Served as clinical advisor at the Department of Prosthodontic Dentistry, Graduate School of Health Science Gacheon University
- Director, OSSTEM AIC Society for Research
- Currently serves as manager at the Department of Prosthesis at Gacheon University of Science and Medicine
- Director of The wise dental hospital

Editors

Director
Lee, Dae-Hee

Seoul Dental Clinic

- Seoul National University Dental College & Graduate school D.D.S M.S Ph.D
- Seoul National University Dental College Adjunct Professor
- Inje University Sanggye Baik Hospital Adjunct Professor
- F & I Implant Research Group Honorary President Osstem Implant AIC Director
- Seoul Dental Clinic Director

Director
Oh, Young-Hak

All Dental Clinic

- D.D.S/M.S.D from School of Dentistry, Seoul National University
- Department of Prosthodontics, Seoul National University Dental Hospital
- Adjunct Professor, College of Dentistry, Seoul National University
- All Dental Clinic Director

Director
Park, Hwee-Woong

Seoul Ace Dental Clinic

- D.D.S/M.S.D from School of Dentistry, Seoul National University
- Department of Prosthodontics, Seoul National University Dental Hospital
- Adjunct Professor, College of Dentistry, Seoul National University
- Seoul Ace Dental Clinic Director

OSSTEM IMPLANT SYSTEM

CONTENTS

2013

Osstem Implant System

I Kinds and design of Osstem implant system

– By Prof. Kim, Young-Kyun

OSSTEM IMPLANT

I Kinds and design of Osstem implant system

It was named AVANA implant in 1995 after machined surface straight standard implant was first launched. Self tapping implant that has been TiO_2 blasting treated was then launched.. Company name changed to Osstem Implant at the end of 1997, and one stage implant MT I and MT II were released in 1997~2001. At the moment, two-stage implant with straight body was named US II. Since then, continuous R&D lead to surface treated products as RBM, SA, HA, BA, CA, and products with various designs as USIII, SSI, SS II, SSIII, GSII, GSIII, TSII, TSIII, TSIV, Ultra-Wide, MS system. **(Table1) (Fig1)**

Table 1. History of the development of Osstem implant and related products

2012	06 Development of TSIII CA Implant 04 Development of TSIII BA Implant
2011	07 Development of CustomFit Abutment 04 Development of LAS-KIT
2010	06 Development of TSIII HA Implant Development of CAS-KIT 04 Development of OSSTEM Guide 03 Development of TSIII SA Implant
2009	06 Start domestic sale of HIOSSEN Implant (USA) 05 Development of New SSIII Implant 01 Developed and patented PEP7(strong osteoinductive material)
2008	06 Development of GSIII Implant
2007	03 Development of MS Implant
2005	05 Development of GSII Implant
2004	11 Development of SSIII Implant 07 Development of USIII Implant
2002	10 Development of SSII Implant 08 Development of USII Implant 01 Authorized Osstem Implant R & D Center
2001	Established AIC(Apsun Dental Implant Research & Education Center)
2000	Establishment of Osstem Implant Inc., trade name change (Osstem Implant)
1997	Mass production and sale of AVANA implant (SooMin general dental material)
1995	Self-development of implant successful and acquired license for industrial manufacture
1992	Promoted self-development of dental implant

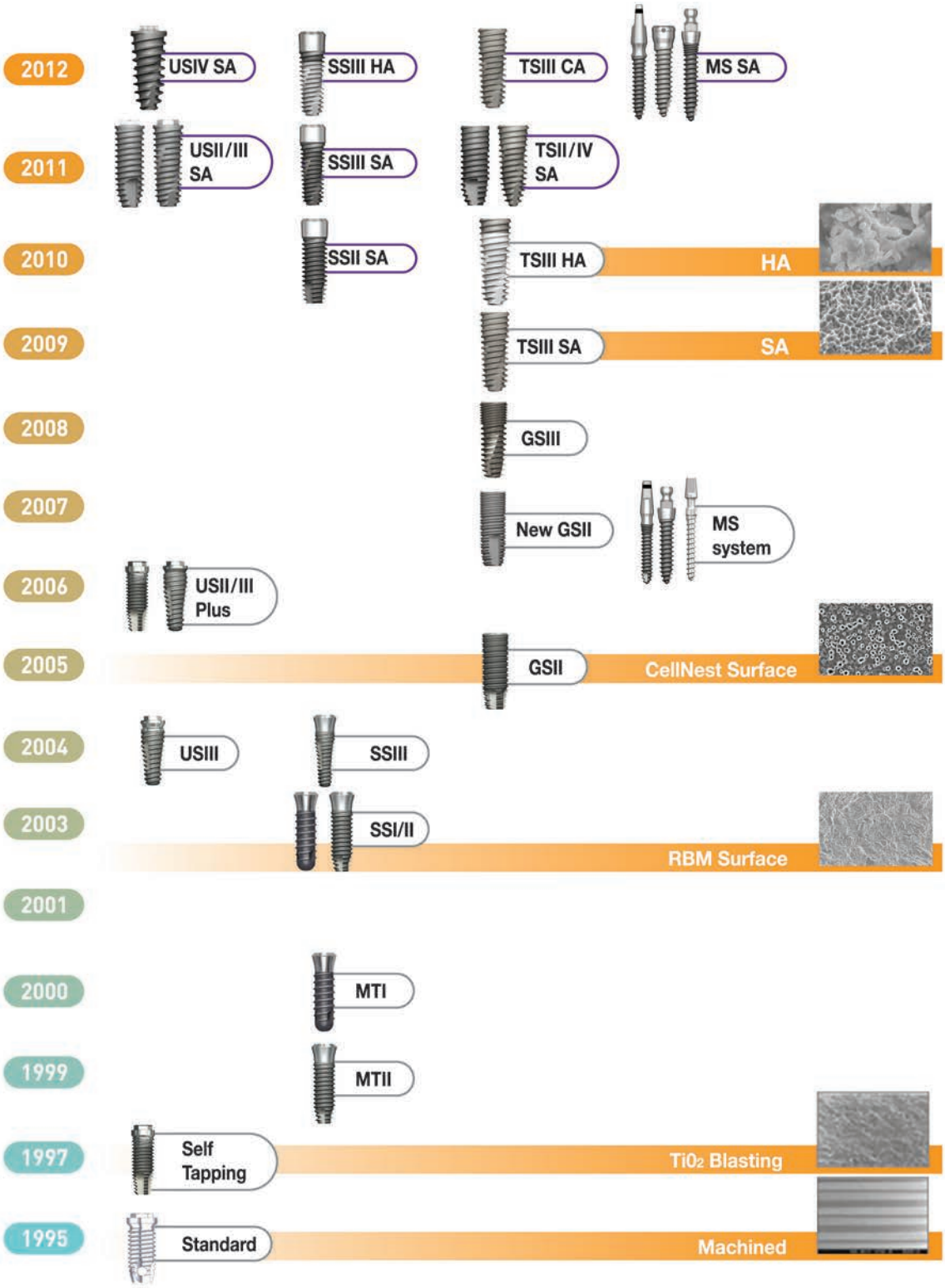


Fig.1 History of the development of Osstem Implant

I Kinds and design of Osstem implant system

In the beginning, Osstem implant launched submerged type US(Universal Solution) series (USII, USIII) which has external hexagon connection type, and non-submerged type SS(Success Solution) series (SSI, SSII, SSIII) which has internal connection type. These implants are still being used today. Since 2005, tapered bodied GS (Gorgeous solution) (GSII, GSIII) and TS(Transcendent Solution) (TSII, TSIII, TSIV) series which have tapered conical sealing connection type and are capable of both submerged and non-submerged installation were launched. **(Fig. 2-5)**

Fig. 2. USII RBM, USIII RBM, USII SA, USIII SA

Fig. 3. SSII RBM, SSIII RBM, SSII SA, SSIII SA

Depending on fixture body shape, it is divided into straight type and tapered type. Straight body has the symbol "II", whereas tapered body has the symbol "III". Recommended insertion torque for all Osstem implant is below 40Ncm.

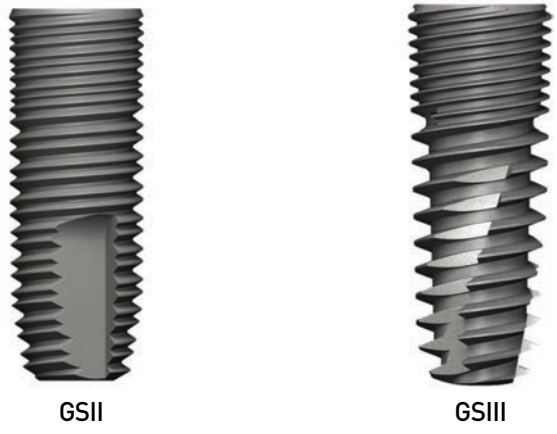


Fig. 4. GSII, GSIII

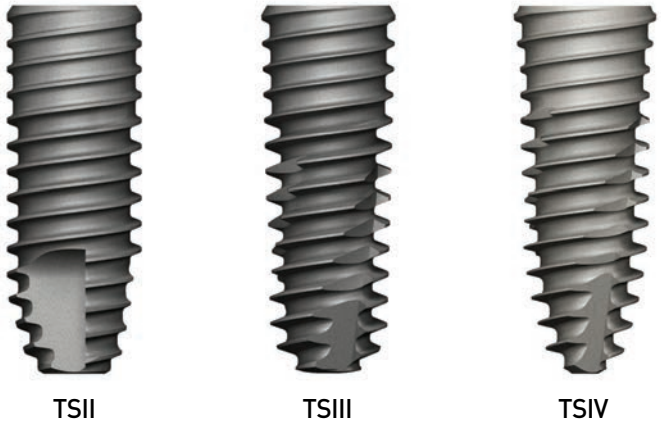


Fig. 5. TSII, TSIII, TSIV

1. US (Universal Solution) System

Hybrid RBM surfaces that are useful for plaque control were supplied in the early stages, **(Fig. 6)** but from 2006, systems that have all their surfaces RBM treated as USII, III Plus system are supplied and used. **(Fig. 7)** Recently, RBM, SLA surface treated products are both available.

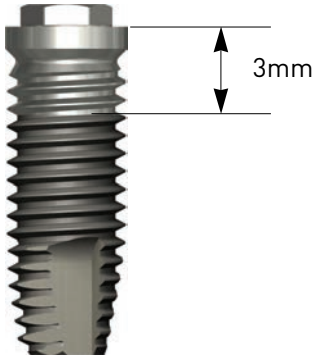


Fig. 6. Hybrid RBM treated old USII system. It has 3mm machined surface from platform

Fig. 7. All surfaces RBM treated USII system

Depending on surface treatment and design, RBM, USIII RBM, USII SA, USIII SA, USIV SA are supplied. **(Fig. 8)**

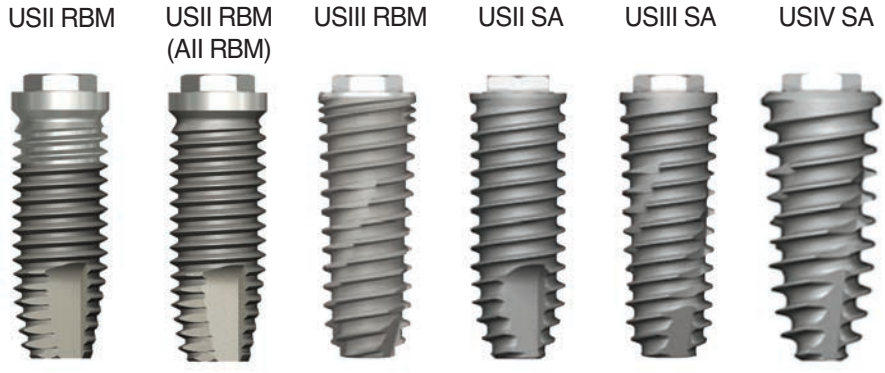


Fig. 8. Various US Implant System

1) USII

(1) Characteristics (Fig. 9)

USII RBM specifications are: 0.6pitch X 0.25~0.4depth X Single thread thread pitch 0.6mm, thread depth 0.25-0.4mm, single thread (single rotation inserts single thread pitch)]. USII SA specifications are: 0.8pitch X 0.4~0.5depth X Double thread [thread pitch 0.8mm, thread depth 0.4-0.5mm, double thread (single rotation inserts two thread pitch)].

① External Hexagon Connection Method
Hexagon's precision is +0.003/-0.005mm, fixture hex and superstructure's tolerance is 7~15㎛, abutment's rotation tolerance is 0.4°~ 2°, and thus shows excellent precision fitness.

② Is a straight body structure, and is a submerged type implant that fundamentally needs two-stage installation. However, one-stage surgery is possible depending on indication.

③ On the lower part of fixture, RBM specification has 4 cutting edges and SA specification has 3 cutting edges which allows self-tapping. Slanted end of fixture also provides excellent initial entry when installing.

④ Screw thread consists of 0.6 pitch triangular screw.

⑤ Diameter of platform and size of hexagon are same and therefore compatible with upper material of Branemark and BIOMET 3i Osseotite.

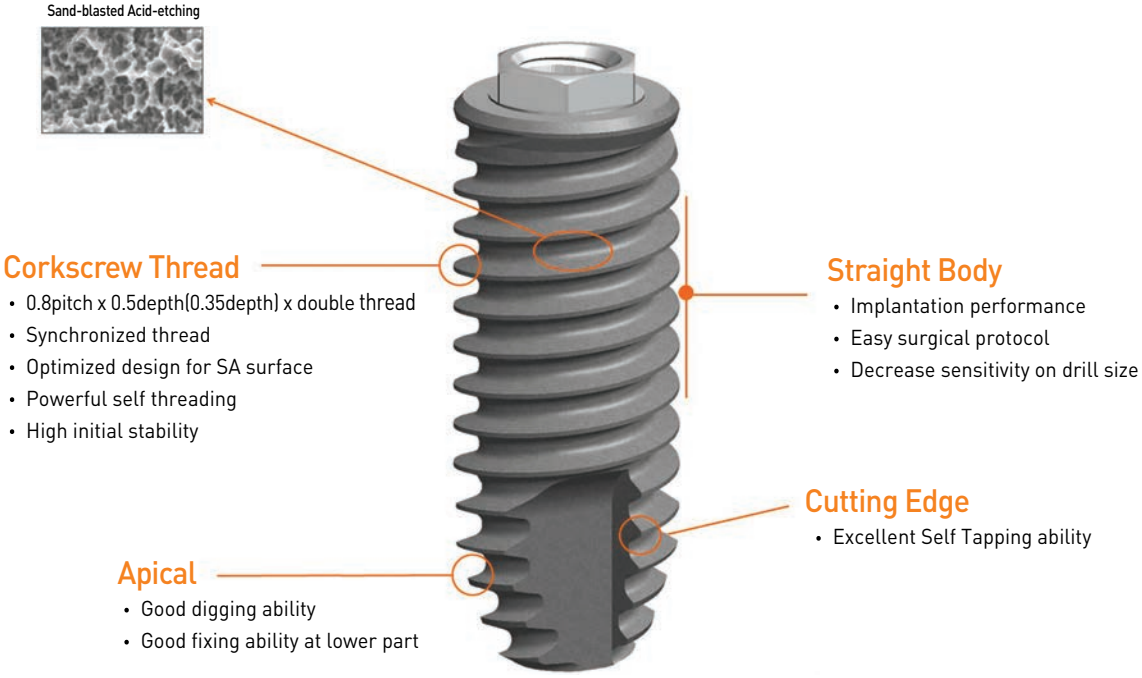


Fig. 9. USII SA fixture

(2) Specification

Various fixture length of 6, 7, 8.5, 10, 11.5, 13, 15mm and diameter of 3.5, 4.0, 4.5, 5.0mm are available.**(Table 2, 3) (Fig. 10-13)**. As shown in image, USII RBM and USII SA differ slightly in length. USII SA's platform's actual diameter is 0.1mm larger than nominal diameter.**(Fig. 14, 15)** By applying a bigger platform than body diameter, when installing, it adds a stopping function as well as a platform switching effect.**(Fig. 16)**

Table 2. Specification of USII SA

Connection	Mini	Regular		Wide PS	Wide
Platform	P3.5	P4.1		P5.0	P5.1
Hex	2.4	2.7		2.7	3.4
Diameter	ø 3.5	ø 4.0	ø 4.5	ø 5.0	ø 5.0
Length	-	-	-	6	6
	-	7	7	7	7
	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13

Table 3. Specification of USII RBM

Connection	Mini	Regular			Wide PS		Wide	
Platform	P3.5	P4.1			P5.0		P5.1	
Hex	2.4	2.7			2.7		3.4	
Diameter	ø 3.3	ø 3.75	ø 4.0	ø 4.5	ø 5.0	ø 5.5	ø 5.0	ø 5.5
Length	-	7	7	7	7	7	7	7
	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13	13	13	13
	15	15	15	15	15	15	15	15

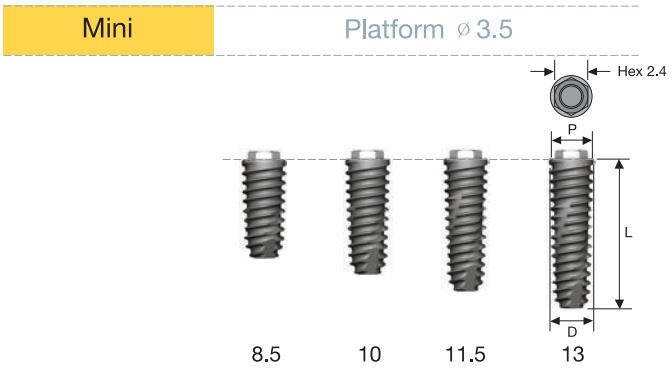


Fig. 10. USII SA Mini Fixtures

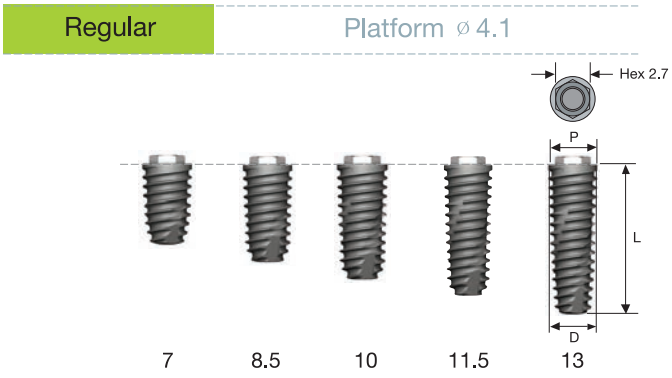


Fig. 11. USII SA Regular Fixtures

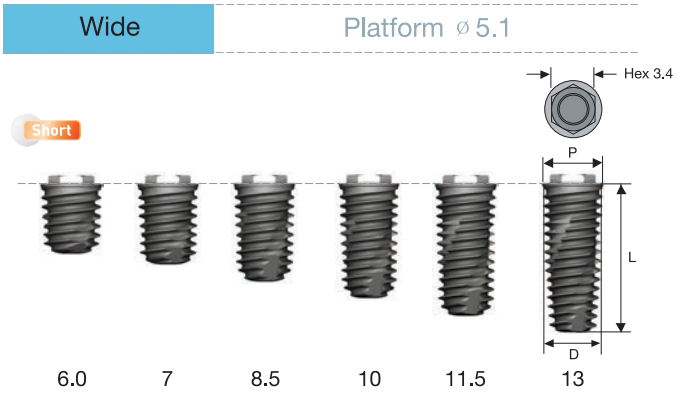


Fig. 12. USII SA Wide Fixtures

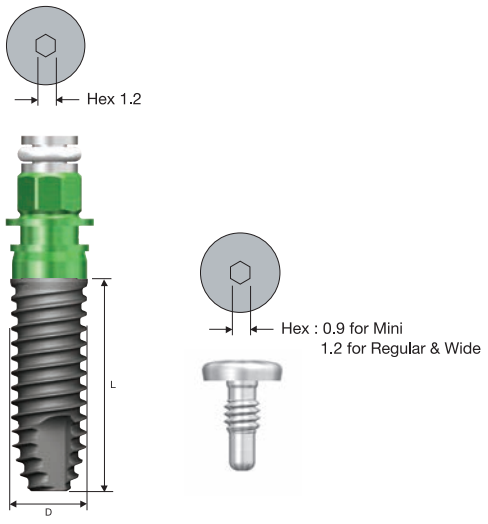


Fig. 13. Pre-mounted USII SA fixture

Length 11.5mm as Standard

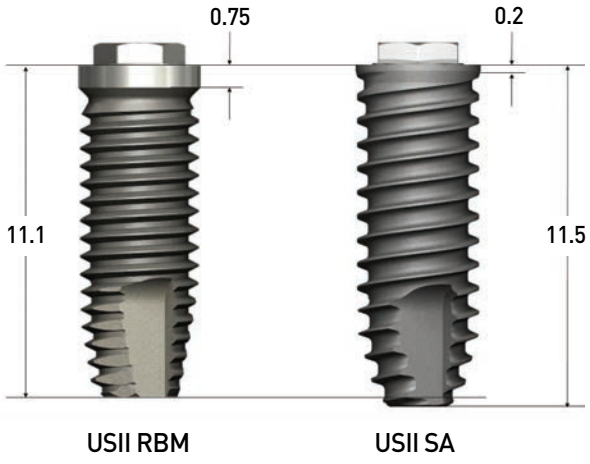
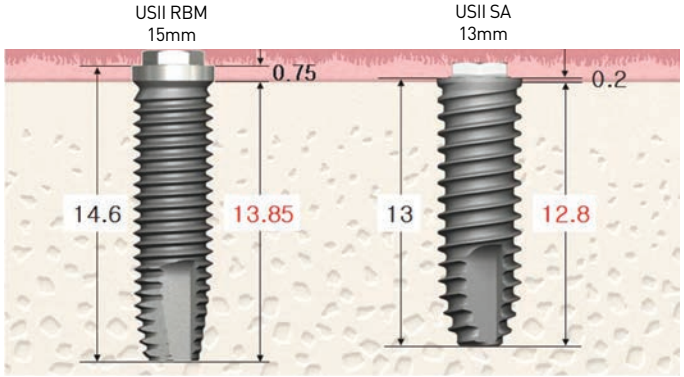


Fig. 14. USII 11.5mm implant specification. USII RBM and USII SA have slightly different structures.

SA 13mm vs RBM 15mm

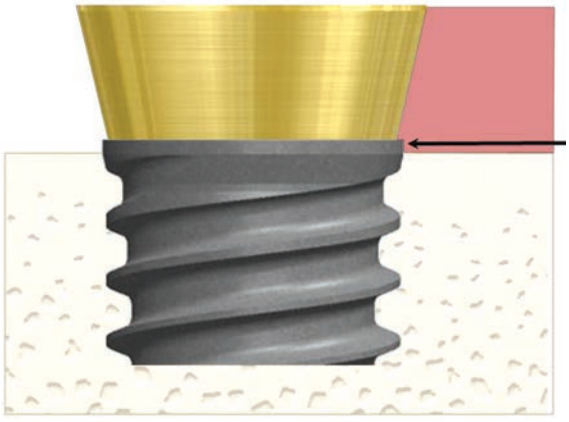


15mm is not available in USII SA

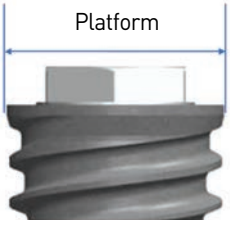
1. SA Surface is better than RBM
2. Bone contact of SA 13mm is similar to RBM 15mm
3. Demand of 15mm is low

Fig. 15. Comparison of USII RBM 15mm and USII SA 13mm. It is recommended to install USII RBM 0.75mm supracrestal, and USII SA 0.2mm supracrestal. In such case, bone contact area does not differ much. Hence, USII SA does not have specification with length of 15mm.

Fixture Platform is bigger than Body diameter (Fixture ø 3.5, ø 4.0)
Fixture Platform is 0.1mm bigger than Abutment diameter



- Stop function on fixture insertion
- Platform switching effect (prevent bacterial invasion)
- Secure long term stability (secure strength)



Platform	Mini	Regular	Wide PS	Wide
Nominal diameter	P3.5	P4.1	P5.0	P5.1
Actual diameter	ø 3.6	ø 4.2	ø 5.1	ø 5.2

Fig. 16. Platform specification of USII SA. Actual diameter is 0.1mm bigger than nominal diameter. By applying a bigger platform than body diameter, when installing, it adds a stopping function as well as a platform switching effect.

(3) Drilling and Implant installation

Guideline from manufacturer should be followed. Recommended installation torque is below 40Ncm, and use of fixture over 4.5mm diameter is suggested for single implant cases for posterior region. Install USII RBM via supra-crestal method, and USII SA should be installed via equi-crestal method. One must drill additionally or countersink when installing sub-crestally. Using hand ratchet and causing excessive torque near platform where over-torque had occurred after implant installation.**(Fig. 17)**

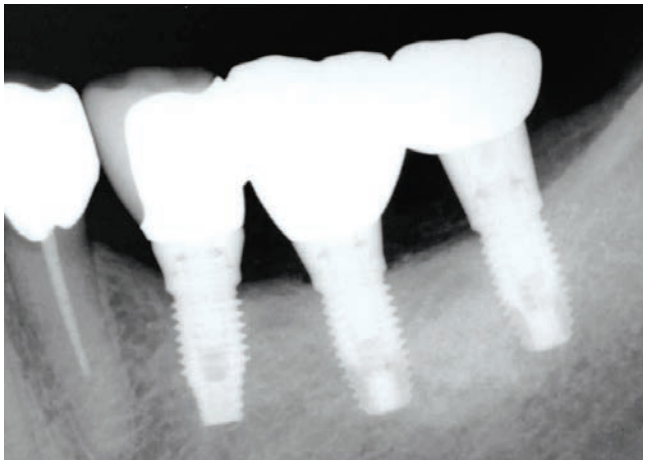


Fig. 17. Periapical radiograph of USII hybrid surface 74 months after installation. Marginal bone remains stable.

2) USIII

(1) Characteristics (Fig. 18)

USIII RBM specification is 0.8pitch X 0.35~0.5depth X Double thread, and USIII SA specification is 0.8pitch X 0.35~0.5depth X Double thread.

① The old USIII had a straight & double tapered body form which could distribute stress, focused on cortical bone by bite force, to trabecular bone. However, the entire fixture has tapered body in the new USIII.
② High initial stability in weak bone quality can be achieved because of bony compression effect.
③ Because of its tapered structure, initial entry is excellent and high early stability can be secured when final seating.
④ Potential adjacent root damage is minimized because of its tapered lower part.
⑤ Potential of perforation in buccal and labial concavity is minimized..
⑥ Useful for immediate implant placement after extraction, as it is shaped similar to natural root.
⑦ Triple taper & double thread
Double thread increases torque when installing, and provides high initial stability in weak bone quality. Decrease in operation time and increases operative convenience. Installation can be complete with only 2-3 rotations in D1-D2 bone quality.
⑧ Superb self-tapping ability due to triple cutting edge.
⑨ Domed apex
Round apical part prevents membrane perforation when performing sinus membrane lift.
⑩ Gap between fixture hex and upper part is 7~15㎛, rotational tolerance with abutment is 0.4°~2°. Hence, exhibits excellent fitness.

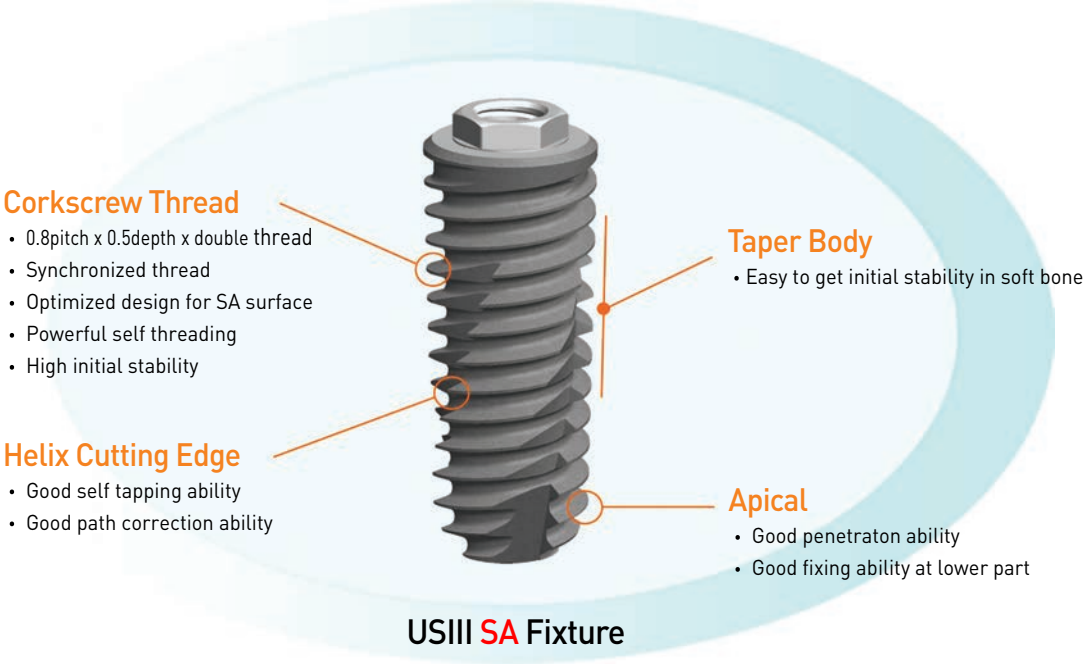


Fig. 18. USIII SA fixture

(2) Specification

Fixture length of 7, 8.5, 10, 11.5, 13, 15mm and diameter of 3.5, 4.0, 4.5, 5.0mm are available. Platform of fixture is larger than body diameter, and is designed to be 0.1mm bigger than abutment diameter. **(Table 4, 5) (Fig. 19-22)**

Table 4. USIII SA

Connection	Mini	Regular		Wide PS	Wide
Platform	P3.5	P4.1		P5.0	P5.1
Hex	2.4	2.7		2.7	3.4
Diameter	ø 3.5	ø 4.0	ø 4.5	ø 5.0	ø 5.0
Length	-	-	-	6	6
	-	7	7	7	7
	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13

Table 5. USIII RBM

Connection	Mini	Regular		Wide PS	Wide
Platform	P3.5	P4.1		P5.0	P5.1
Hex	2.4	2.7		2.7	3.4
Diameter	ø 3.5	ø 4.0	ø 4.5	ø 5.0	ø 5.0
Length	-	-	-	6	6
	-	7	7	7	7
	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13
	15	15	15	15	15

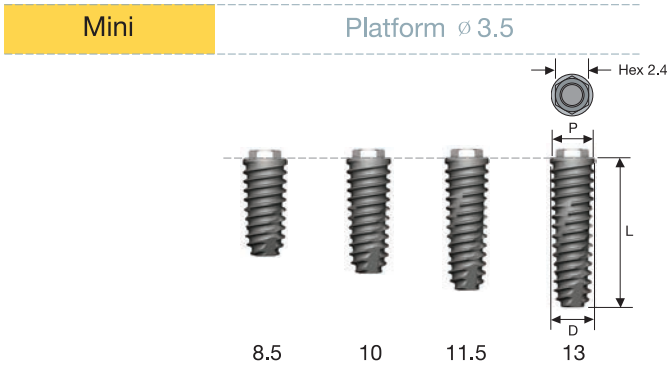


Fig. 19. USIII SA Mini Fixtures

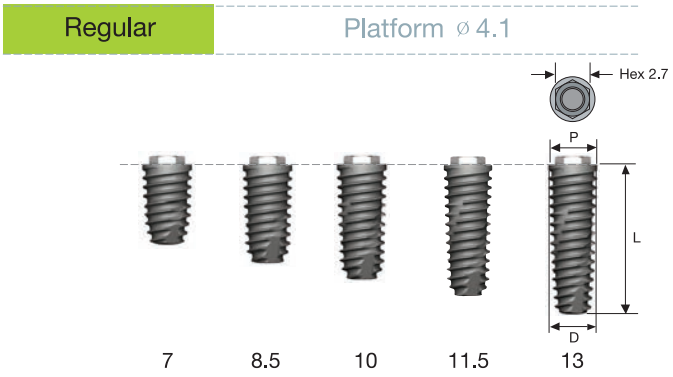


Fig. 20. USIII SA Regular Fixtures

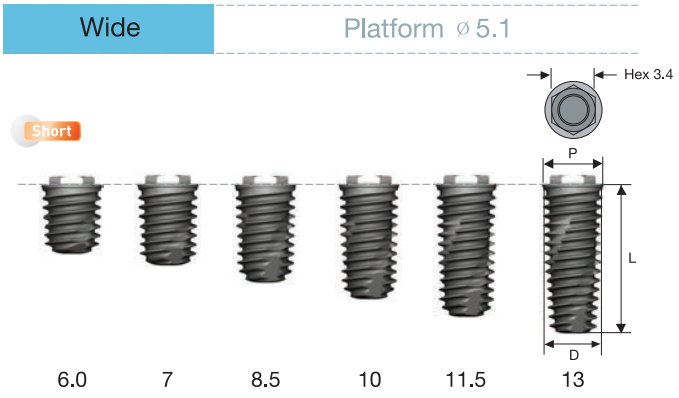


Fig. 21. USIII SA Wide Fixtures,
Short implant of 6mm are provided recently.

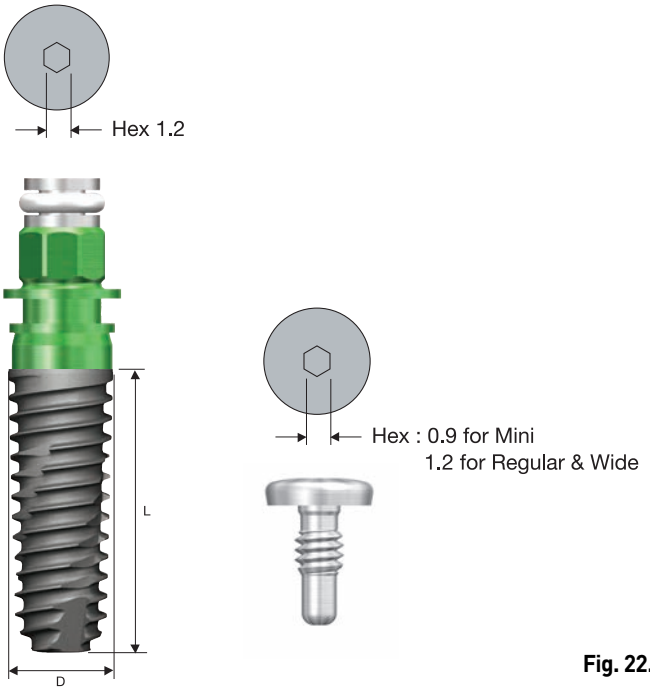


Fig. 22. Specification of pre-mounted USIII SA fixture

(3) Drilling and implant installation

Guidelines from manufacturer should be followed. Recommended installation torque is below 40Ncm, and use of fixture over 4.5mm diameter is suggested for single implant cases for posterior region. Using hand ratchet and causing excessive torque near platform where over-torque had occurred after implant installation. **(Fig. 23)**

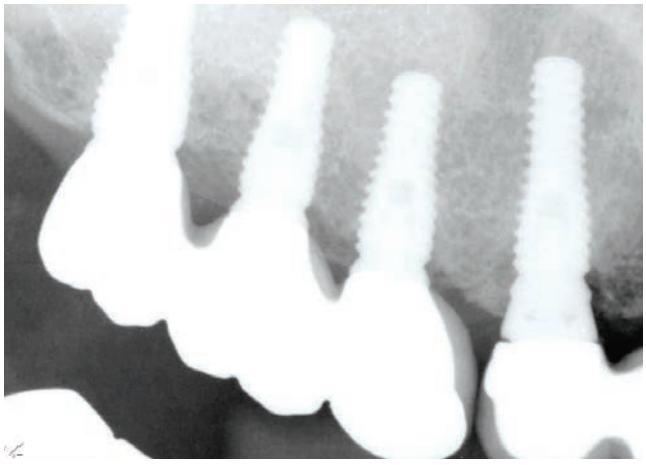


Fig. 23. Periapical radiograph of old design USIII hybrid surface 50 months after installation. Marginal bone remains stable.

2. SS (Success Solution) System

It is a typical one stage implant system. Depending on surface treatment and design, SSII RBM, SSIII RBM, SSII SA, SSIII SA, SSIII HA are supplied. **(Fig. 24)**

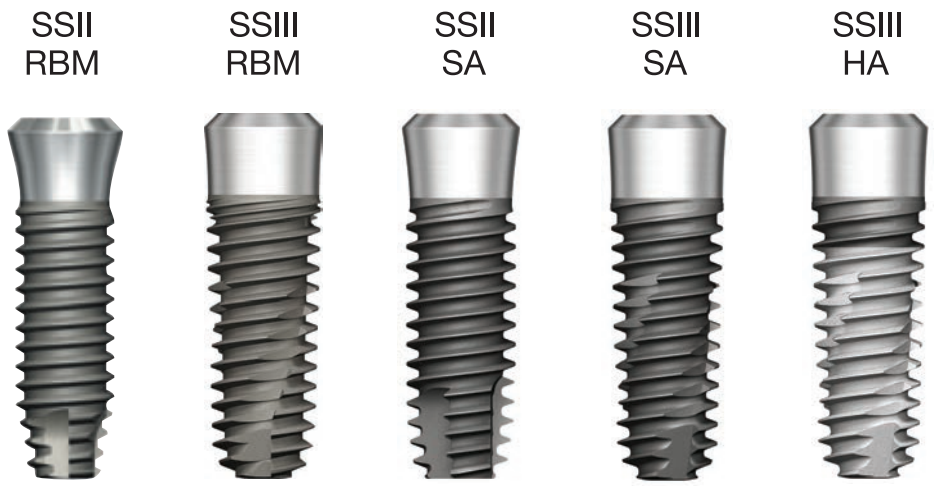


Fig. 24. Various SS system

1) SSII

Is a non-submerged type straight body fixture based on one stage operation. Has stable connection structure of Internal Octa and 8° Morse Taper.

(1) Characteristics (Fig. 25)

SSII RBM specification is 0.8pitch X 0.35~0.45depth X Single thread, and SSII SA specification is 0.8pitch X 0.35~0.45depth X Double thread. Fixture with internal 8° Morse taper connection and straight body, It is based on one stage operation.

① Implant of Staumann corporation developed in Korean style
② Fixture thread is designed with triangular screw with 0.8 pitch, which secures high initial stability in weak bone tissue, and distributes bite force.
③ Inclined end part grants excellent initial entry.
④ 4 bladed cutting edge allows enhanced self-tapping.

⑤ Because internal octagon is located on the lower part of Morse taper (middle of Morse taper for Straumann ITI), Morse taper contact area is larger than ITI. Hence, provides excellent stability in connection area. Connection with superstructure is inside the fixture, removing micromobility and thus preventing bone resorption**(Fig. 26)**

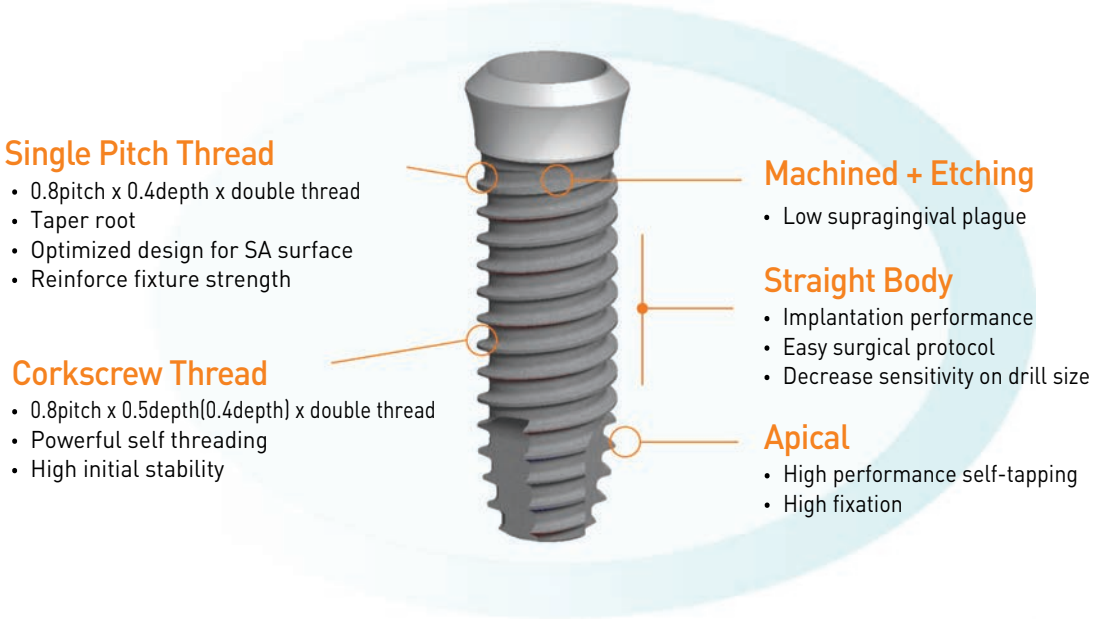


Fig. 25. SSII SA fixture sturcture

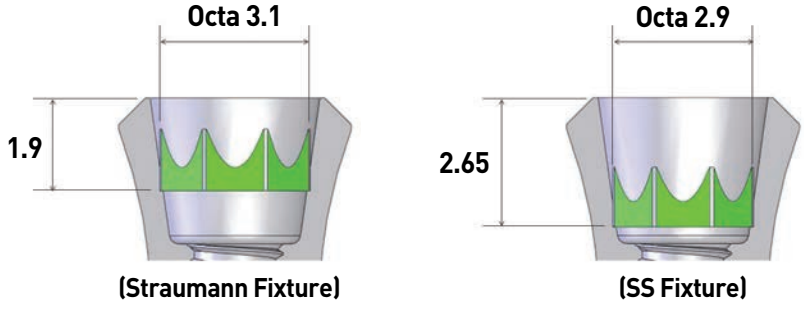


Fig. 26. Connection type of Straumann ITI and SSII fixture.

(2) Specification

1.8mm, 2.0mm, and 2.8mm kinds of Collar height are provided. Collar has machined surface excellent in tissue affinity and useful in plaque control. However, total heights of all three kinds are different, and should be installed so that border between lower part of collar and surface treated fixture is placed on level of alveolar bone crest. On the other hand, collar 1.8mm, 2.8mm of total height are same while SLA surface treatment heights are different. Hence, ITI implant with 2.88 collar is installed by adjusting border between SLA surface to alveolar bone crest level. 1.8 mm collar ITI implant should be installed by adjusting SLA border 1mm lower than alveolar bone crest. RBM surface and SLA surface(SSII SA) are provided. 7, 8.5, 10, 11.5, 13, 15mm length are prepared, and SSII SA also has 6mm. Fixture diameter for SSII SA are 4.0, 4.5, 5.0mm, and 3.3, 4.1, 4.8mm for SSII RBM.**(Table 6, 7) (Fig. 27, 28, 29)** 3.3mm SSII mini implant is external hexagon connection type and has straight body, but surgical procedure is same as that of SSII. Material for superstructure is same for that of external connection USII and USIII. It was formerly named USIV.

Table 6. SSII SA Fixture

Connection	Regular				Wide PS	
Platform	P4.8				P6.0	
Diameter	ø 4.0		ø 4.5		ø 4.5	ø 5.0
G/H	1.8	2.8	1.8	2.8	2.0	2.0
Length	-	-	-	-	-	6
	7	-	7	-	7	7
	8.5	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13	13
	15	15	15	15	15	15

Table 7. SSII RBM

Connection	Mini		Regular				Wide
Platform	P3.5		P4.8				P6.0
Diameter	ø 3.3		ø 4.1		ø 4.8		ø 4.8
G/H	1.8	2.8	1.8	2.8	1.8	2.8	2.0
Length	-	-	7	-	7	-	7
	8.5	8.5	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13	13	13
	15	15	15	15	15	15	15

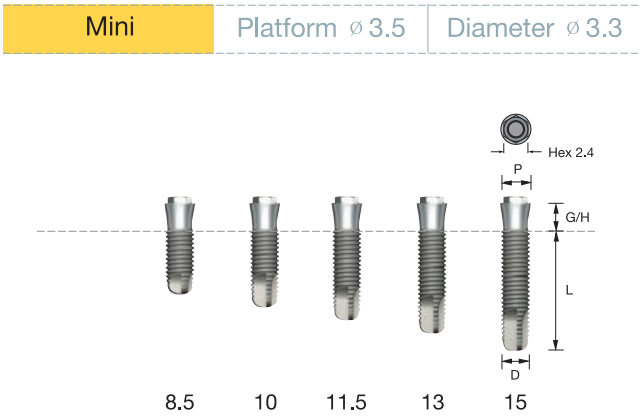


Fig. 27. SSII RBM Mini Fixtures

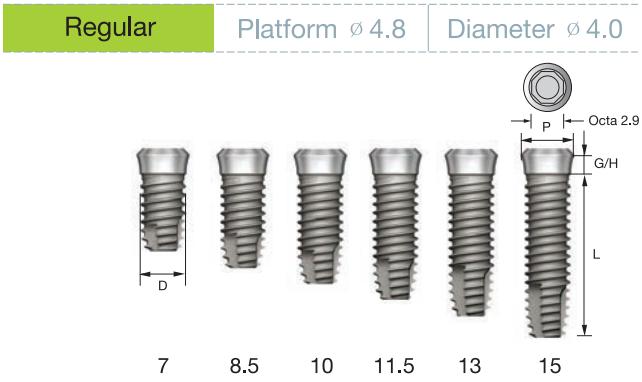


Fig. 28. SSII SA Regular Fixtures

Fig. 29. SSII SA Wide Fixtures

(3) Drilling and Implant installation

Guideline from manufacturer should be followed. Recommended installation torque is below 40Ncm, and use of fixture over 4.5mm diameter is suggested for single implant cases for posterior region. **(Fig. 30)**

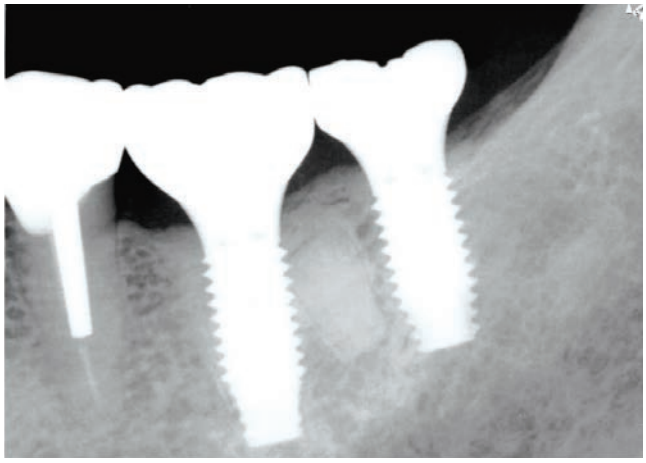


Fig. 30. Periapical radiograph of 71 year old, female patient. 67 months after SSII installation. Marginal bone remains stable.

2) SSIII

(1) Characteristics (Fig. 31)

SSIII RBM specification is 0.8pitch X 0.35~0.5depth X Double thread, and SSIII SA specification is 0.8pitch X 0.35~0.5depth X Double thread.

① Implant based on one stage operation.
② It has internal 8° Morse taper connection. The old SSII had a double tapered shape and triple tapered thread which secure high initial stability in weak bone tissue and distribute stress due to bite force. The entire fixture has tapered body in the new SSII.
③ Superb self-tapping ability due to corkscrew thread.
④ Structure of fixture and drilling procedure is same as those of USIII

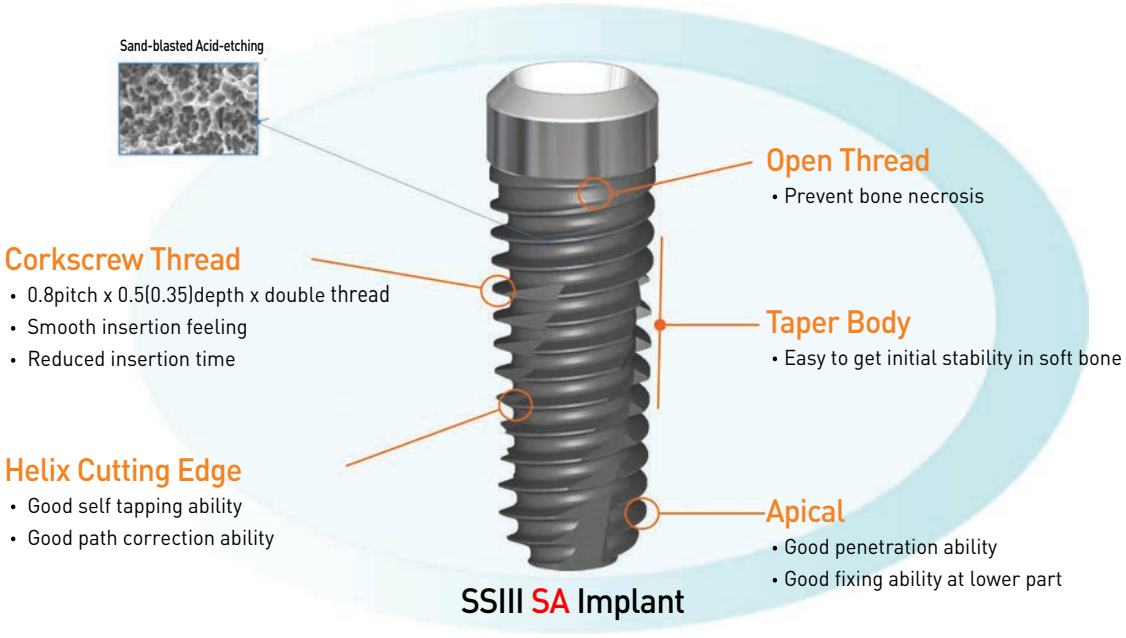


Fig. 31. SSIII SA fixture

(2) Specification

3 different surfaces of RBM, SLA, HA(Hybrid type with HA and RBM surface) are provided. Various fixture length of 6, 7, 8.5, 10, 11.5, 13mm and diameter of 3.5, 4.0, 4.5, 5.0mm, and 4.8mm(regular), 6.0mm(wide) from the platform are available.**(Table 8, 9, 10) (Fig. 32, 33, 34)**

Table 8. SSIII RBM

Connection	Regular				Wide PS	
Platform	P4.8				P6.0	
Diameter	ø 4.0		ø 4.5		ø 4.5	ø 5.0
G/H	1.8	2.8	1.8	2.8	2.0	2.0
Length	-	-	-	-	-	6
	7	-	7	-	7	7
	8.5	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13	13
	15	15	15	15	15	15

Table 9. SSIII SA

Connection	Regular						Wide	
Platform	P4.8						P6.0	
Diameter	ø 3.5		ø 4.0		ø 4.5		ø 4.5	ø 5.0
G/H	1.8	2.8	1.8	2.8	1.8	2.8	2.0	2.0
-	-	-	-	-	-	-	-	6
Length	-	-	7	-	7	-	7	7
	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13	13	13	13

Table 10. SSIII HA

Connection	Regular				Wide PS	
Platform	P4.8				P6.0	
Diameter	ø 4.0		ø 4.5		ø 4.5	ø 5.0
G/H	1.8	2.8	1.8	2.8	2.0	2.0
Length	-	-	-	-	-	6
	7	-	7	-	7	7
	8.5	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13	13

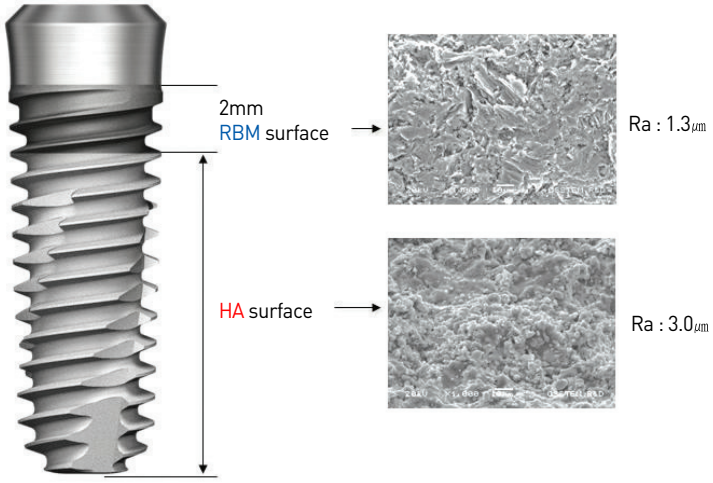


Fig. 32. SSIII HA Implant

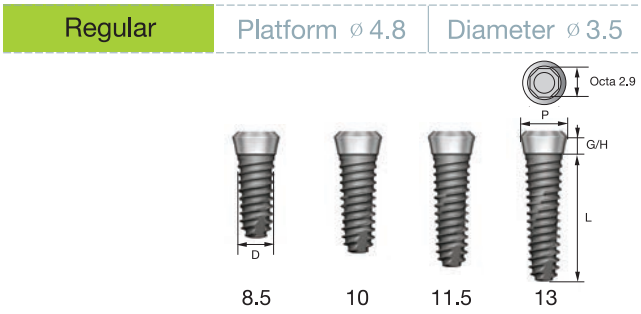


Fig. 33. SSIII SA Regular Fixtures. ø 3.5 diameter Regular fixtures have been recently released. There is no specification for length 7mm.

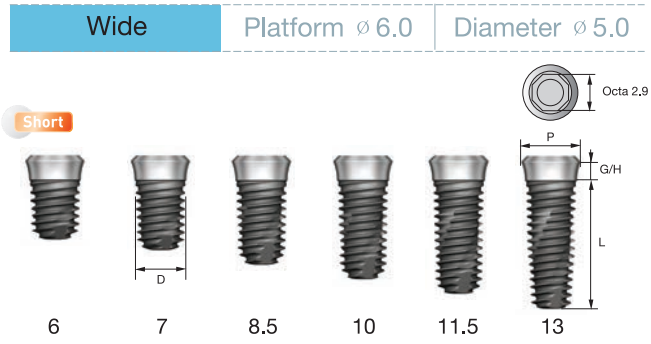


Fig. 34. SSIII SA Wide Fixtures. Length of 6mm are provided for diameter ø 5mm SSII SA, HA.

(3) Drilling and Implant installation

Both tapered drill kit and straight drill kit can be used. In soft bone regions (D3, D4), use only the standard straight drill to install. In hard bone regions (D1, D2), use USIII exclusive shaping drill and tapered tap, drill with SSIII Marking line until the lower marking line, and with USIII until upper marking line.**(Fig. 35)**

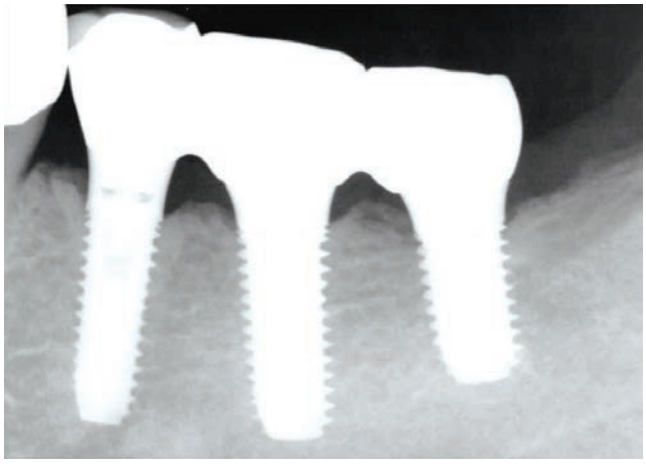


Fig. 35. Periapical radiograph after 67 months of SSII installation in left mandibular posterior region.

3. GS (Gorgeous Solution) System

GS fixture is a two stage operation based submerged type fixture. It possesses a stable Connection structure with internal hex and conical seal of 11° taper. Straight formed GSII CellNest, GSII RBM, and tapered form GSIII RBM were released between 2005 and 2008. **(Fig. 36)**

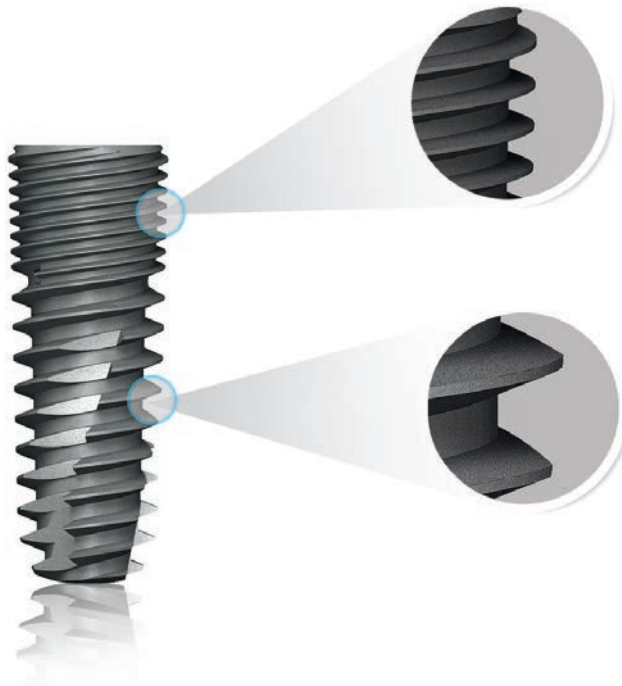
Fig. 36. GS Implant Series

1) GSIII

GSIII fixture is a two stage operation based submerged type fixture. It possesses a stable Connection structure with internal hex and conical seal of 11° taper. GSIII fixture minimizes bone resorption, and secures initial stability in poor bone quality. The easy depth control allows the fixture to be used in various bone qualities.

(1) Characteristics (Fig. 37)

① By applying 0.4pitch X 0.25depth X fourfold thread microthread (4 edge screw) on upper part of implant, stress on crestal area could be distributed. Also, by amplifying contact with screw thread in thin cortical bones (D3, D4), secured stability.
② Corkscrew thread
By applying 0.8 pitch X 0.5depth X double thread, excellent self-tapping ability is achieved.
Direction control is simple, and initial stability is increased even in poor bone quality
③ Is a tapered body with 1.5° degree taper.
④ GSIII fixture is entirely taper, and its cutting edges in all of macrothread GSII RBM allows reduction of resistance from the lateral side when modifying the insertion path.
⑤ Even after shallow drilling, implant digs into bone tissue and fixates in the lower part.
⑥ Useful after drilling with small diameter.
⑦ Rapid installation. 1.6mm is installed per rotation, and its taper structure enables pre-insertion into the drilled hole which allows simple and rapid installation.



Micro Thread

- 0.4p x 0.25d x fourfold thread
- Distribute stress on bone
- **Stimulate bone evenly**
- Increase cell response
- Reinforce fixture strength

Corkscrew Thread

- 0.8p x 0.5d x double thread
- **Powerful self threading**
- Easy change path
- Increase insertion torque at soft bone
- Increase initial stability at soft bone
- Decrease sensitivity on drill size

Fig. 37. GSIII Fixture Design

(2) Specification

Diameter of 3.5, 4.0, 4.5, 5.0mm, and length of 7 (not for 3.5mm diameter), 8.5, 10, 11.5, 13, 15mm are equipped. **(Fig. 38)**

Fig. 38. Pre-mounted GS III fixture

(3) Drilling and Implant installation (Fig. 39)

Either use both straight drill and cortical drill or exclusive taper drill to install.

① **Straight Drill KIT**

Use only straight drill in soft bone, lower part of cortical drill in normal bone, and upper part of cortical drill in hard bone.

② **Taper Drill KIT**

In weak bone quality, use drill with diameter 1 step smaller than that of fixture. In normal bone, use corresponding diameter taper drill and install. In hard bone, use corresponding taper drill, and then additionally use cortical drill to install.

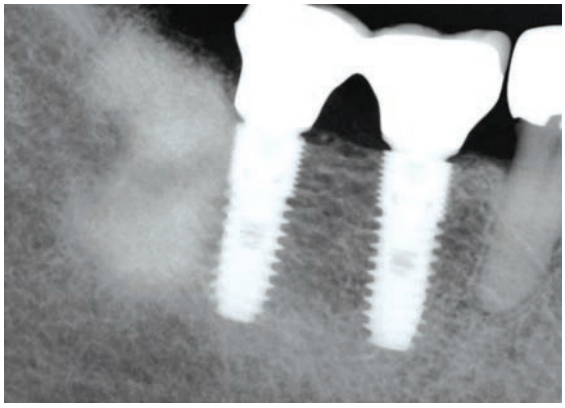


Fig. 39. Periapical radiograph of GSIII 3 years after installation in right mandibular molar site.
#37 distal side shows evidence of bone grafting.

4. TS (Transcendent Solution) System

Submerged type implant with Internal Hex and conical seal connection of 11° taper. Depending on the diameter of opening of Internal Hex and Morse Taper, it is divided into Mini Connection and Regular Connection. No mount and pre-mounted fixture are provided.**(Fig. 41)** Depending on surface modification method and design, TSII SA, TSIII SA, TSIII HA, TSIII BA, TSIII CA, TSIV SA are provided.**(Fig. 42)**

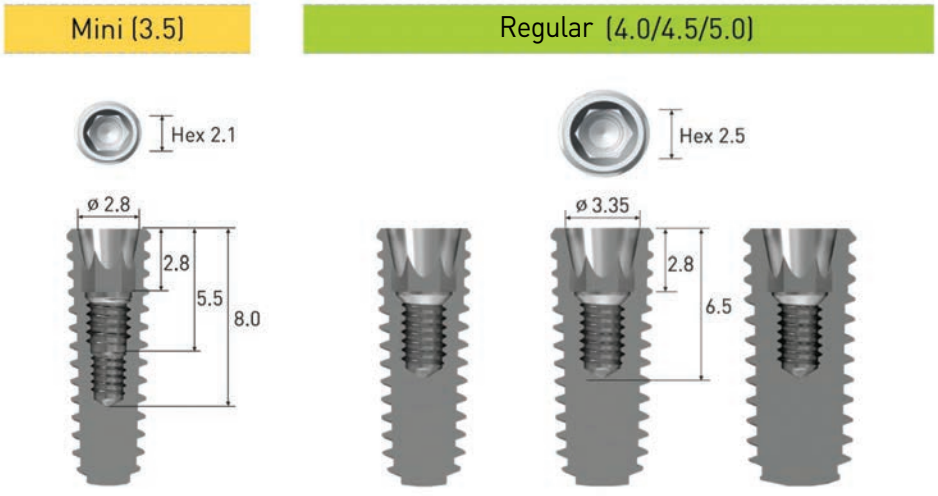


Fig. 40. TSIII Fixture Connection

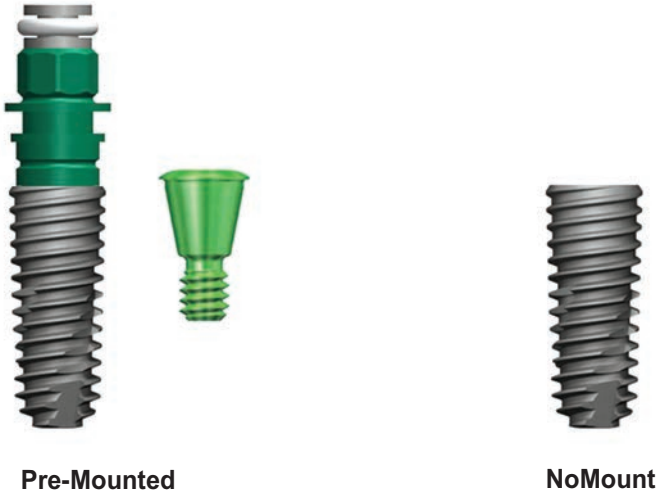


Fig. 41. Pre-Mounted and NoMount Fixture

Fig. 42. A variety of TS series.

1) TSII

(1) Characteristics (Fig. 43)

① Submerged type implant with Internal Hex and conical seal connection of 11° taper.
② Excellent installation performance as straight body. Enhanced insertion feeling as well as amplified initial stability by adopting Macro Thread on entire fixture.
③ Small thread(0.8 pitch X 0.2 depth X double lead) on upper part reinforces the walk thickness and minimizes bone loss. In addition, by adopting open thread on top part, pressure necrosis is minimized.
④ By applying single corkscrew thread (0.8 pitch X 0.5 depth(0.35 depth) X double lead) in middle part, excellent self-tapping and initial stability is achieved.
⑤ By selecting sharp apex design for the lower part, self-tapping ability, initial stability, and direction modification ability have all in enhanced.

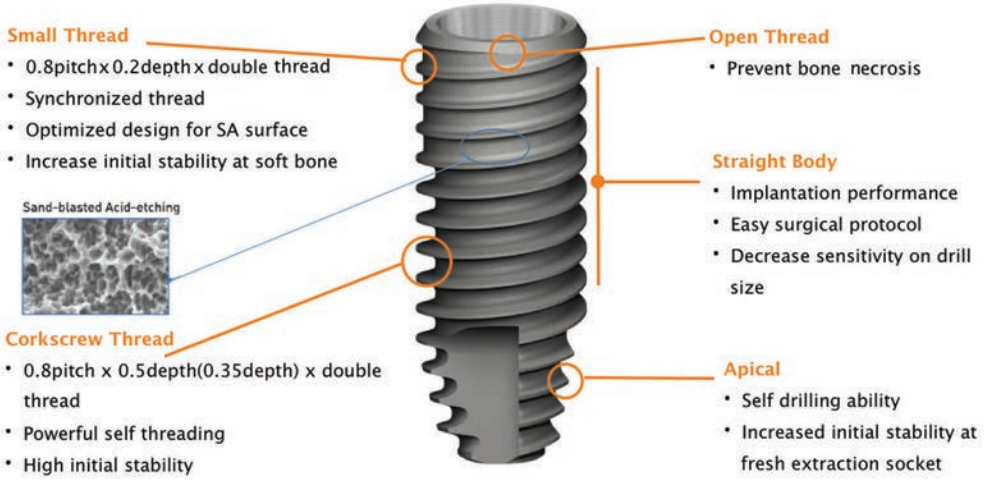


Fig. 43. TSII SA Fixture Design.

(2) Specification

Mini type with diameter of 3.5mm and Regular type with 4.0, 4.5, and 5.0mm are available. Length of 6, 7, 8.5, 10, 11.5, 13, 15mm are available. Total 24 types of no mount and pre-mounted type are provided. 6mm short implant specification has been recently added. **(Table 11) (Fig. 44-46)**

Table 11. TSII Implant

Connection	Mini	Regular		
Hex	2.1	2.5		
Diameter	ø 3.5	ø 4.0	ø 4.5	ø 5.0
	-	-	-	6
Length	-	7	7	7
	8.5	8.5	8.5	8.5
	10	10	10	10
	11.5	11.5	11.5	11.5
	13	13	13	13
	15	15	15	15

Product	F3.5	F4.0	F4.5	F5.0
Actual diameter	ø 3.5	ø 4.2	ø 4.4	ø 4.9
Connection	Mini	Regular		
Design				
6				TS2S5006S
7		TS2S4007S	TS2S4507S	TS2S5007S
8.5	TS2M3508S	TS2S4008S	TS2S4508S	TS2S5008S
10	TS2M3510S	TS2S4010S	TS2S4510S	TS2S5010S
11	TS2M3511S	TS2S4011S	TS2S4511S	TS2S5011S
13	TS2M3513S	TS2S4013S	TS2S4513S	TS2S5013S
15	TS2M3515S	TS2S4015S	TS2S4515S	TS2S5015S

Fig. 44. TSII SA Fixture

Mini Diameter ø 3.5

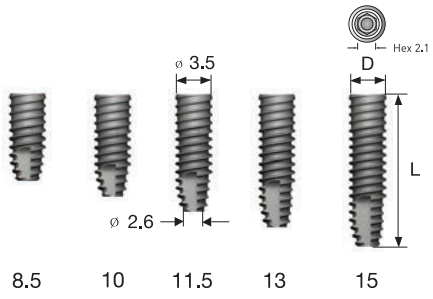
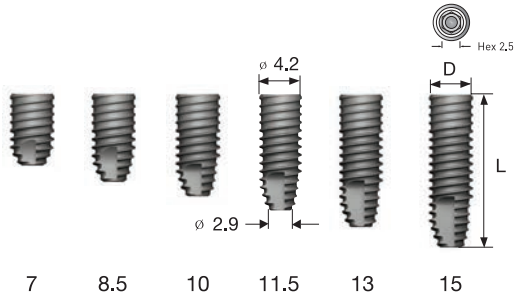
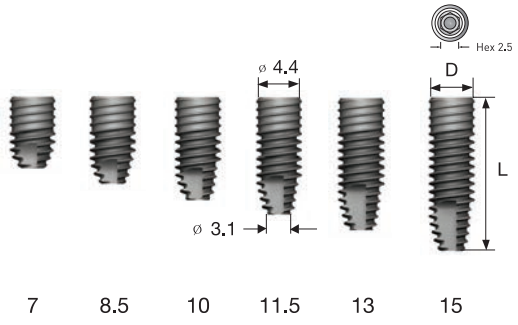


Fig. 45. TSII Mini Fixtures

Regular Diameter ø 4.0



Regular Diameter ø 4.5



Regular Diameter ø 5.0

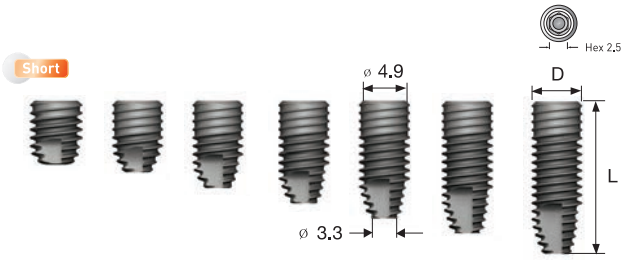


Fig. 46. TSII Regular Fixtures

(3) Drilling and implant installation.

Use the same surgical KIT used for standard GS system.**(Fig. 47)**

Control implant depth considering gingival thickness, shape of alveolar bone, and surrounding conditions. Generally it is recommended to place 0.5~1.0mm in sub-crestal position.

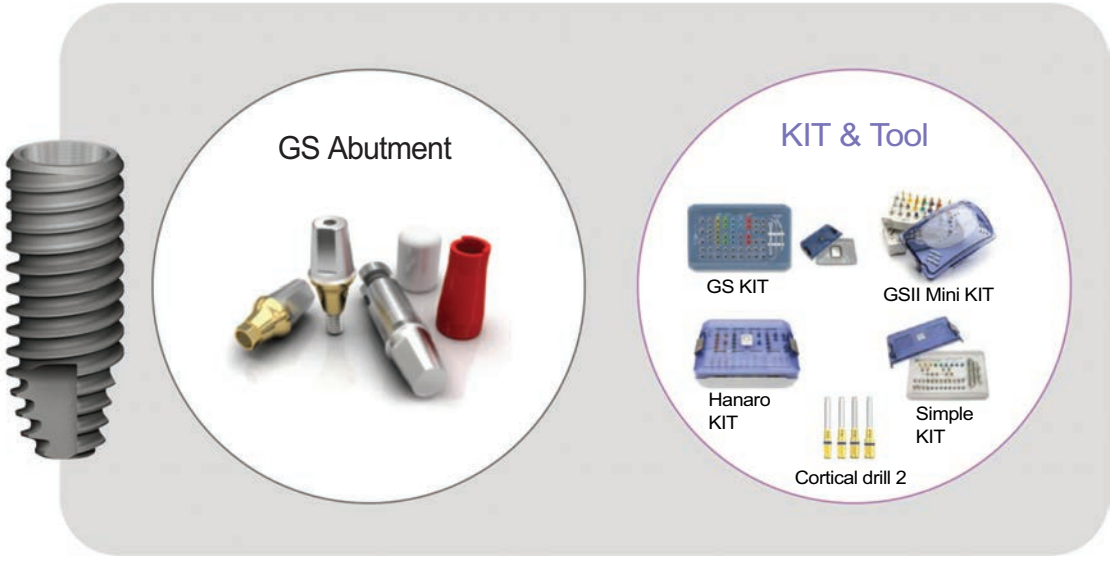


Fig. 47. TSII drill kit uses the same surgical KIT used for standard GS system

2) TSIII

(1) Characteristics (Fig. 48)

① Has 1.5° degree taper angle so that installation torque can increase adequately. Suitable for immediate or early loading because of excellent initial stability.
② Submerged type implant with Internal Hex and conical seal connection structure of 11° taper.
③ Initial stability is easily gained in poor bone quality, and adoption of corckscrew thread (0.8 pitch X 0.5 depth X double lead) allows powerful self-tapping ability and implant direction control.
④ An open thread was applied on the upper part of implant for bone necrosis prevention purposes.
⑤ Applying single pitch microthread(0.8 pitch X 0.25 depth X double lead) increased SA surface effect and reinforced fixture strength.
⑥ Applying helix cutting edge provides excellent self-tapping ability and direction control.
⑦ Applying drilling blades on apex enhances drilling ability and stability of lower part.
⑧ Has dual thread screw with single macro thread of 0.8mm Pitch. Each rotation has 1.6mm of rapid installation speed. **(Fig. 49)**

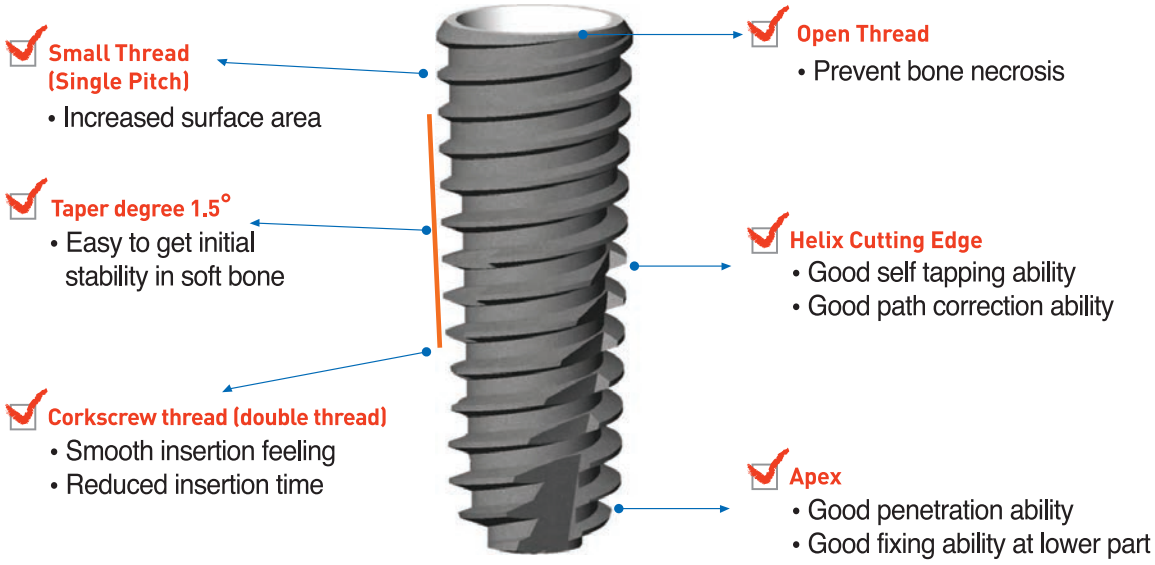


Fig. 48. TIII Fixture Design

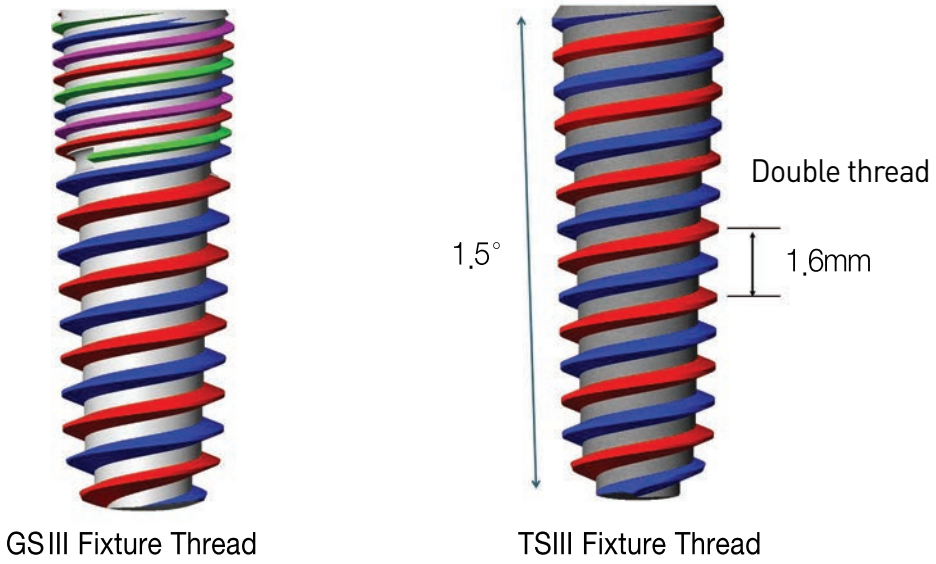


Fig. 49. TSIII fixture thread is a single macro thread.
It is a dual thread structure in which each rotation installs two pitches (1.6mm).

(2) Specification

Length of 7, 8,5, 10, 11,5, 13, 15mm, diameter of 3.5(apex 2.5, top 3.7mm), 4.0(apex 2.8, top 4.2mm), 4.5(apex 3.1, top 4.6mm), 5.0mm(apex 3.7, top 5.1mm) are provided.**(Fig. 50) (Table 12)**. Recently, length 6mm for TSIII fixture with diameter ø5.0mm has been released and provided. All upper products from GS System are compatible, and there are two types of abutment connection specifications. One is the Mini connection for Fixture 3.5, and the other is the Regular connection for the rest of diameters. For Regular connection, in fixtures with diameter over 4mm, same abutment regardless of diameter.**(Fig. 51-54)** SA surface TSIII SA, SA surface with low crystalline thin film Nano-HA coated TSIII BA, and HA coated TSIII HA are supplied.

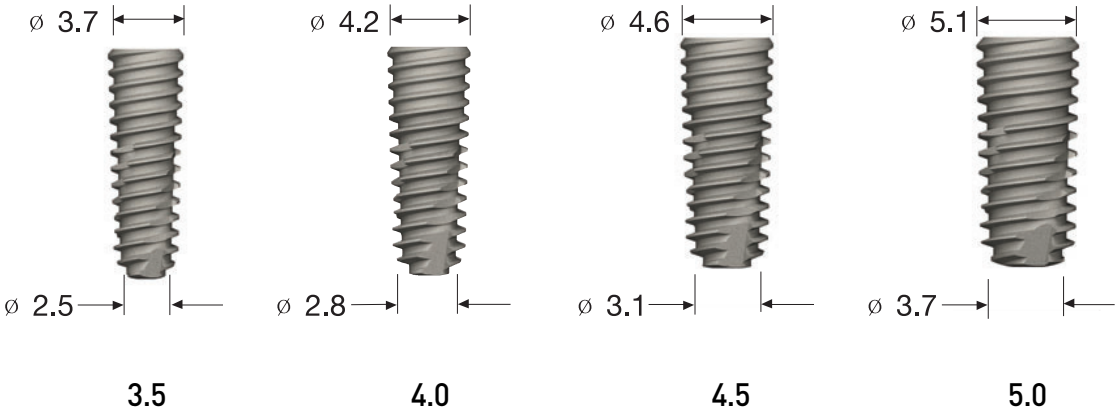


Fig. 50. TSIII fixture diameter. Actual diameter is bigger than labeled value.

Table 12. Diameter and Length of TSIII Fixture

Connection	Mini	Regular		
Hex	2.1	2.5		
Diameter	ø3.5	ø4.0	ø4.5	ø5.0
Length	-	-	-	6
	-	7	7	7
	8.5	8.5	8.5	8.5
	10	10	10	10
	11.5	11.5	11.5	11.5
	13	13	13	13
	15	15	15	15

TSIII SA Fixture 3.5
(Yellow/Purple)

TSIII SA Fixture 4.0/4.5/5.0
(Green)

Fig. 51. Pre-mounted TSIII implant fixture

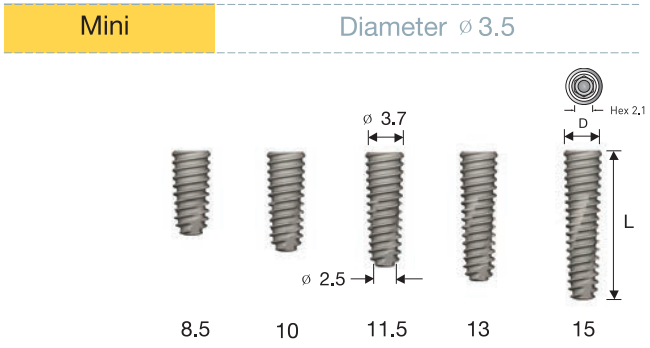
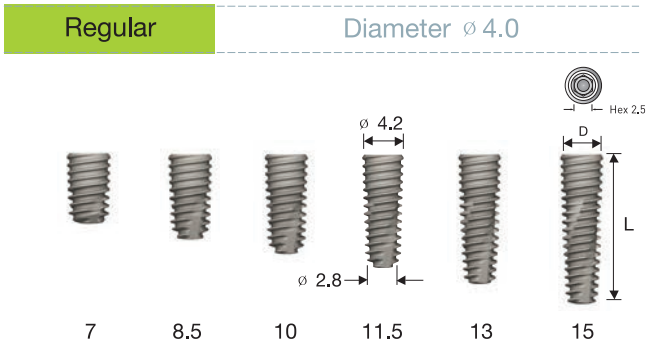


Fig. 52. TSIII Mini Fixtures



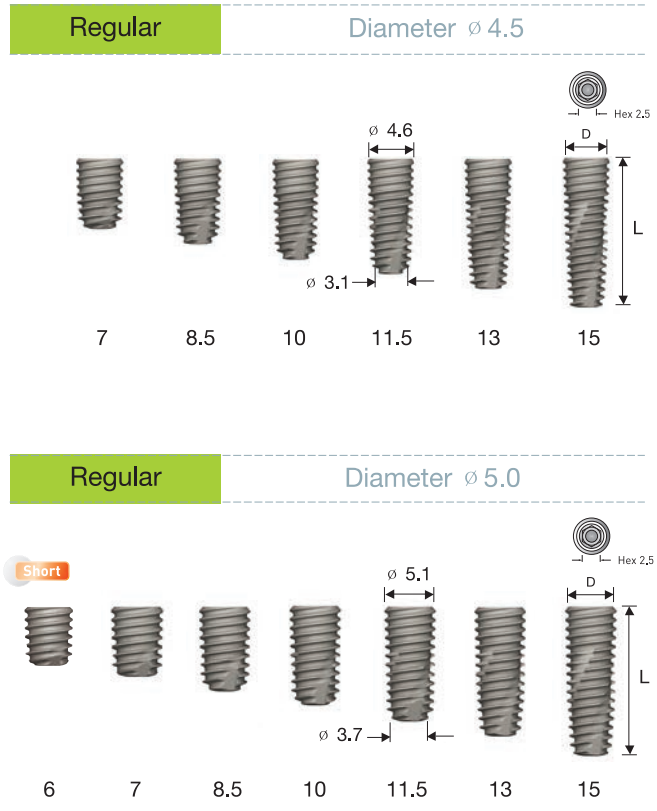


Fig. 53. TSIII regular system.
Diameters of 4, 4.5, and 5mm are available.

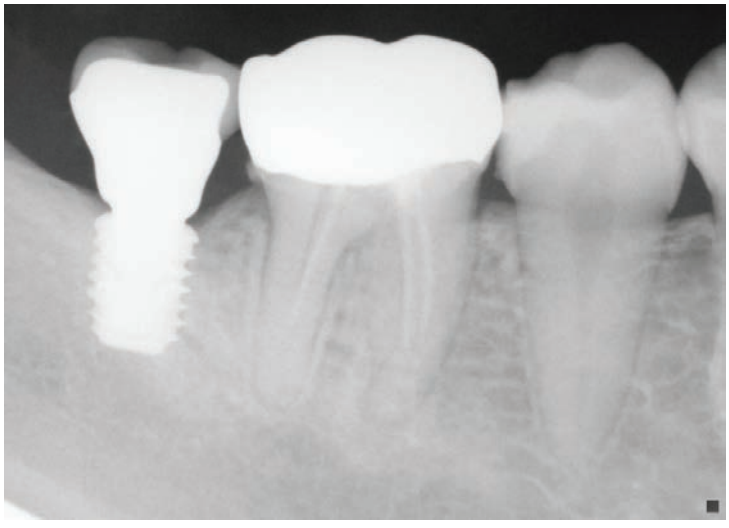


Fig. 54. Periapical radiograph of TSIII SA short implant installed at #47 in 26 year old female patient.
Short implant of 6mm has been recently released.

(3) Drilling and Implant installation

Apply same surgical procedure and kit as GSIII system. An individual cortical drill 3 could be purchased for use if one already has an Osstem surgical kit. **(Fig. 55)** A separate Tapered kit is prepared to make tapered implant installation more easy. **(Fig. 56)** Recommended installation torque is 40Ncm or below. However, it is 35Ncm or below for HA coated implant.

Fig. 55. Purchasing individual cortical drill allows additional use with existing Osstem Kit.

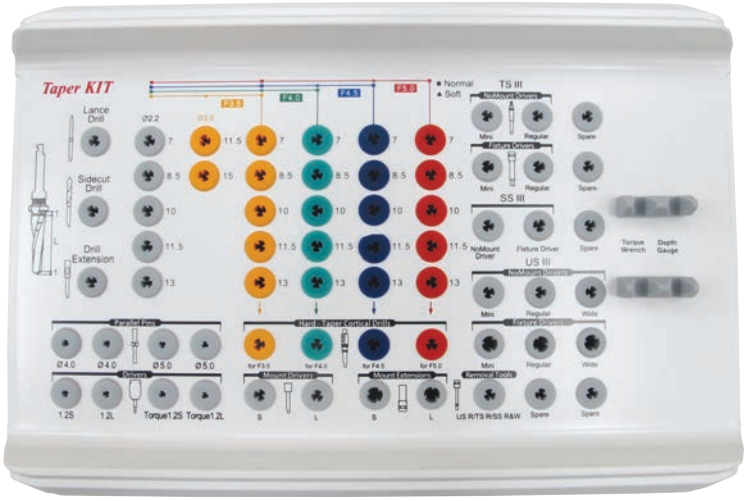


Fig. 56. Tapered KIT. Mini specific and Regular specific are separately prepared.

3) TSIV

(1) Characteristics (Fig. 57, 58, 59)

① Fixture thread consists of 0.8~1.2pitch X 0.45~0.65depth X Double thread
② Submerged type implant with Internal Hex and conical seal connection structure of 11° taper.
③ Implant specific to weak bone quality or where maxillary sinus bone grafting is required. Insertion feeling and initial stability has been enhanced.
④ Helical cutting edge, corkscrew thread and sharp apex design applied allows installation with minimum drilling (i.e. diameter of 2mm or 3mm in D4 bone quality) in poor bone quality.
⑤ Immediate installation after extraction provides high initial stability. It provides high initial stability during Immediate implant placement after extraction.
⑥ High self-tapping ability allows precise direction control when installing.
⑦ There is no need to use osteotome in maxillary molar region, and recommended installation torque is 40Ncm or below.

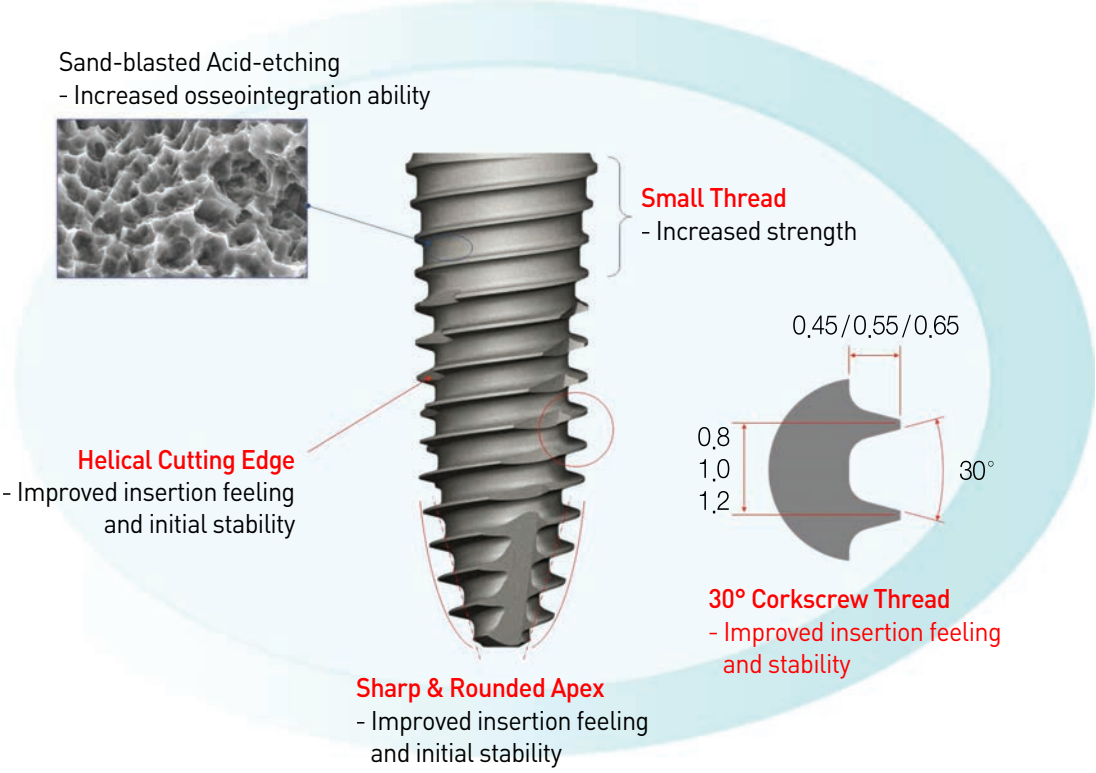


Fig. 57. TSIV Fixture Design.

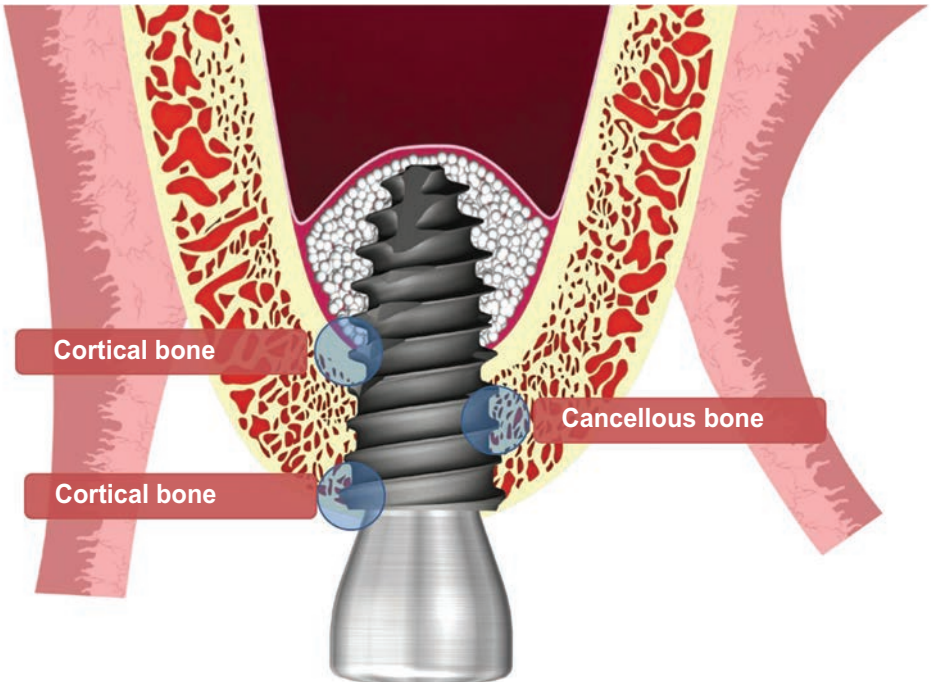
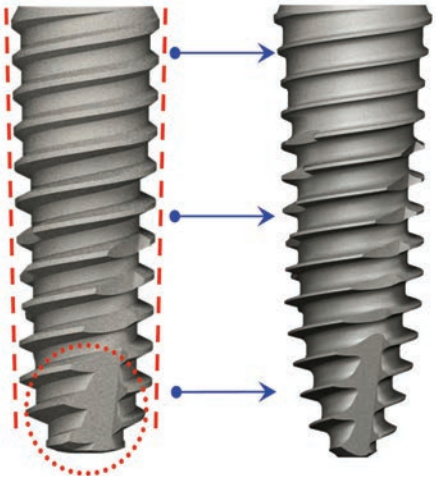


Fig. 58. Insertion feeling and initial stability are excellent where maxillary sinus bone grafting is required.



- **Body Design**
  Increased stability by under drilling
- **Thread Design**
  Big and sharp thread which enables good penetration
- **Cutting Edge**
  Highly formed to improved insertion feeling and initial stability
- **Sharp Apex Design**
  Sharp Apex Design Good penetration ability

Fig. 59. Comparison of TSIII and TSIV fixture.

(2) Specification

There are no mini-system and 15mm length for TSIV. 15 types of fixtures (lengths 7, 8.5, 10, 11.5, 13mm, diameters 3.0, 3.5, 5.0mm) are supplied. Surface has been SA treated.**(Table 13) (Fig. 60, 61)**

Table 13. Diameter and length of TSIV

Connection	Regular		
Hex	2.5		
Diameter	ø 4.0	ø 4.5	ø 5.0
Pitch	0.8	1.0	1.2
Length	7	7	7
	8.5	8.5	8.5
	10	10	10
	11.5	11.5	11.5
	13	13	13

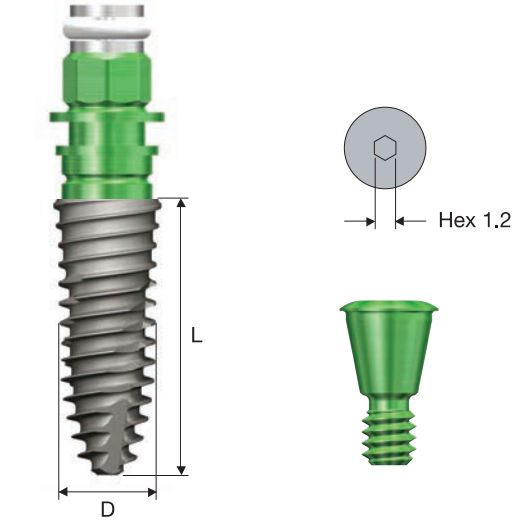
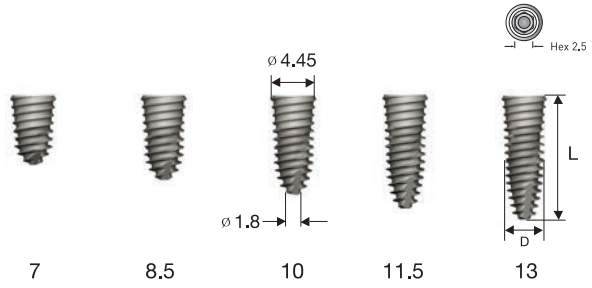
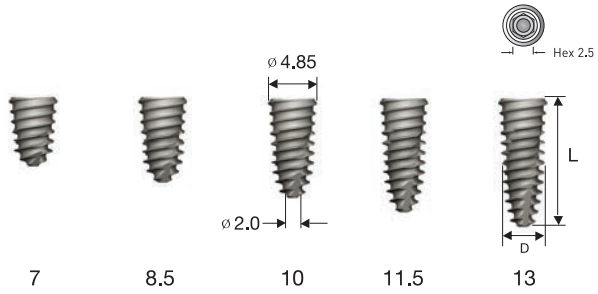


Fig. 60. Pre-mounted TSIV Fixture.

Regular Diameter ø 4.0



Regular Diameter ø 4.5



Regular Diameter ø 5.0

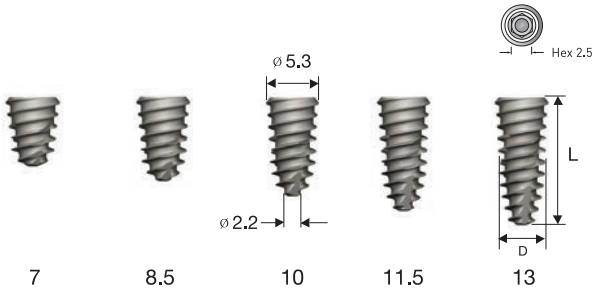


Fig. 61. TSIV Regular Fixtures. Actual diameter is bigger than labeled value.

(3) Drilling and implant installation.

TSIV is an implant designed for maxillary sinus and weak bone quality, and is not recommended for normal or hard bone quality. Because its large pitch of thread rapidly installs the fixture, the installation speed should be 15 rpm or below.**(Fig. 62, 63)**

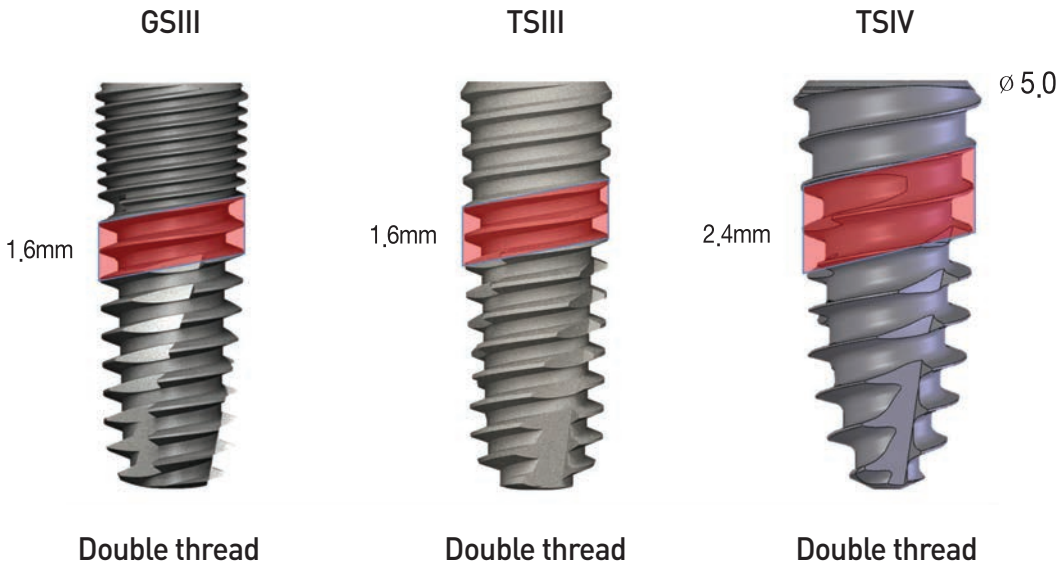


Fig. 62. TSIV fixture thread enables faster installation per one turn than GSIII or TSIII.

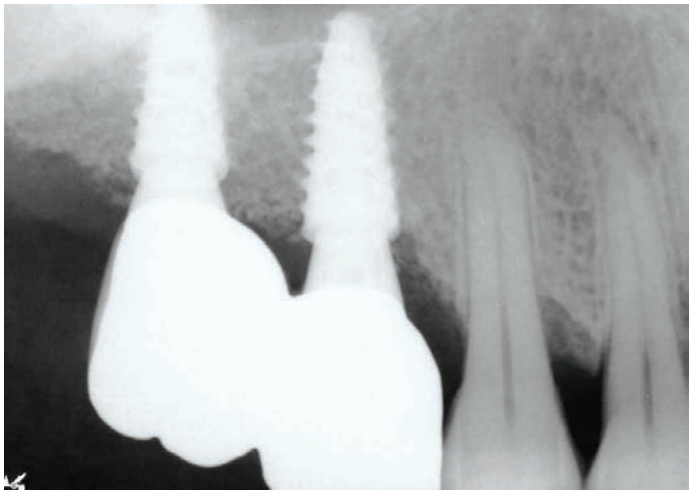


Fig. 63. Periapical radiograph after 3 months of prosthesis function. Maxillary sinus bone grafting and two TSIV implants were installed in #16 and #17 regions

5. Ultra-Wide Fixture

Allows selective usage: either to replace after removal of failed implant or to install immediately after extraction in molar regions.**(Fig. 64, 65)**

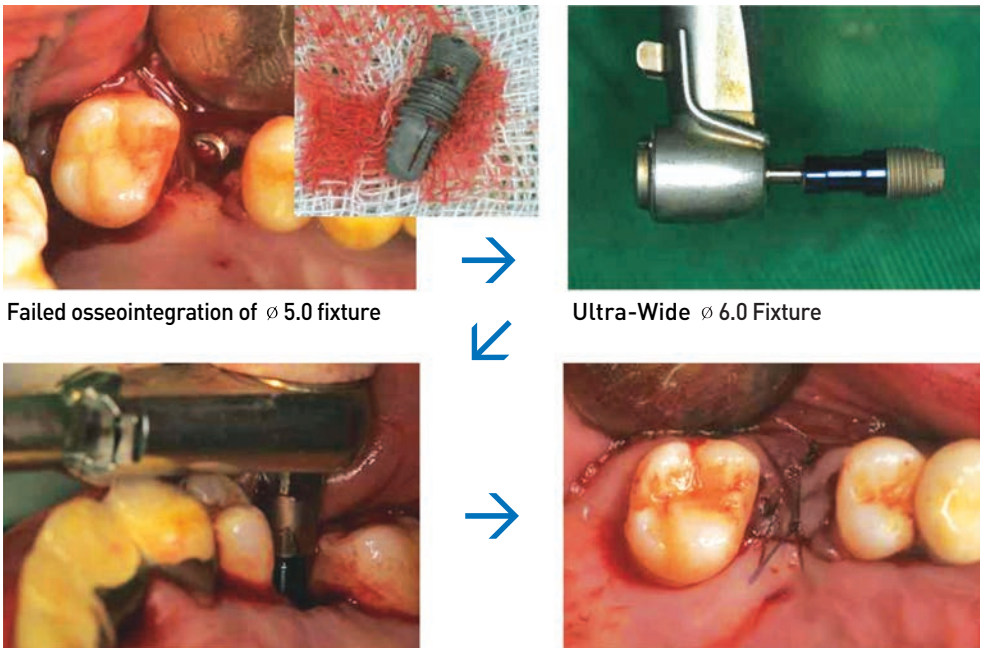


Fig. 64. Retrieve failed implant and replaced to Ultra-Wide fixture immediately

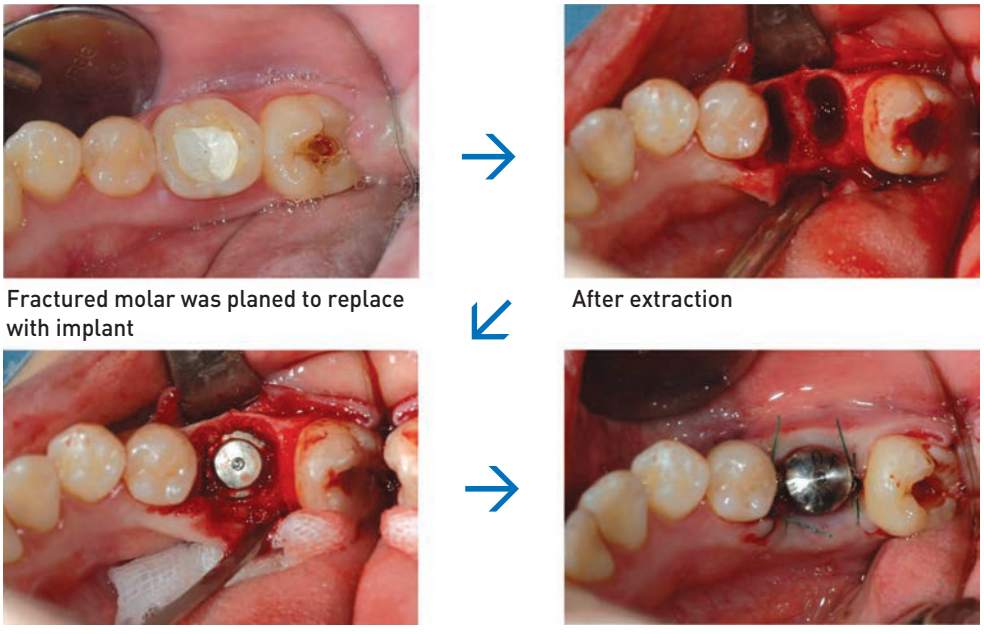


Fig. 65. Case in which implant was installed immediately after tooth extraction

1) Straight body

① Is advantageous when vertical height of alveolar bone lacks because of maxillary sinus or inferior alveolar nerve. **(Fig. 66)**

② Advantageous in securing initial stability when installing immediately after tooth extraction.

③ Should be used with sufficient width of the alveolar bone.

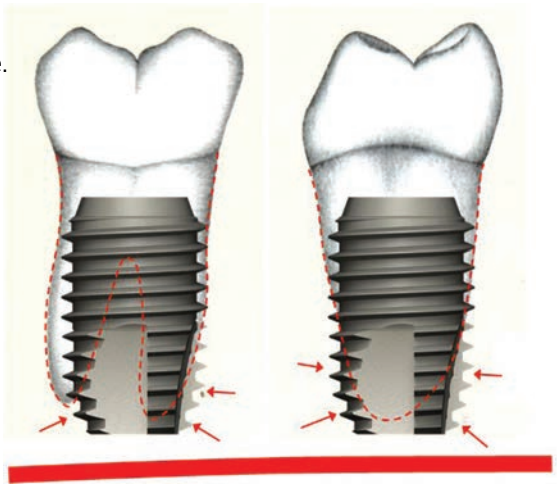


Fig. 66. Ultra-Wide straight fixture is advantageous when vertical height of alveolar bone lacks because of maxillary sinus or inferior alveolar nerve.

2) Tapered body

① Use either in narrow width of the alveolar bone, or has steep incline.**(Fig. 67)**

② When installing immediately after extraction, vertical height of alveolar bone must be sufficient to secure initial stability.

③ Securing initial stability is easy in weak bone quality, whereas difficulties will arise with depth control in hard bone quality.

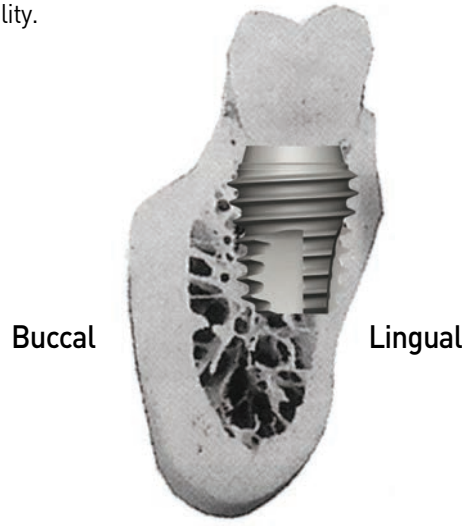


Fig. 67. Tapered body is more suitable if base of alveolar bone is narrow or has steep incline.

3) USII Ultra-Wide (Fig. 68)

① It is an external hex wide diameter fixture
② Tolerance of Fixture Hex and Upper part is 7~15㎛, rotation tolerance is 0.4 °~2 °.
③ Platform switching effect minimizes bone resoprtion and amplifies soft tissue volume.
④ Optimized apex design provides initial stability even in apical 3mm of extraction socket.
⑤ Applied excellently biocompatible RBM surface.
⑥ 4 bladed cutting edge provides excellent self-tapping ability.

Fig. 68. USII Ultra-Wide

4) SSII Ultra-Wide (Fig. 69)

① A non-submerged wide diameter fixture with internal Octa connection.
② Commonly uses SS wide abutment components.
③ Excellent prevention of bone resorption because of the lack of micro-mobility due to connection with upper part being inside the fixture.
④ Applied collar (G/H 2.0) of machined surface that allows compatibility with gingival tissue and plaque control.
⑤ Optimized apex design provides initial stability even in apical 3mm of extraction socket.
⑥ Applied all RBM surface.

Fig. 69. SSII Ultra-Wide

5) GSII Ultra- Wide (Fig. 70, 71)

① Submerged wide diameter fixture of internal connection type.
② Can commonly use GS Standard abutment components.
③ Optiized apex design provides initial stability even in apical 3mm of extraction socket.
④ Appled excellently biocompatible RBM surface.
⑤ Maintains stable connection with upper part in Rigid Motion.
⑥ 4 bladed cutting edge provides excellent self-tapping ability.

Fig. 70. GSII Ultra-Wide

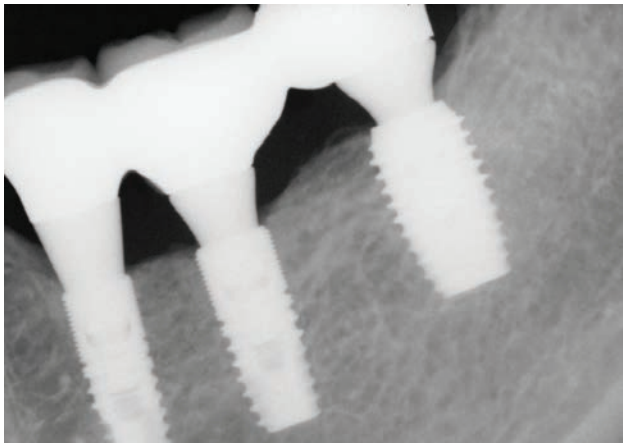


Fig. 71. GSII Ultra-Wide 6 x 6.0mm fixture was placed immediately after extraction of #37. Periapical radiograph after 2 years of prosthesis function.

6) TSIII Ultra-Wide (Fig. 72, 73)

By selecting hybrid SA surface, fixture bevel area (0.5mm) surface roughness has been reduced for easy plaque control and prevention of peri-implantitis.

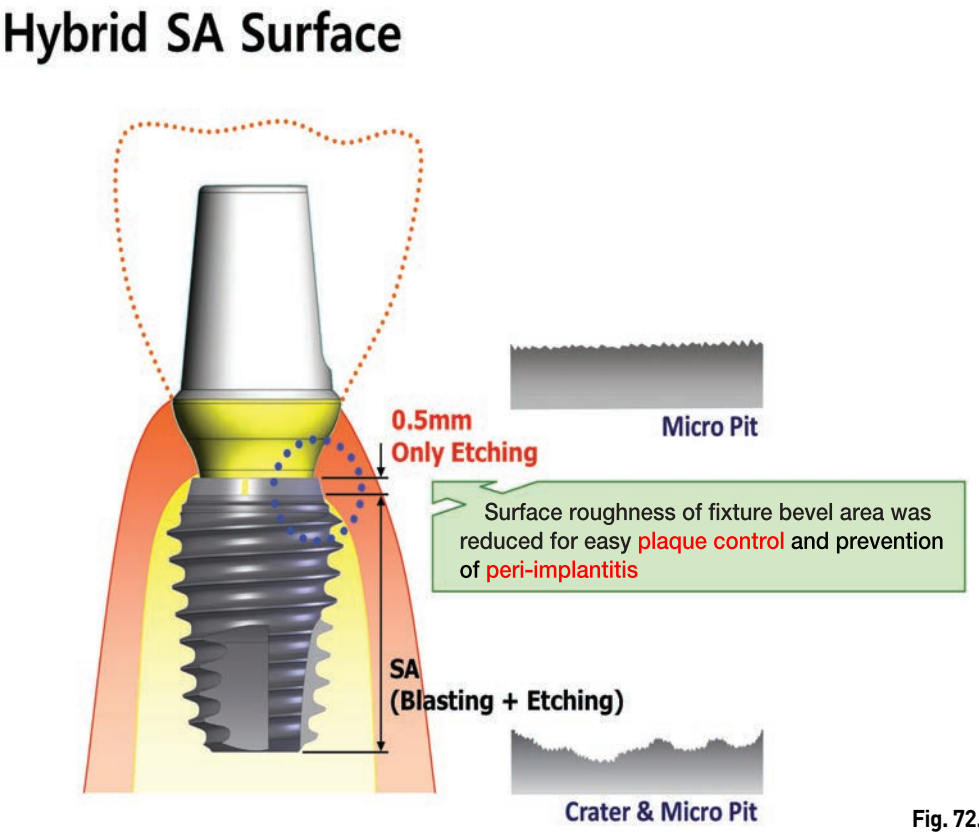


Fig. 72. TSIII Ultra-Wide

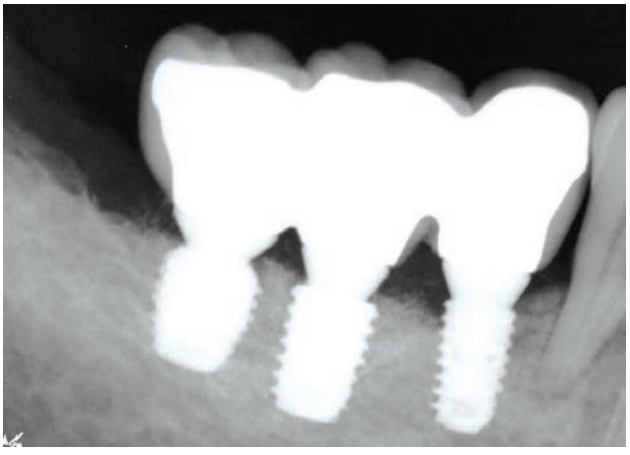


Fig. 73. Periapical radiograph of right mandibular molar site after completion of implant prosthesis. TSIII Ultra-Wide(6D/6L) on #47, TSIII SA(#45:4D/7L, #46:5D/7L) on #45 and 46 have been installed.

7) Specification

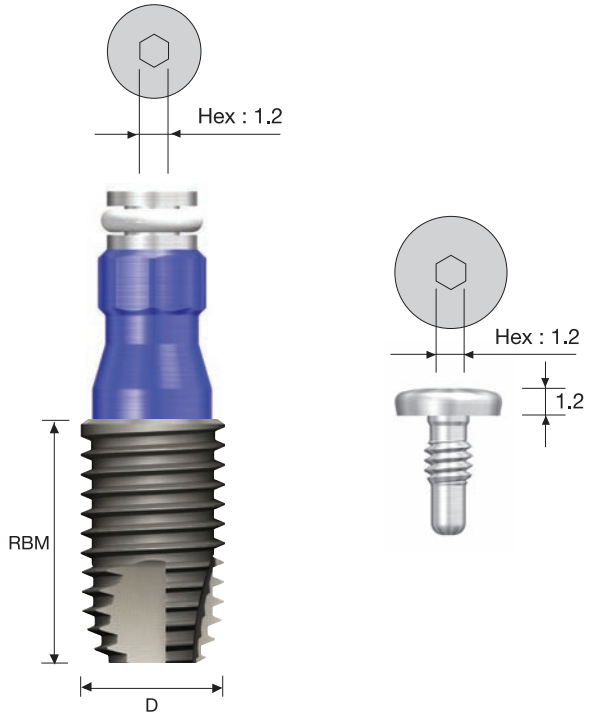
Diameter of 6mm and 7mm are provided. Depending on the system, length of 6, 7, 8.5, 10, 11.5, 13mm are provided.

(1) USII Ultra-Wide

Specifications with diameter of 6, 7mm, length of 7, 8.5, 10, 11.5, 13mm are prepared.**(Table 14) (Fig. 74)**

Table 14. Diameter and length of USII Ultra-Wide

Connection	Wide	
Platform	P5.1	
Hex	3.4	
Diameter	ø 6.0	ø 7.0
Length	6	6
	7	7
	8.5	8.5
	10	10
	11.5	11.5
	13	13



(∗Mount and Cover Screw is same as US Wide)

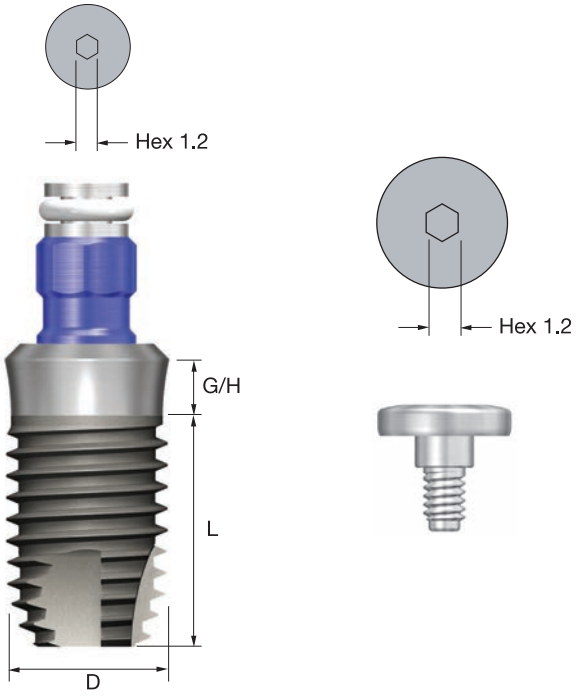
Fig. 74. Pre-mounted US Ultra-Wide system

(2) SS Ultra-Wide

Specifications with diameter of 6, 7mm, length of 7, 8.5, 10, 11.5, 13mm are prepared.**(Table 15) (Fig. 75)**

Table 15. Diameter and length of SSII Ultra-Wide

Connection	Wide	
Platform	P6.0	
Diameter	ø 6.0	ø 7.0
G/H	2.0	2.0
Length	7	7
	8.5	8.5
	10	10
	11.5	11.5
	13	13



(∗Mount and Cover Screw is same as SS Wide)

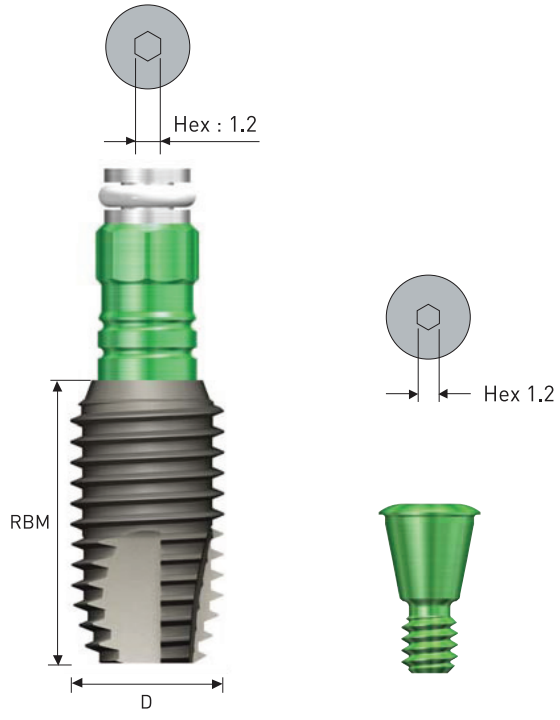
Fig. 75. Pre-mounted SS Ultra-Wide system

(3) GS Ultra-Wide

Specifications with diameter of 6, 7mm, length of 7, 8.5, 10, 11.5, 13mm are prepared.**(Table 16) (Fig. 76)**

Table 16. Diameter and length of GS Ultra-Wide

Connection	Regular	
Hex	2.5	
Diameter	ø 6.0	ø 7.0
Length	6	6
	7	7
	8.5	8.5
	10	10
	11.5	11.5
	13	13



(*Mount and Cover Screw is same as GS Regular)

Fig. 78. GSII Ultra-Wide system

(4) TSIII Ultra-Wide

Specifications with diameter of 6, 7mm, length of 6, 7, 8.5, 10, 11.5, 13mm are prepared.**(Table 17) (Fig. 77)**

Table 17. Diameter and length of TSIII Ultra-Wide

Connection	Regular	
Hex	2.5	
Diameter	ø 6.0	ø 7.0
Length	6	6
	7	7
	8.5	8.5
	10	10
	11.5	11.5
	13	13

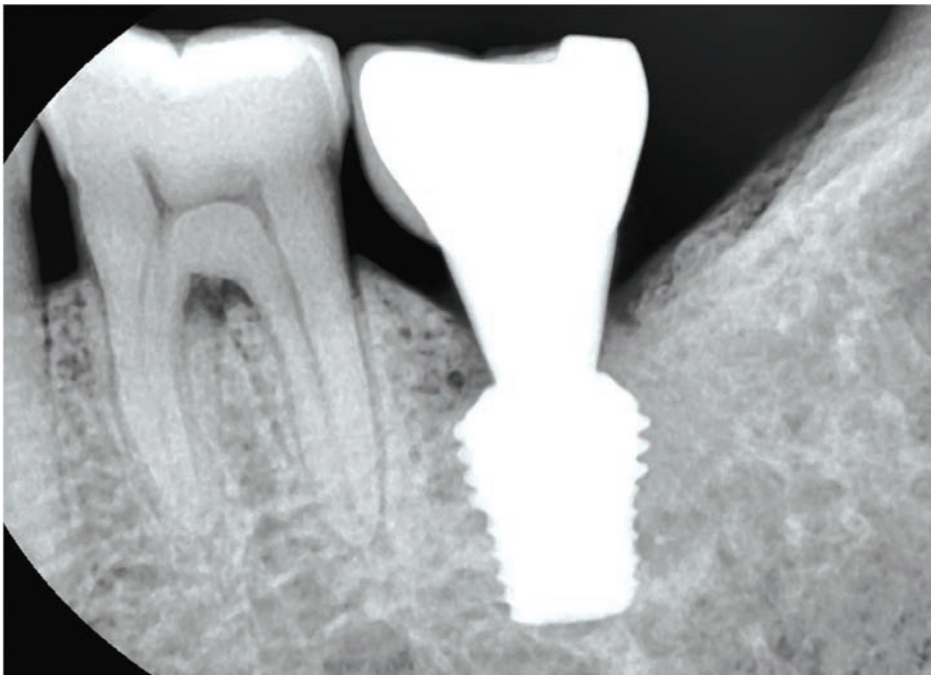


Fig. 79. TSIII 7.0x10.0mm fixture was installed at #46 after extraction using trephine technique. Periaoical radiograph 1 year after crown delivery.

6. MS(Micro Solution) system

4 types of MS system are supplied. Depending on the type, various machined surface, RBM and SA surface modifications are applied. **(Fig. 78)**

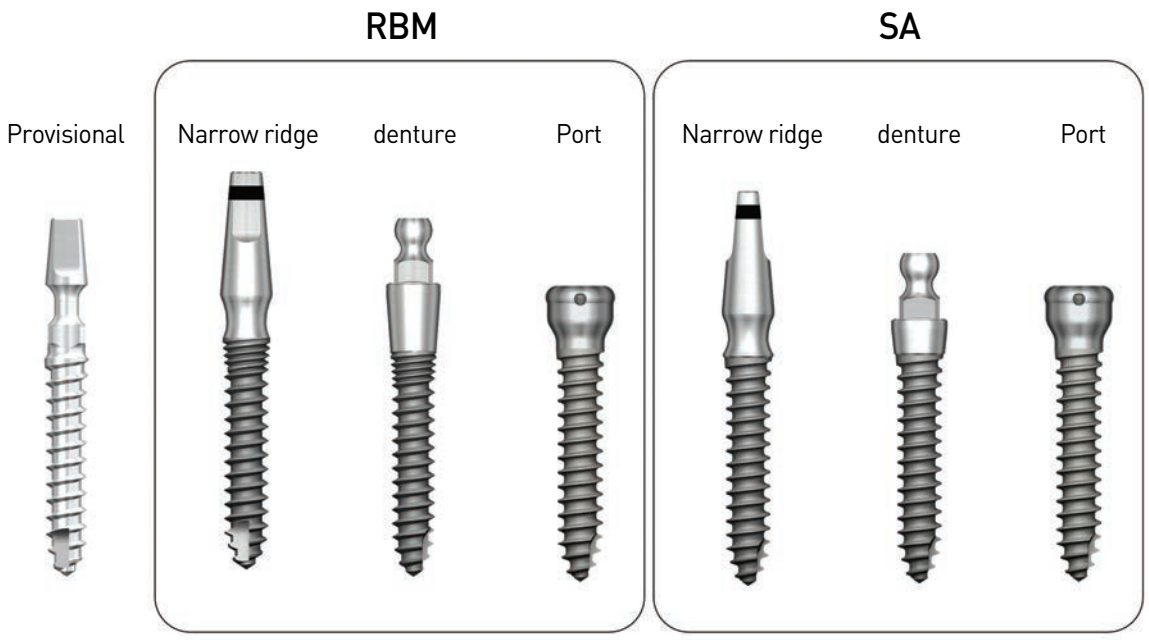


Fig. 78. 4 types of MS Implants.

1) Narrow Ridge Type

SA surface treated Narrow ridge MS implants consist of single macrothread. (0.8 pitch X 0.35 depth)

(1) Charcteristics (Fig. 79)

① Implant suitable for narrow space as mandibular anterior region.
② Fixture and abutment are one body to aptly resist masticatory force.
③ RBM surface was initially chosen, but has been replaced with SA surfaces for faster osseointegration.
④ Structure and size around abutment have been optimized for prosthetic procedure without preparation.
⑤ Fixture body, thread design and drill have been optimized to increase initial stability and bone tapping ability.

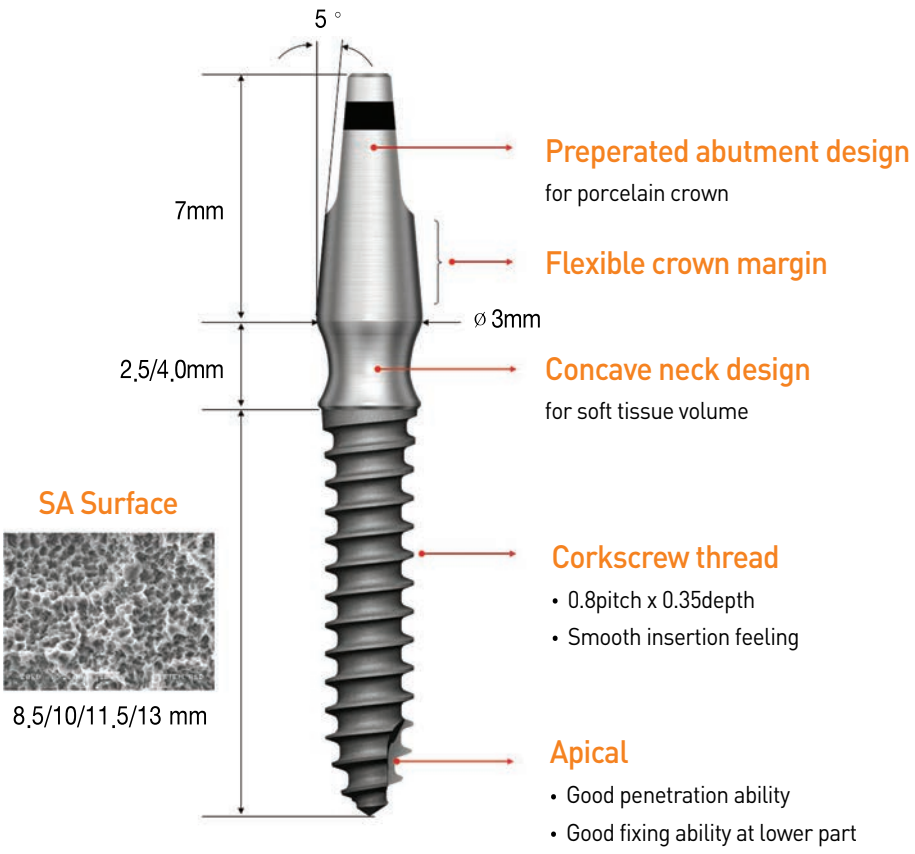


Fig. 79. Narrow Ridge Type MS SA Implant

(2) Specification

For MS RBM implant, length of 10, 11.5, 13, 15mm are provided. For MS SA implant, length of 8.5, 10, 11.5, 13mm are provided. 2.5mm and 3.0mm of diameter are ready. **(Table 17), (Fig. 80)**

Table 18. Diameter and length of MS SA implant narrow ridge type

Diameter	ø 2.5		ø 3.0	
G/H	2.5	4.0	2.5	4.0
Length	8.5 10 11.5 13	8.5 10 11.5 13	8.5 10 11.5 13	8.5 10 11.5 13

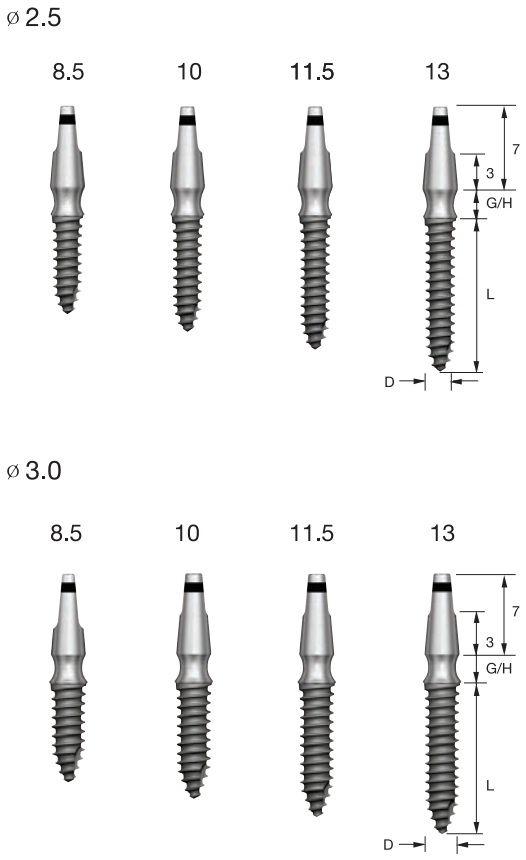


Fig. 80. Specifications for MS SA implant (Narrow ridge)

(3) Drilling and implant installation (Fig. 81)

All MS type implants undergo the same drilling operative procedure and installation torque less than 30Ncm is recommended.

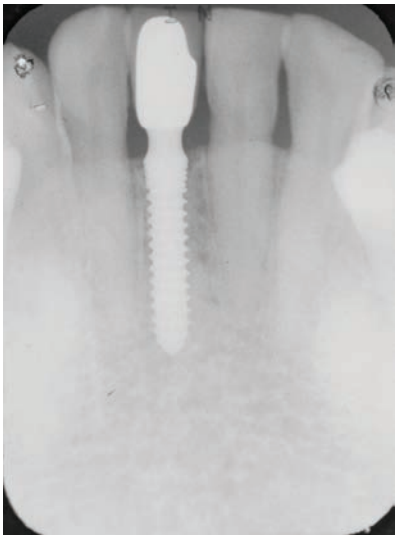


Fig. 81. Periapical radiograph 2 years after installation of MS implant in #41.

2) Provisional Type

(1) Characteristics (Fig. 82)

① Screw thread consists of 1.0pitch X 0.25depth X Single thread.
② Used when attaching immediate provisional restoration on complete or partial edentulous patients.
③ Because neck portion can bend, direction can be modified and maintain strength.
④ Can simply create temporary prosthesis using titanium provisional cap and lab Analog.
⑤ 4 edge structure is applied where driver is connected to lower part of neck.
⑥ Fixture body, thread design and drill have been optimized to increase initial stability and bone penetration ability.

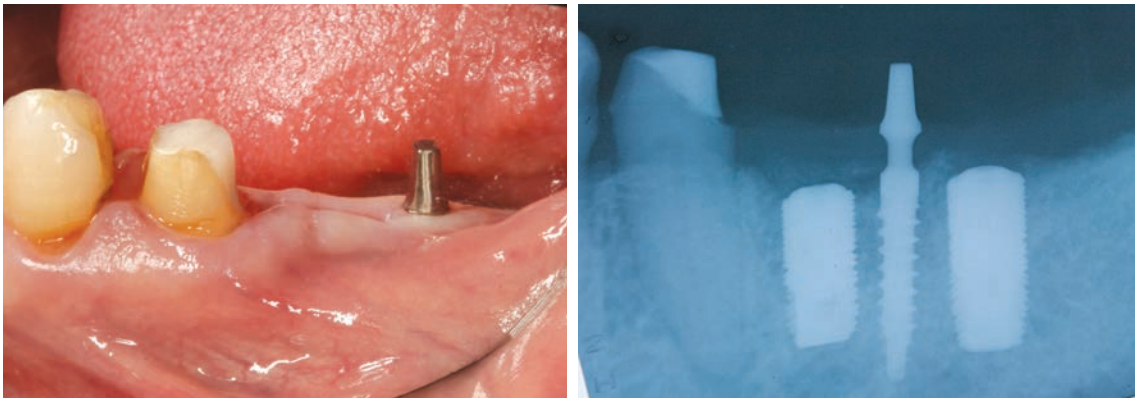


Fig. 82. MS Implant (provisional) installed to fabricate temporary prosthesis.

(2) Specification

Diameters 1.8, 2.5mm, lengths 10, 13, 15mm are prepared.**(Table 19) (Fig. 83)**

Table 19. Diameter and length of provisional type MS Implant

Diameter	ø 1.8		ø 2.5	
G/H	4.0		4.0	
Length	10	10	10	10
	13	13	13	13
	15	15	15	15

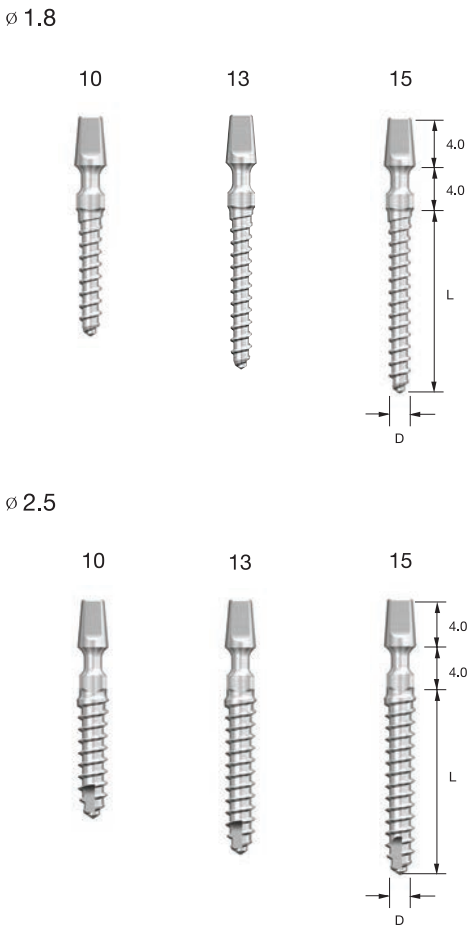


Fig. 83. Provisional type MS implant.

3) Denture Type

(1) Characteristics (Fig. 84)

① Screw thread consists of 0.8pitch X 0.35depth X Single thread.
② It is implant for denture support in edentulous patients with narrow bone width, or in cases where normal implant installation is difficult.
③ Possesses SA surface that provides excellent osseointegration.
④ Simple manufacture of denture using Retainer and Lab Analog.
⑤ Ball type structure was selected for connection of O-ring attachment.
⑥ Use 2 or 4mm depending on gingival height.

Fig. 84. Denture type MS Implant

(2)Specification

For MS RBM implant, lengths of 10, 11.5, 13, 15mm are provided. For MS SA implant, lengths of 8.5, 10, 11.5, 13mm are provided. 2.5mm and 3.0mm of diameter are ready..**(Table 20)**

Table 20. Diameter and length of MS SA denture type implants

Diameter	ø 2.5		ø 3.0	
G/H	2.0	4.0	2.0	4.0
Length	8.5 10 11.5 13	8.5 10 11.5 13	8.5 10 11.5 13	8.5 10 11.5 13

4) MS Port

MS Port is an MS implant designed in the form of Locator Head to overcome limitations of using Locators where mini diameter fixtures are difficult to use because of narrow ridges.
Port is a stable implant where denture can be safely attached.

(1) Characteristics (Fig. 85, 86)

① It is an implant for dentures with fixture body and locator abutment integrated.
② Is 100% compatible with Zest locator attachment.
③ Use in cases where implants with normal diameter Is difficult to install due to narrow bone width.
④ Use 2 or 4mm selectively depending on gingival height
⑤ Body and thread design was selected to provide optimal insertion feeling and installation torque regardless of bone quality

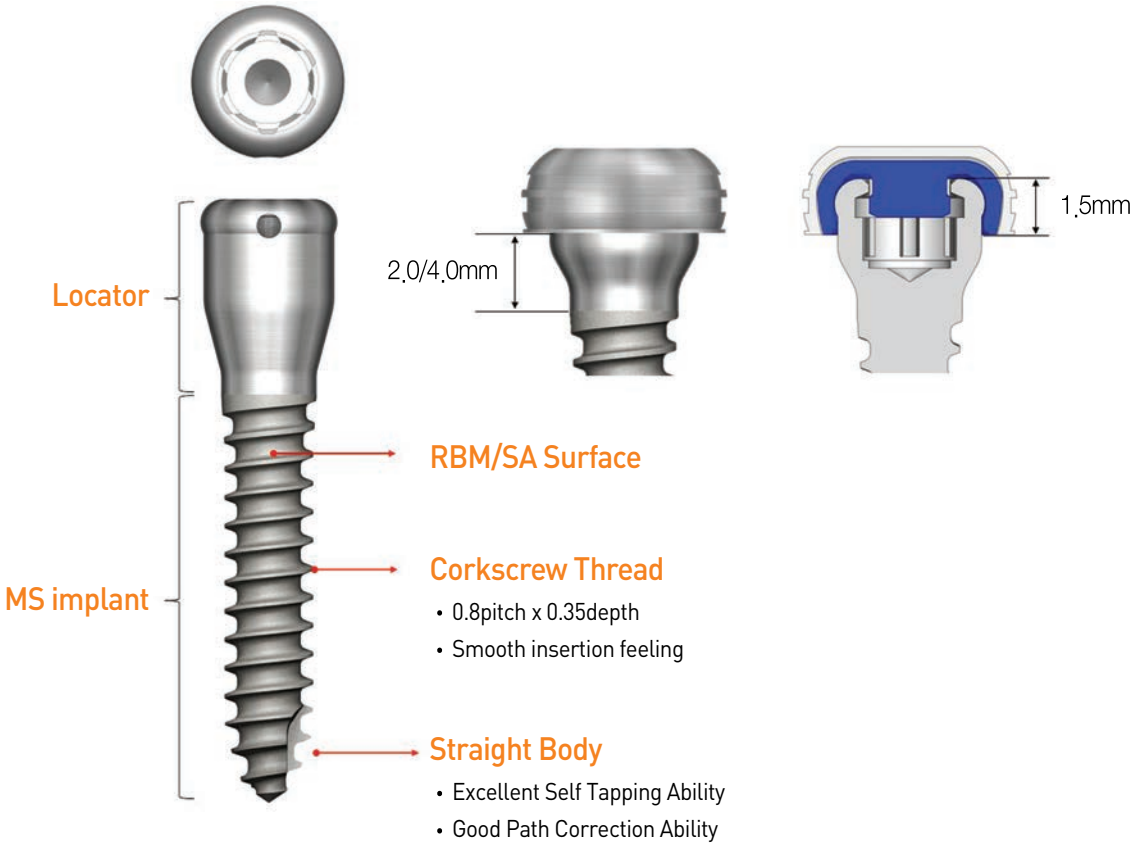


Fig. 85. MS Port Design.

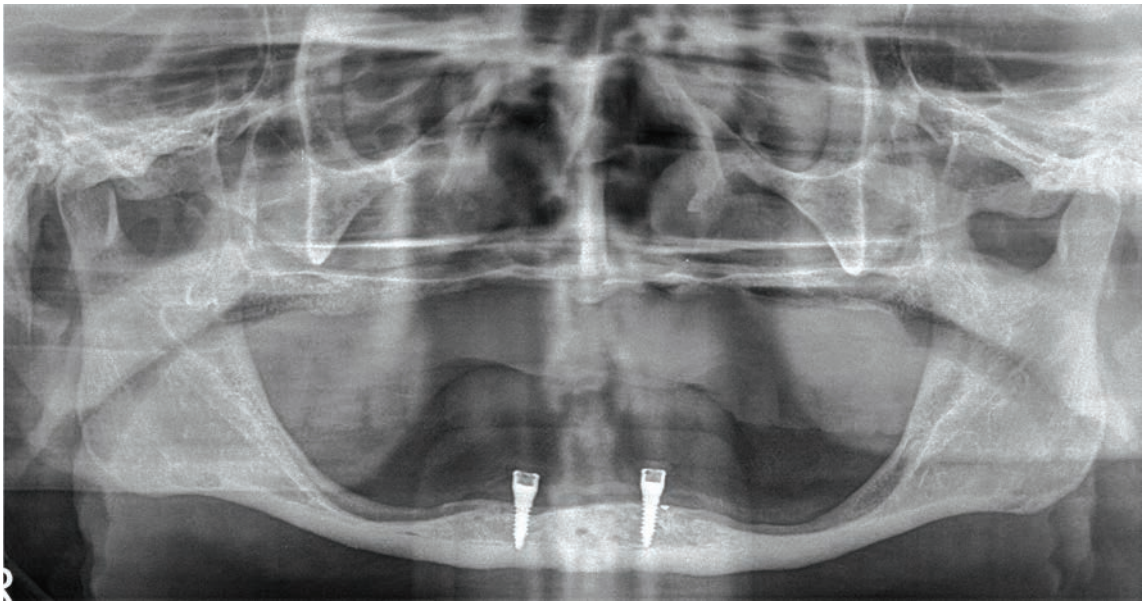


Fig. 86. Panorama 1 year after installation of MS port implant in 75 year old male patient with severe resorption of mandible.

(2) Specification

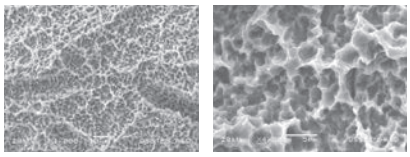
Diameters of 2.5, 3.0, 3.5mm, lengths of 7, 8.5, 10, 11.5, 13mm are prepared. **(Table 21)**

Table 21. Diameter and length of MS Port implant

Diameter	ø 2.5		ø 3.0		ø 3.5	
G/H	2.0	4.0	2.0	4.0	2.0	4.0
Length	-	-	-	-	7	7
	8.5	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13	13

2013

Osstem Implant System



II Surface Treatment

- By Dr. Lee, Dae-Hee

OSSTEM IMPLANT

II Surface Treatment

It is no exaggeration to claim that the history of implant is the history of surface treatment. From the early smooth surface to various surface treatments, developments still occur repeatedly.

Non-modified titanium surface (henceforth smooth surface) is very reactive and forms a 2~17nm thick oxide layer to achieve chemical stability. It is known that appositional growth of regenerated bone occurs (distance osteogenesis) after installation on bone tissue, and leads to osseointegration. Such implants with smooth surfaces are the 1st generation. They are bio-inert, as well as passively interact. Implant surface and methods of osseointegration is revolutionized from the 2nd generation. By adding maco or micro-roughness on bio-inert smooth surfaces, surface areas could be increased.

Some typical methods are: additive methods (TPS (titanium plasma spray), sintering (Endopore)), and subtractive methods (blasting, acid etching, sandblasted large-grit acid etching (SLA)). With osteoconduction and bone formation guided by contact osteogenesis enabling osseointegration, these surface treatment methods have greatly affected operative procedures and timing of loading implants.
For example, immediate installation after tooth extraction, nonsubmerged implants placement, and immediate or early loading which were unthinkable in the first generation smooth surface implants. The protocol of implant installation had since significantly transformed.

Since 3rd generation, the focus has been shifted from the mechanical integration between bone and implant due to increase in surface roughness, to integrating the bone's calcium phosphate ions and titanium implant surface's ions. Such bonding osteogenesis methods (osseocoalescence) as HA (hydroxyapatite) coating, introduction of fluorine, anodizing, and inserting implant in NaCl solution with nitrogen preserved (SLActive), have been introduced to pursue chemical bonding. The implants have now become bioactive because of the surface chemistry.

4th generation implant surface treatment methods are to incorporate signaling molecules as peptide or BMP2 (bone morphogenetic protein 2) on the implant surface. By applying such growth factors, the implants will exhibit biomimetic effects in which implant surfaces possess both osteoconductivity and osteoinductivity. However, the methods of installation, storage, especially the prevention of degeneration during distribution are still challenges to be tackled.

Early products of Osstem Implant all had machined surfaces with surface roughness of Ra 0.1-0.3㎛. TiO_2 blasted products were released around 1997 and have been used clinically since. In early 2000, rough surface implants have been widely used with the development of RBM surface treatment techniques. With the progress in surface treatment, anodized surface, SA surface, and HA coating surface products have been released.

1. RBM(Resorbable Blast Media)

Grit blasting is the method of increasing surface roughness by creating defects by applying sufficient pressure to metallic substrate of silica, resorbable bioceramic (e.g. HA), alumina, or titanium dioxide. Osstem RBM treatment is to blast with biocompatible hydroxyapatite〈$Ca10(PO_4)6(OH)_2$〉powder. Cleansing method regulated by ASTM F-86 is applied. 20% dilute HNO_3 is used to remove hydroxyapatite remaining from surface treatment.
Osstem's RBM treatment has been adopted in US, SS, GS, and MS series, and has proven its efficiency and safety with over 10 years of clinical usage. Generally, 12 weeks loading protocol is applied to RBM surface treated implant. Depending on the case, the loading duration is either decreased of extended. The most objective method is to refer the ISQ values from Osstell Mentor, etc.

Average surface roughness (Ra) for RBM is approximately 1.2-1.8㎛.**(Fig. 2-1, 2-2)** Hybrid surface (machined surface for upper 3mm, RBM surface for rest of lower part) was initially supplied. That is, it was to bring advantage in controlling deposited plaque in case of crestal bone loss that results in exposure of implant surface. However, with further researches suggesting exposure of rough surfaces to be harmless, the entire surface became RBM treated.**(Fig. 2-3)**

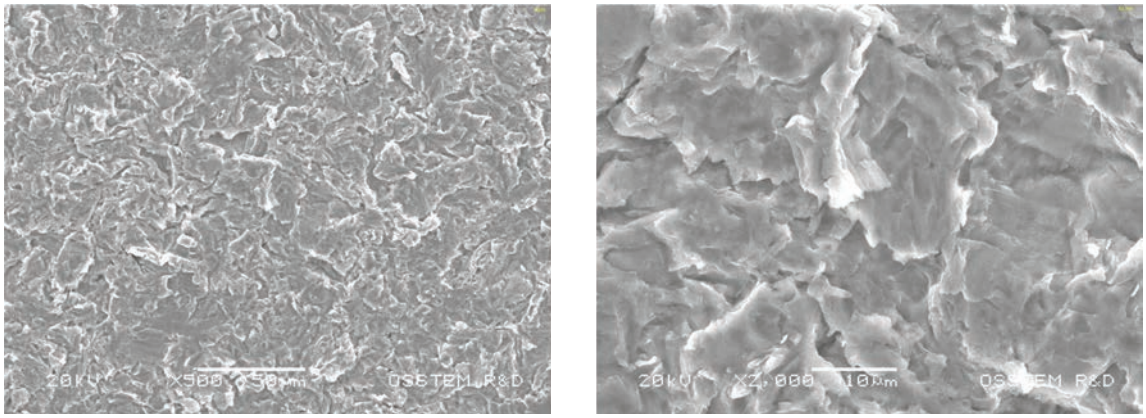
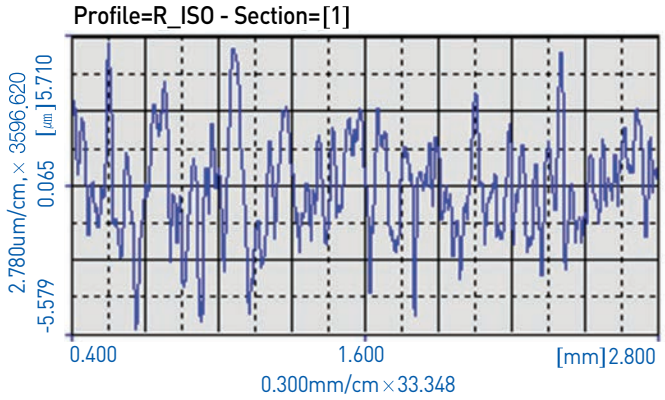


Fig. 2-1. SEM photo of RBM surface.



Parameter Sum Table

	Profile=R_ISO - Section=[1]	Average Vahie
Ra (㎛)	1.480	1.480
Rz (㎛)	9.033	9.033
Rt (㎛)	10.752	10.752

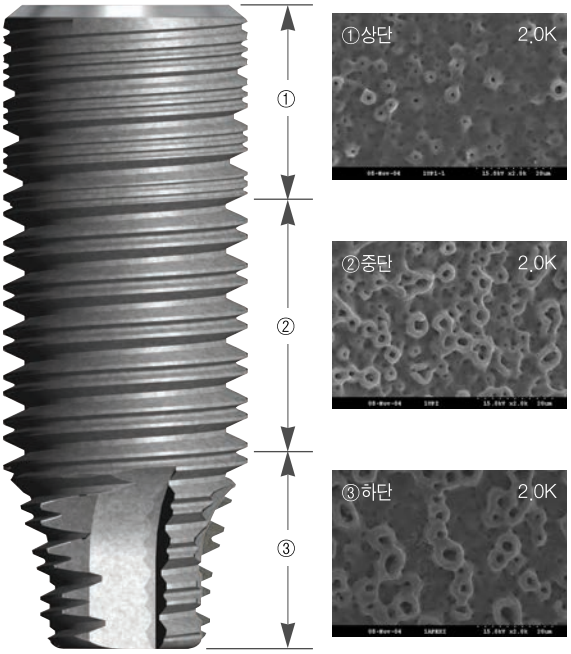
Fig. 2-2. Implant roughness graph produced by surface roughness tester. The X axis represents measurement distance, and Y axis represents unevenness. Distance between thread (above) and furrow (below) represents the roughness. Ra: Ra: average surface roughness. Rz: Average value of 5 biggest disparities between high thread and low furrow. Rt: distance from highest thread to lowest furrow.

Fig. 2-3. Hybrid RBM and all RBM surface USII implants.

2. Anodized Surface (CellNest)

Porosity favored by cells has been applied. Upper part's roughness is 0.2-0.4㎛, and lower part's roughness is 0.8-1.2㎛. Titanium metal ion exposure has been completely prevented by applying a 2-3㎛ oxidized layer, and blood protein adsorptive power has been amplified by strengthening surface energy. This surface treatment was once applied to GSII system, but is now discontinued.**(Fig. 2-4)**

CellNest Surface of GSII



Cell prefer porosity (Cell Nest)

Upper surface roughness: **0.2 ~ 0.4**㎛

Lower surface roughness : **0.8~1.2**㎛

Gradiation

Increased oxidized Layer : 1~10㎛

Completely prevent exposure of Titanium ion Reinforced surface energy →Increased blood protein adsorption

AFM Image

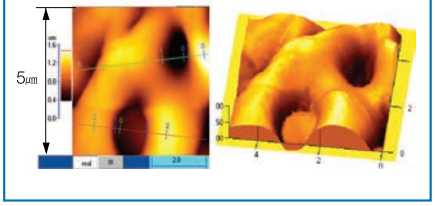


Fig. 2-4. CellNest Surface of GSII

3. SA (Sandblasted with alumina and Acid etched) Surface

The most difficult treatment method of 2nd generation surface treatments, Osstem blasts surface using large particles (250~500㎛) of alumina (Al_2O_3) as Grit blasting media on grade 4 titanium, then etches using strong acids as HCl, H_2SO_4, and HNO_3. Blasting is responsible for macroroughness, and etching is responsible for microroughnesss. The treatments supplement each other. This method affects the resulting surface depending on the ratio of acid solution, temperature, time of etching, order, etc. Also, residue alumina from blasting are mostly removed from etching procedure, but may remain intact. This decreases surface osteoconductivity.**(Fig. 2-5)** Osstem takes precision control so that there are approximately 50 per unit area.

Consists of both Crater and micro-pit, Ra is 2.5 ~ 3.0㎛ , and roughness is even.**(Fig. 2-6, 7)** Surface area has been increased over 45% compared to RBM. Compared to RBM surface, it will show 20% higher early cell response and early bone healing. Therefore, loading may be possible after 6 weeks of installation.**(Fig. 2-8, 9, 10)** Surface chemical composition is Ti, O,C, and N. **(Fig. 2-11)** Osstem fixtures with SA surface include US, SS, and TS series. Fixtures with SA surfaces are advantageous than RBM for parts with relatively poor bone quality, maxillary sinus bone grafting cases, or early loading and immediate installation after extraction cases. Their usage is increasing.

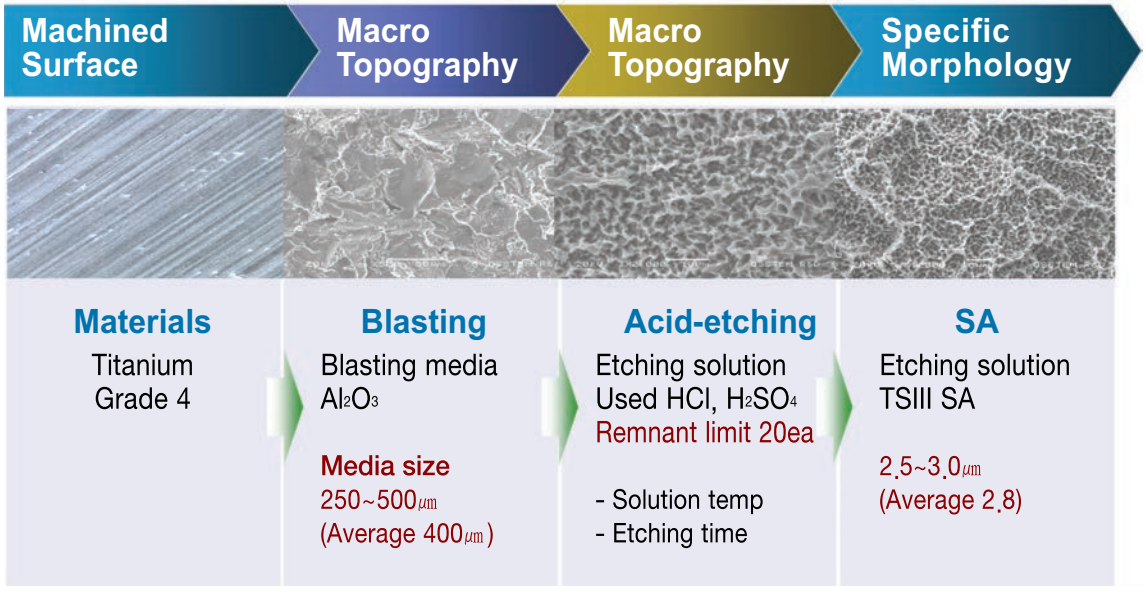


Fig. 2-5. Process of SA surface treatment

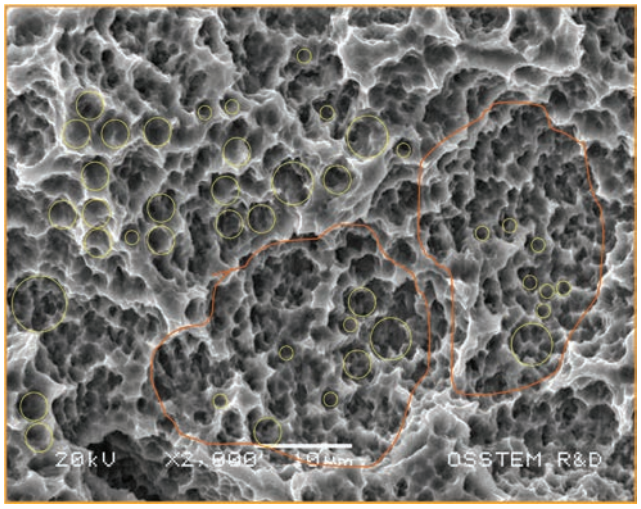
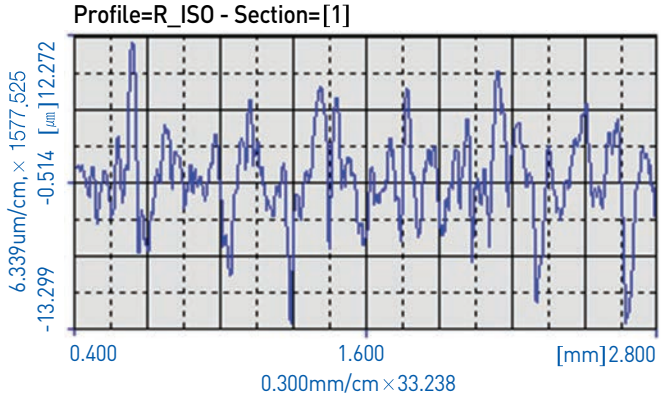


Fig. 2-6. SEM image of SA surface. It shows compound shape of crater and micro-pit. Surface roughness is Ra 2.5~3.0㎛.



Parameter Sum Table

	Profile=R_ISO - Section=[1]	Average Vahie
Ra (㎛)	2.794	2.794
Rz (㎛))	20.810	20.810
Rt (㎛)	24.354	24.354

Fig. 2-7. Surface roughness is Ra 2.5~3.0㎛.

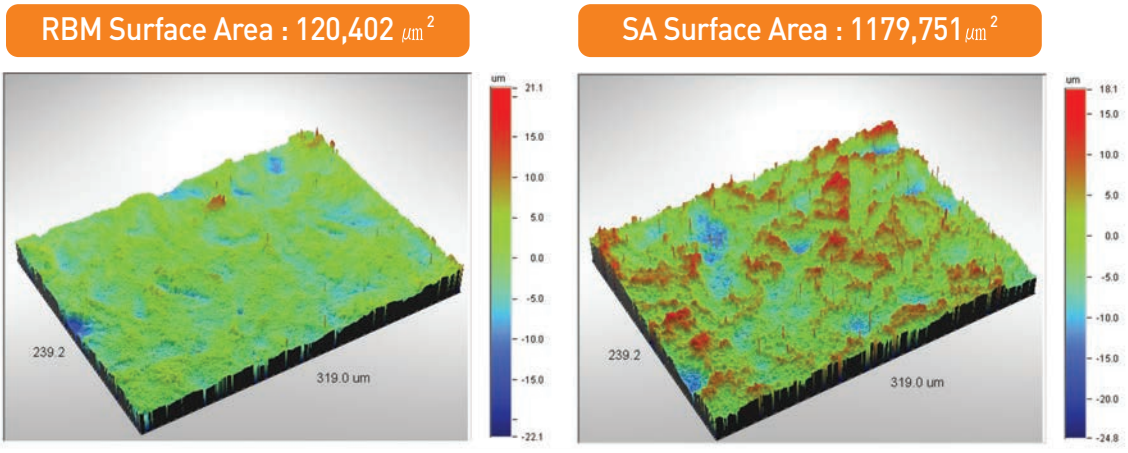


Fig. 2-8. Surface area has been increased over 45% compared to RBM.

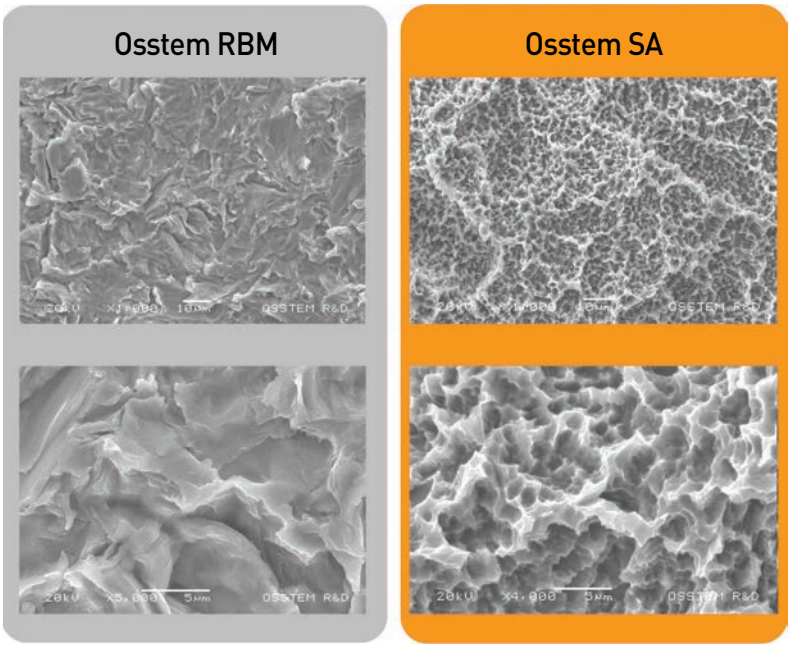


Fig. 2-9. Surface area has been increased over 45% compared to RBM. Compared to RBM surface, it will show over 20% faster cell response and bone healing.

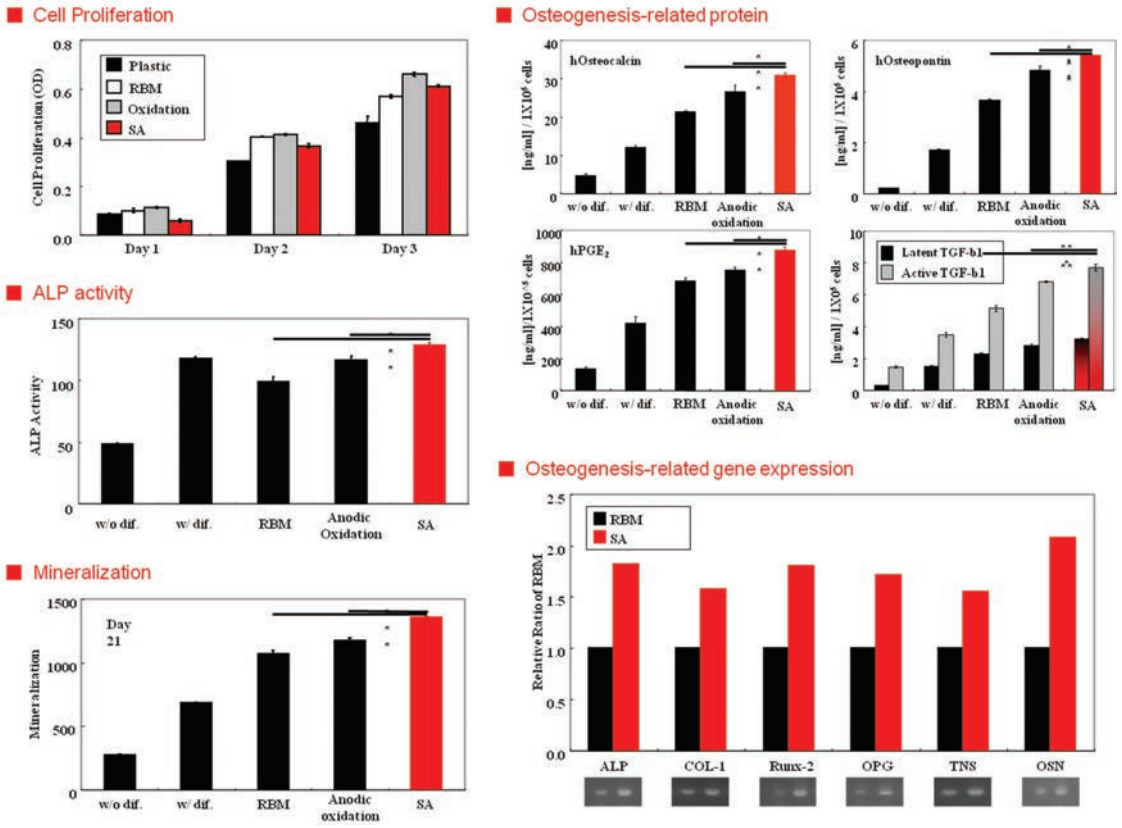
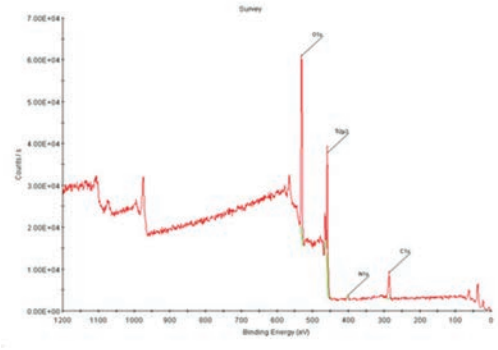


Fig. 2-10. Compared to RBM surface, it will show 20% higher early cell response and early bone healing.



Element	Content (at%)
C	34.85
O	49.15
Ti	12.75
N	3.25

Fig. 2-11. Surface chemical composition is Ti, O,C, and N

4. HA Coating

The hybrid type method of having upper 2mm as RBM surface, and the rest as HA coated surface is selected. Hybrid type coating accelerates bone reaction in trabecular bone, limits bacteria deposition in the upper part, and minimizes marginal bone loss. **(Fig. 2-12)** Osstem HA coating is created by first plasma spraying microsized HA powder on initial RBM surface, removing contaminants and unstable HA, TCP phase with a series of hydrothermal treatment, and finally refining pure HA phase. **(Fig. 2-13, 14)** Such method of surface treatment has been known for its high failure rates and different success rates between companies because of the exfoliation of HA coating layer during functioning. However, to solve such issue of exfoliation, Osstem has increased the degree of crystallinity to 98% to tackle the problem at its source. **(Fig. 2-15)** The Ca/P ratio is 1.69. Cell experiment results demonstrated, compared to RBM, over 20% increase in bone differentiation ability, and animal experiment results demonstrated over 50% increase in osseointegration ability and 300% increase in osseointegration force. Cell proliferation on HA surface, ALP (Alkaline phosphatase) activity, and mineralization has also observed to be higher than SA and RBM, BIC(bone implant contact), RTV(removal torque value) tested in animal experiments have demonstrated HA surface to be higher than those of SA, RBM surfaces. **(Fig. 2-14~20)** Loading after 4 weeks of installation may be possible depending on the case. Thickness of HA coating is 20-70㎛, and bonding strength is 78MPa. This secures long term security of the coating layer. **(Fig. 2-21, 22)** However, because of potential cracking on HA coating layer during installation, manufacturer guidelines must be followed, and installation torque should not exceed 35Ncm. HA surface selected on TSIII, SIII products are being supplied. TSIII HA has lengths (not for diameter 3.5mm), 8.5, 10, 11.5, 13, 15mm, and diameters 3.5, 4, 4.5, 5mm prepared. **(Fig. 2-23, 24) (Table 2-1, 2)**

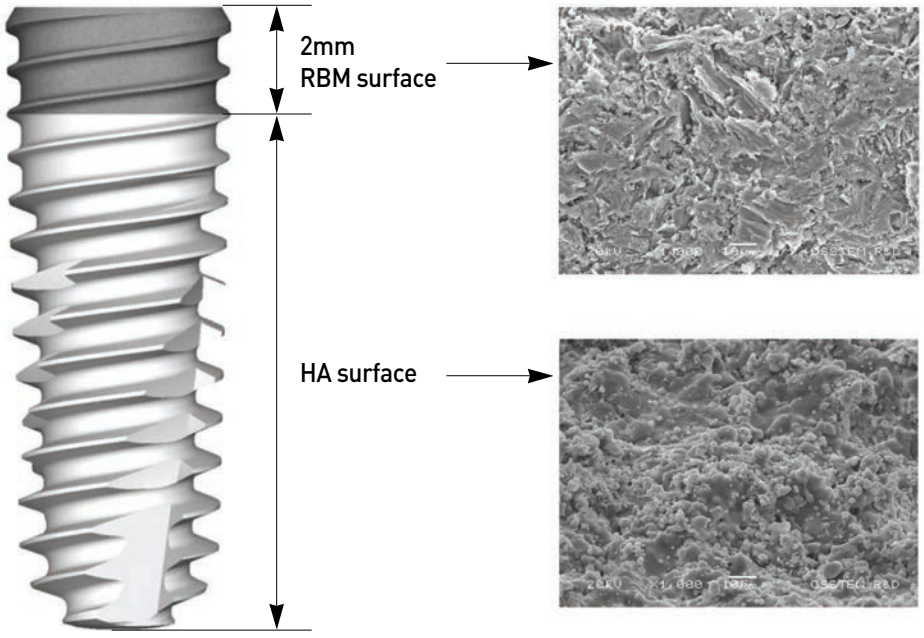


Fig. 2-12. Hybrid type with HA and RBM surface.

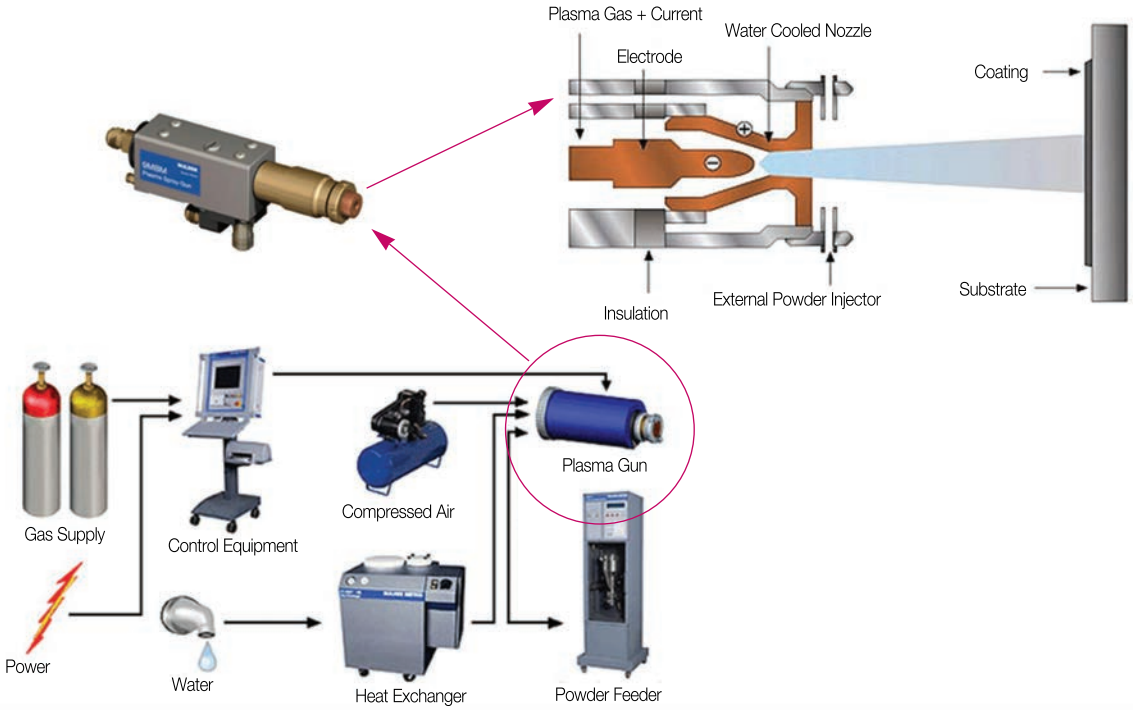


Fig. 2-13. HA coating is created by spraying HA powder after melting the powder with high temperature plasma

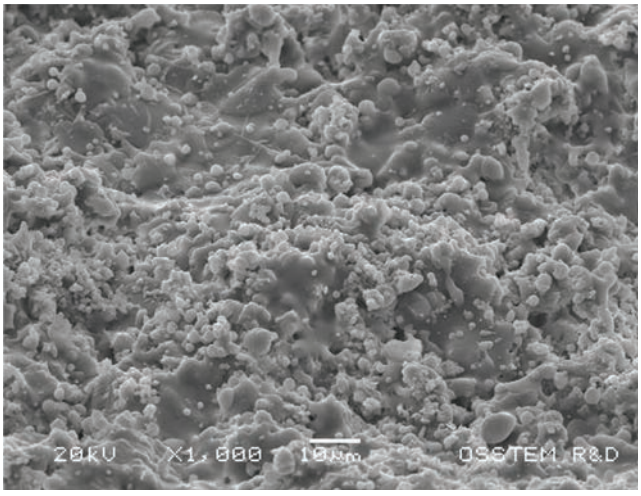


Fig. 2-14. SEM image of HA surface. Increased surface area by applying optimal shape and roughness.

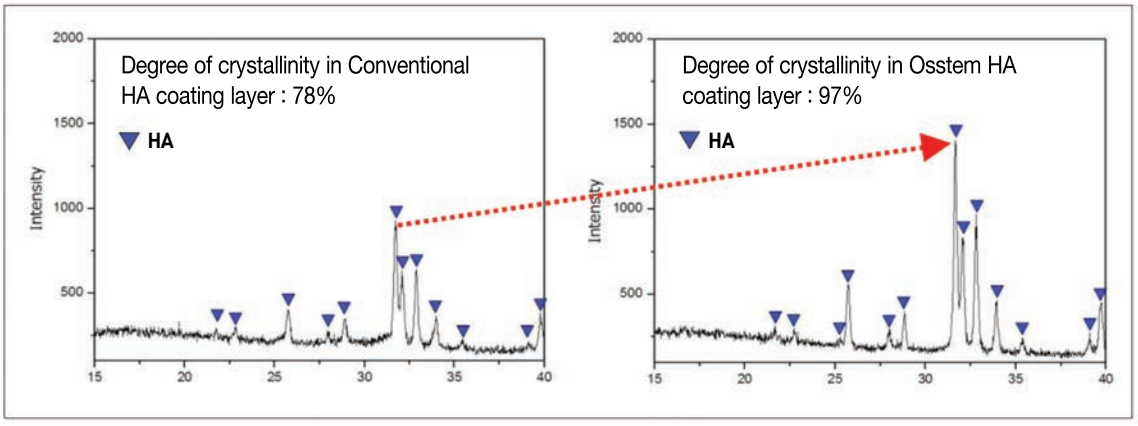


Fig. 2-15. Osstem HA surface secures long term stability because it has high degree of crystallinity which solve the exfoliation of HA coating layer

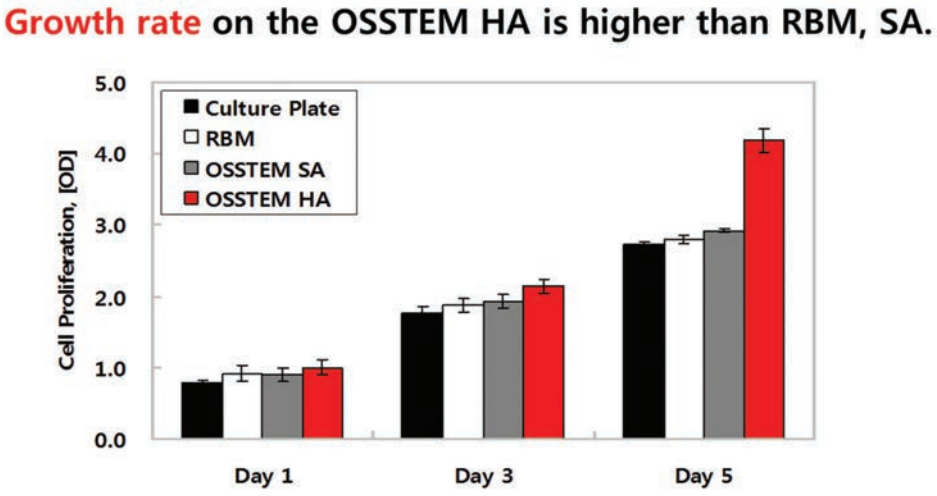


Fig. 2-16. Cell test showed much enhanced bone differentiation ability and cell proliferation rate compare to RBM and SA.

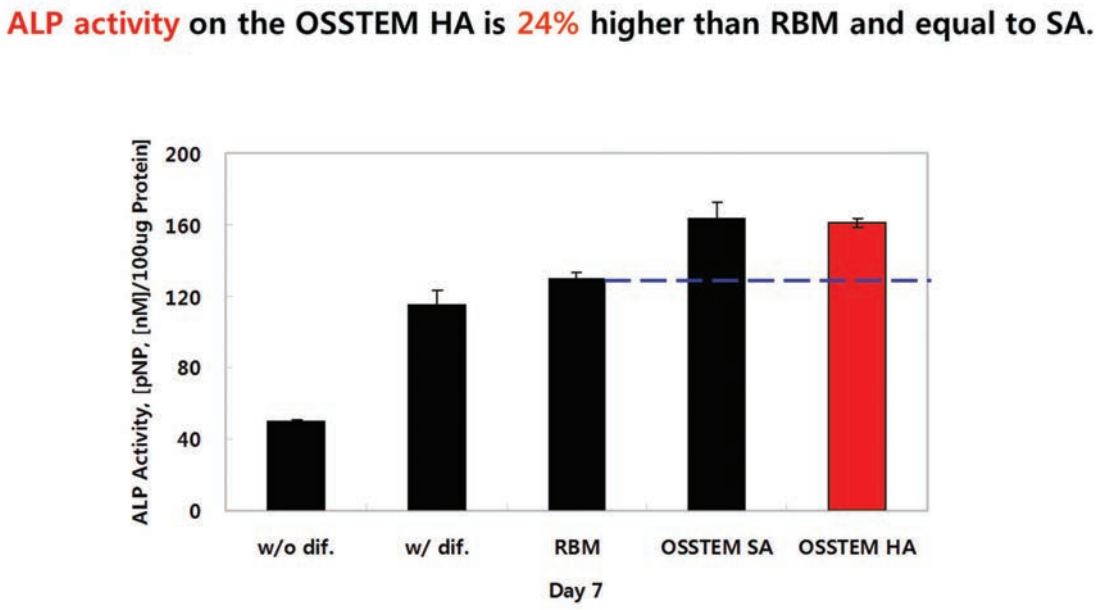


Fig. 2-17. ALP(alkaline phosphotase) activity demonstrated higher than SA and RBM

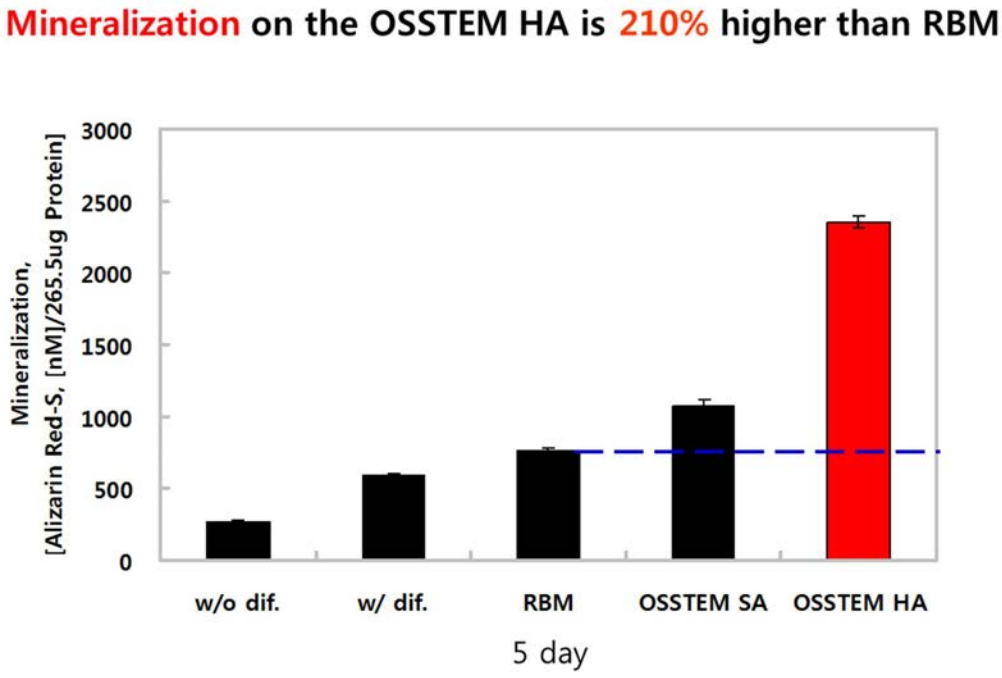


Fig. 2-18. Mineralization at HA surface demonstrated higher than SA and RBM

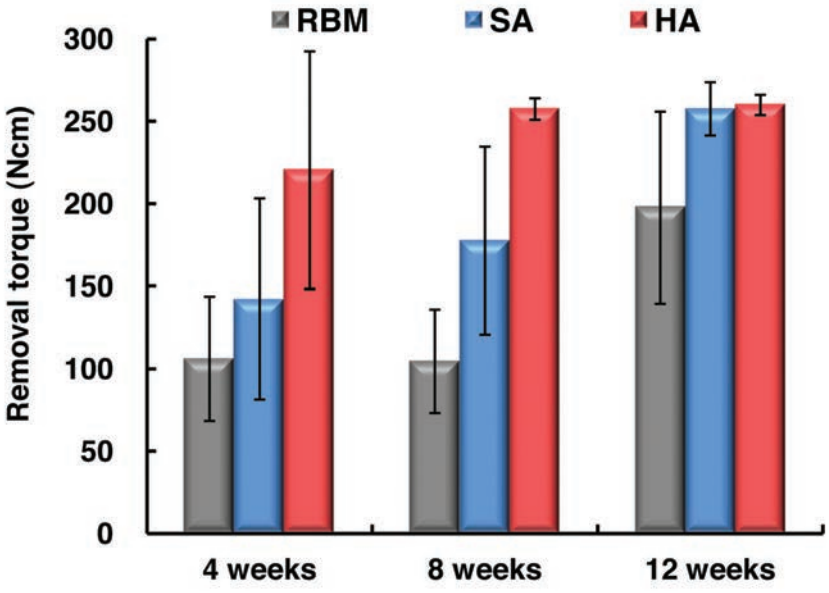


Fig. 2-19. RTV(removal torque value) of 4 weeks, 8weeks and 12 weeks tested in 12 micropig tibia showed higher osseointegration ability in HA surface than those of SA, RBM surfaces.

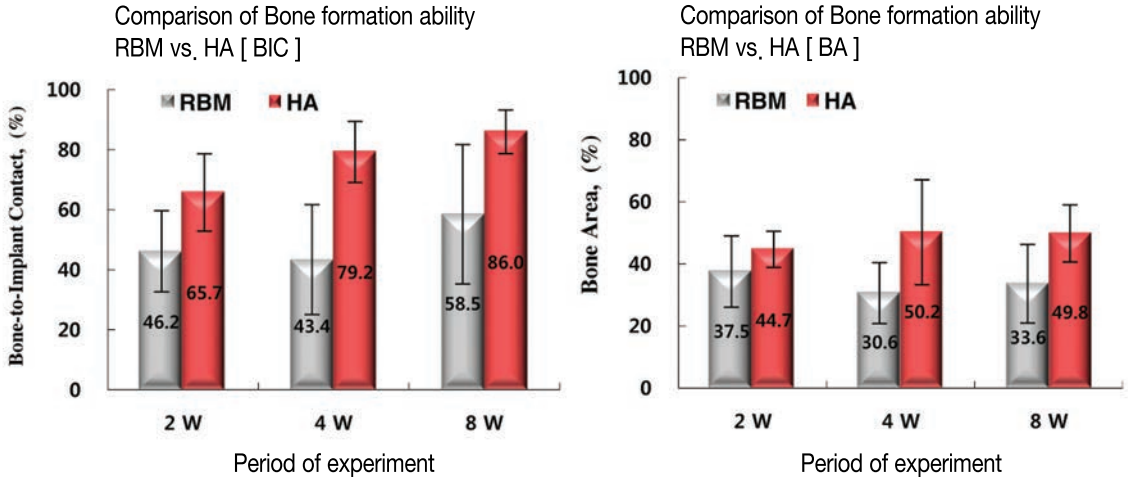


Fig. 2-20. BIC(bone implant contact), tested in animal experiments have demonstrated HA surface to be over 50% higher than those of RBM surfaces

TSIII SA VS. Competitor

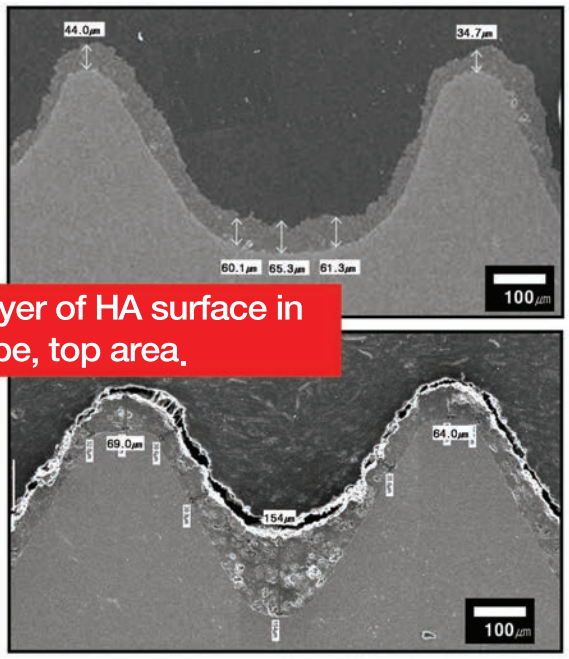
Thickness of HA coating layer

Osstem TSIII HA

20~70㎛

Company Z HA

20~150㎛



Uniform layer of HA surface in valley, slope, top area.

Fig. 2-21. Compare to competitors, Osstem HA surface has uniform layer of HA surface with thickness of 20-70㎛ in valley, slope, top area.

Differentiated Osstem HA surface compared to conventional HA surface

Improved extended safety and extended stability of HA coating layer
by enlarging the tensile and shear strength of HA coated layer

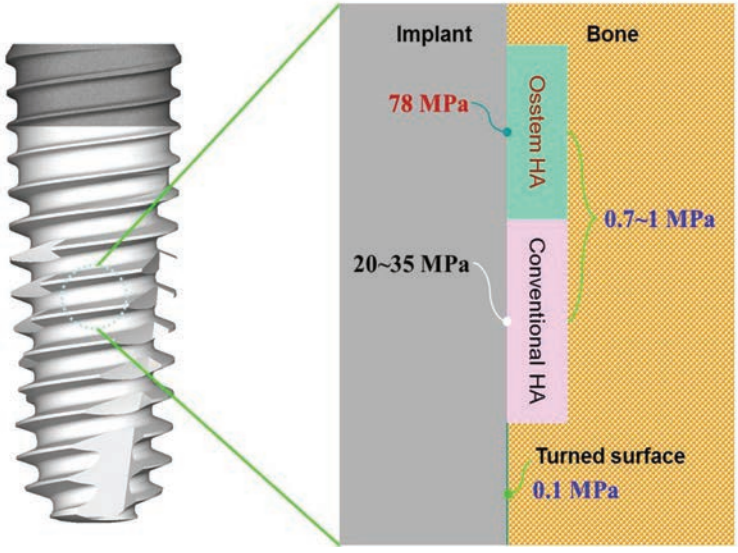


Fig. 2-22. Bonding strength of 78MPa secures long term stability of bonding layer

II Surface Treatment

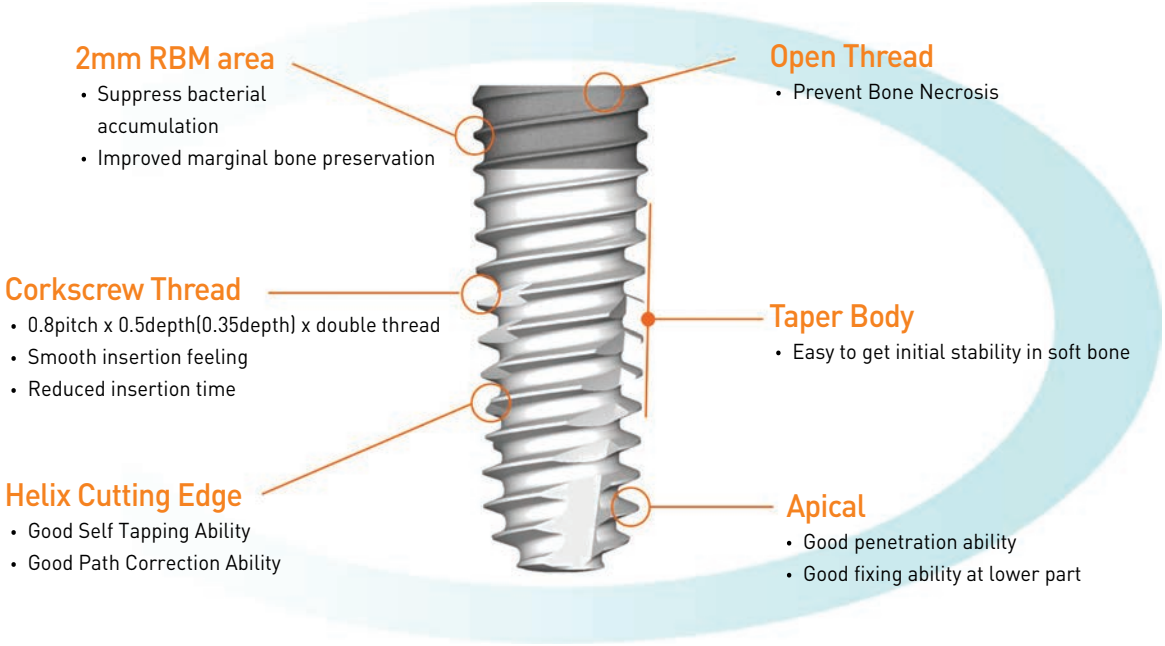


Fig. 2-23. Design of TSIII HA fixture is same as TSIII SA except surface treatment.

Table 2-1. Diameter and length of TSIII HA Implant

Connection	Mini	Regular		
Hex	2.1	2.5		
Diameter	ø 3.5	ø 4.0	ø 4.5	ø 5.0
Length	-	7	7	7
	8.5	8.5	8.5	8.5
	10	10	10	10
	11.5	11.5	11.5	11.5
	13	13	13	13
	15	15	15	15

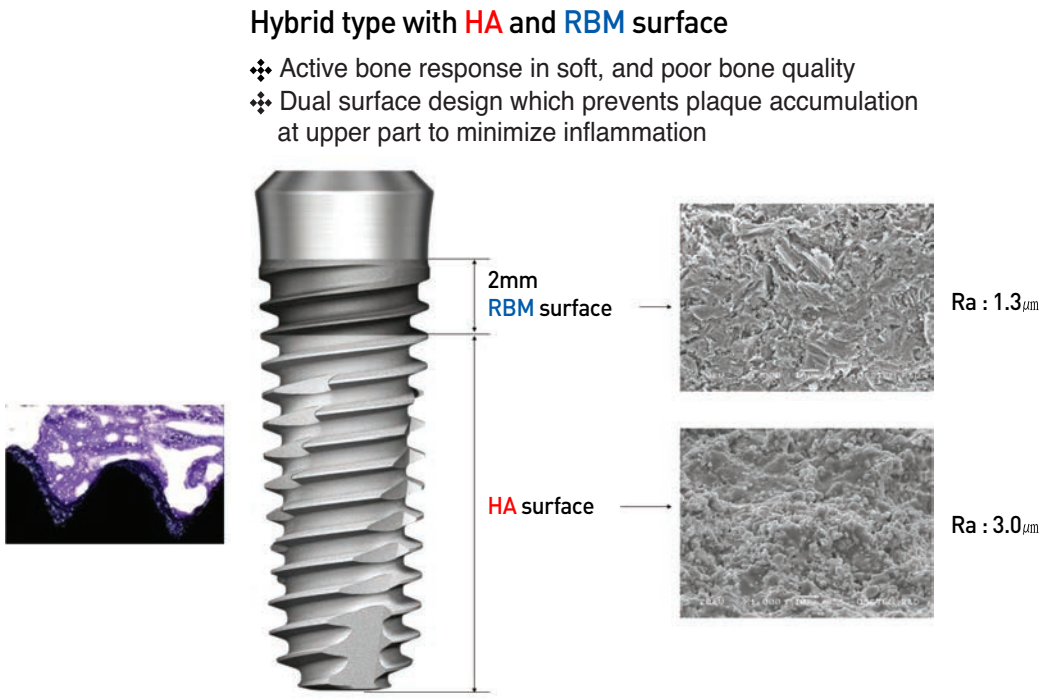


Fig. 2-24. SSIII HA fixture has optimal HA surface and thread design while maintaining excellent insertion ability of SSIII RBM.

Table 2-2. Diameter and length of SSIII HA Implant

Connection	Regular				Wide PS	
Platform	P4.8				P6.0	
Diameter	ø 4.0		ø 4.5		ø 4.5	ø 5.0
G/H	1.8	2.8	1.8	2.8	2.0	2.0
Length	-	-	-	-	-	6
	7	-	7	-	7	7
	8.5	8.5	8.5	8.5	8.5	8.5
	10	10	10	10	10	10
	11.5	11.5	11.5	11.5	11.5	11.5
	13	13	13	13	13	13

5. BA (Bio-SA)

Maintained optimal physical surface topography of SA surfaces and materialized biologically active surface through chemical treatment. Pure titanium's bioactive properties have been amplified by preventing atmospheric carbon contamination. High surface energy provides excellent hydrophilicity as well as protein adsorption followed by blood affinity. It shows increased osteoinductivity as chemical activity is increased by Ca ions. Exfoliation problem of HA coating layer is solved through ultra thin (under 10nm) HA which increase osseointegration, and bioabsorption process of coating layer which participate in bone remodeling. Cell experiment demonstrates bone differentiation ability to have increased over 15% in comparison to SA. Animal experiment shows osseointegration abilities to have increased over 20% in comparison to SA**(Fig. 2-25~27)**

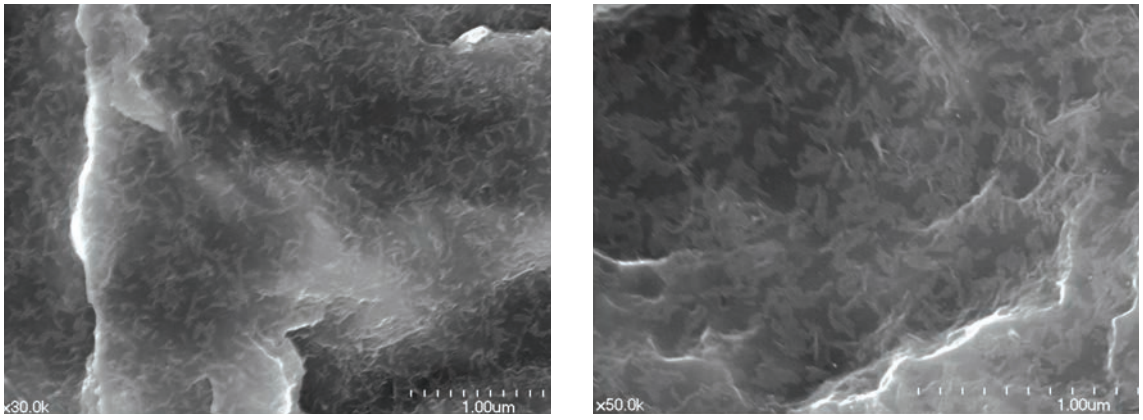


Fig. 2-25. TSIII BA surface SEM view.

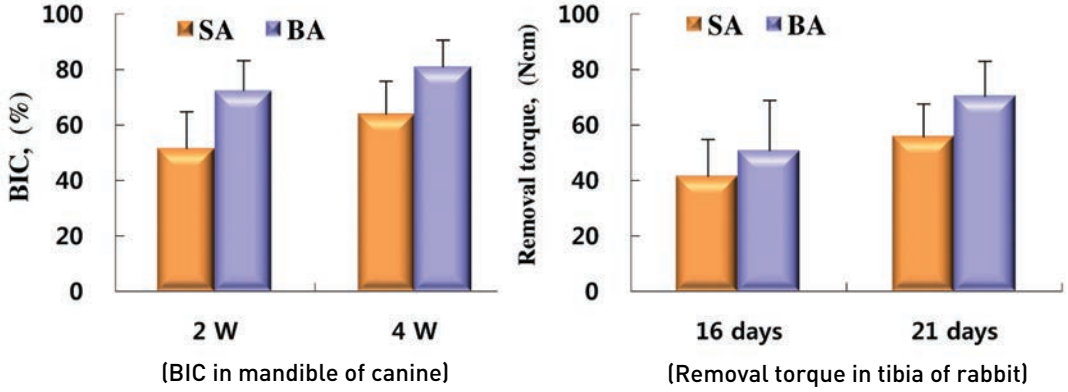


Fig. 2-26. BIC and RTV of BA are significantly higher than those of SA.

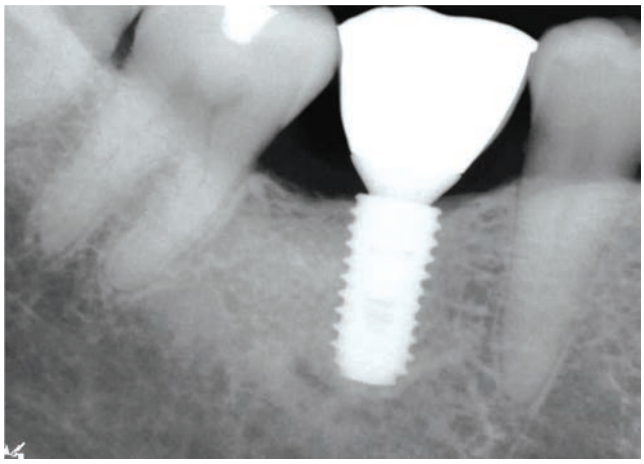


Fig. 2-27. Periapical radiogram after 1 year functioning of prosthesis. Final crown was delivered 6 weeks after implantation.

6. CA (Calcium-SA)

The basic concept of Calcium implant is to have basal surface as SA, and to have the implant immersed in $CaCl_2$ solution. Calcium implant is similar to Straumann's SLActive, but the solution used is different. Instead of NaCl solution, using $CaCl_2$ solution adds the bone formation and calcification abilities of Ca^{+2} ions. Calcium implants, unlike previous implants (RBM, TPS, SA, etc.), have its titanium surface activated, protects surface from carbon contamination, and has super-hydrophilicity. **(Fig. 2-28)** Such characteristics induce excellent blood affinity, and increase blood protein adsorption ability threefold. Such protein increases preosteoblast attachment ability, and accelerates differentiation to osteoblast. Moreover, it greatly enhance bone formation ability by stimulating proliferation of differentiated osteoblast.**(Fig. 2-29)**

〈Wettability Test〉

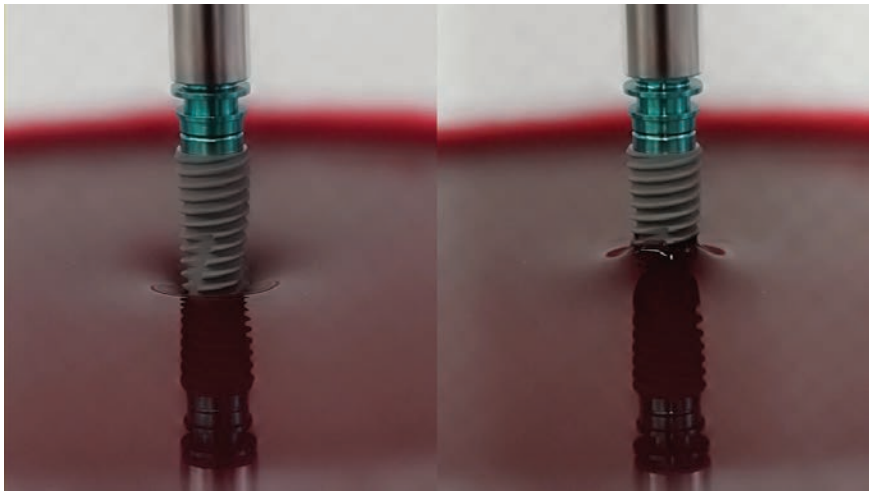


Fig. 2-28. Evaluation of blood wettability of TSIII SA and TSIII CA fixture.

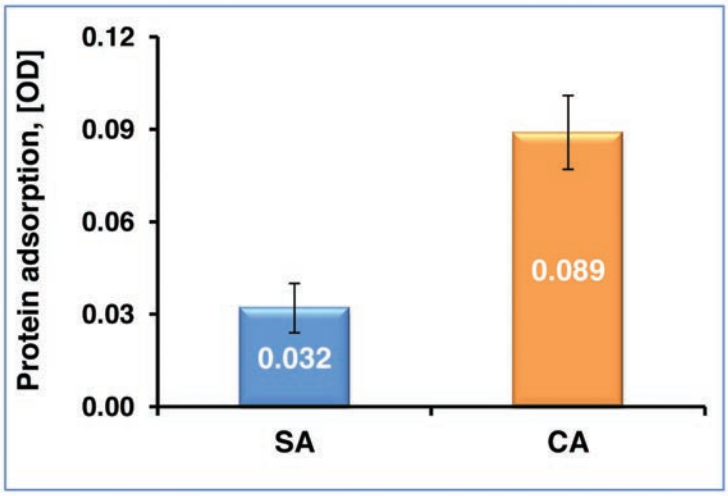


Fig. 2-29. Calcium implant significantly enhanced protein adsorption ability.

Calcium implant's (TSIII CA) excellent bone formation ability has been proven through various animal experiments, over 30% compared to existing SA surfaces. Hence, early healing period is reduced more than twice, and allows prosthetic loading after 4~6 weeks in normal bone quality.**(Fig. 2-30~32)** Supported by Korean Ministry of Health and Welfare, dental hospital of Seoul national university is conducting "clinical research comparing TSIII CA and Straumann SLActive". In addition, other multiple private hospitals and general hospitals are conducting clinical evaluation and researches. Calcium implants are effective in all indications, and will prove exceptional when using in guided bone regeneration with Smart-Builder. The implant needs to be used within 10 minutes of being taken out of the ampoule for maximum efficiency.**(Fig. 2-33~40)**

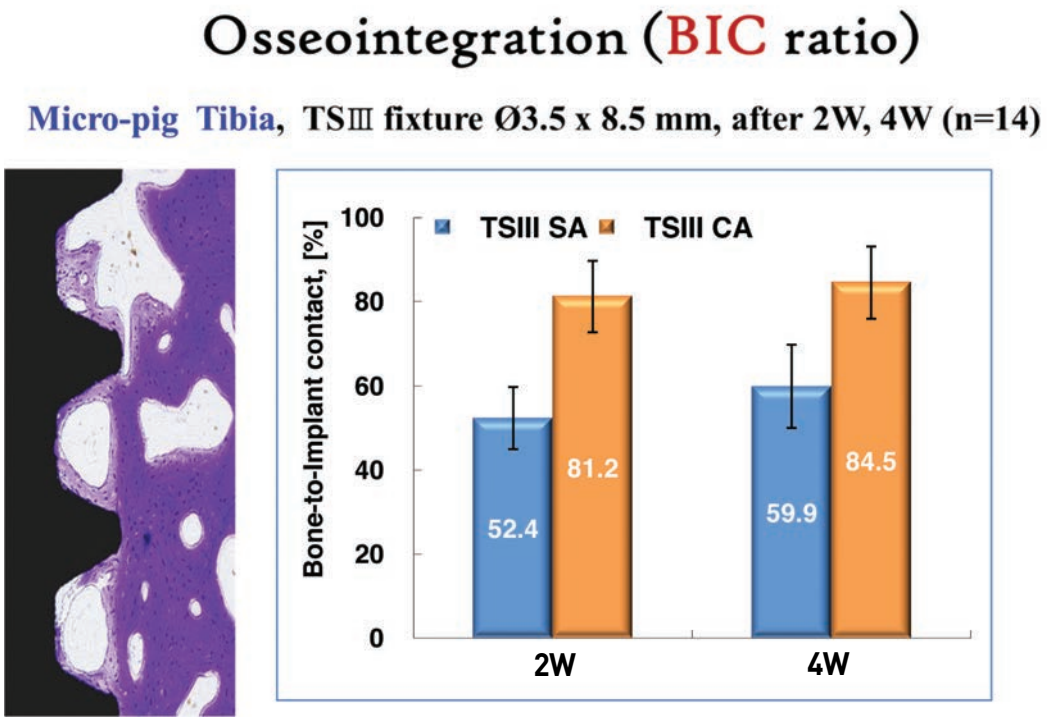


Fig. 2-30. BIC (bone implant contact) of TSIII CA implant tested in micro-pig experiments has demonstrated to be significantly higher than that of SA implant

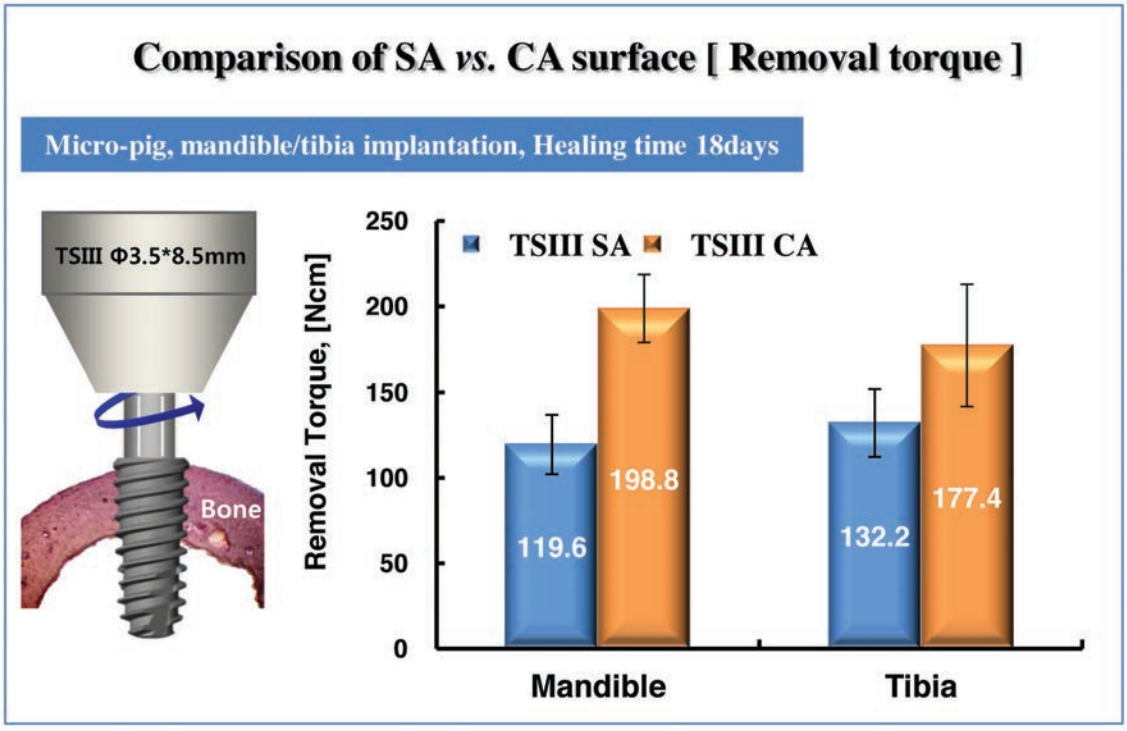


Fig. 2-31. Removal torque test of TSIII CA implant has demonstrated to be significantly higher than that of SA implant.

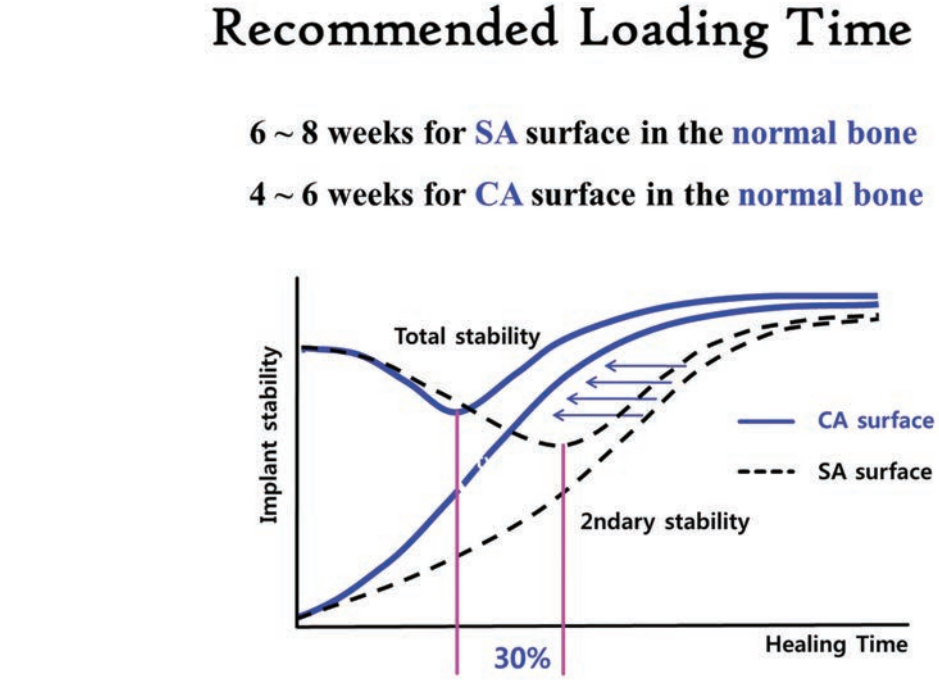


Fig. 2-32. TSIII CA implant allows prosthetic loading after 4~6 weeks in normal bone.

Fig. 2-33. TSIII CA fixture immersed in $CaCl_2$ solution

Fig. 2-34. TSIII CA implant needs to be used within 10 minutes after being taken out from ampoule.

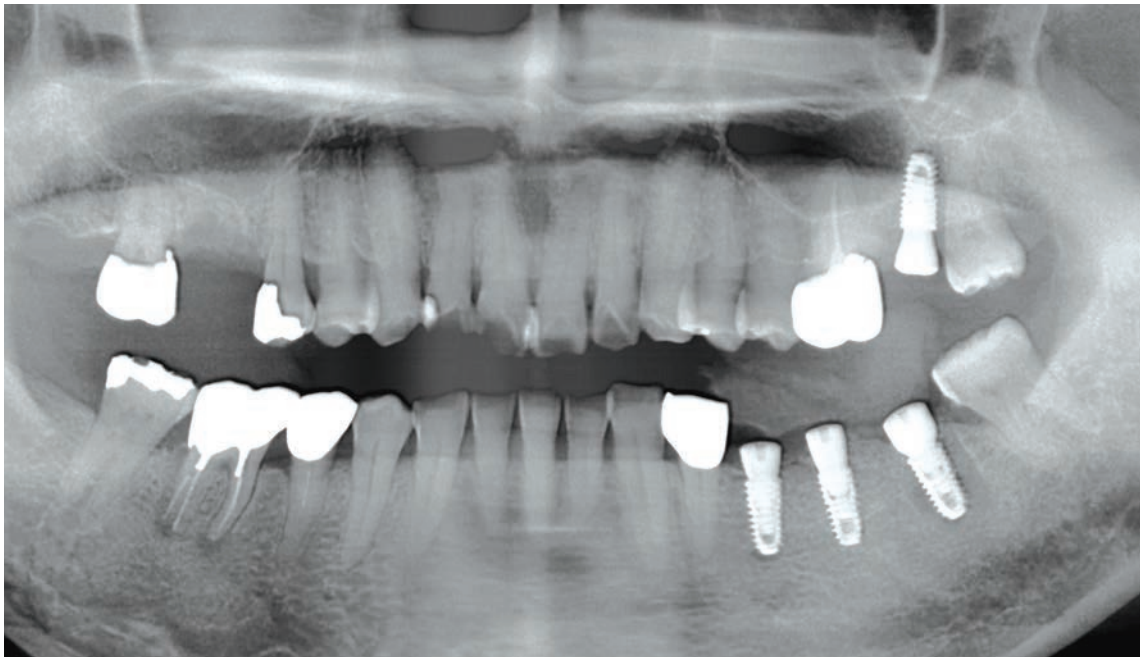


Fig. 2-35. Panoramic view of three Osstem TSIII CA implants placed in left mandibular posterior region.

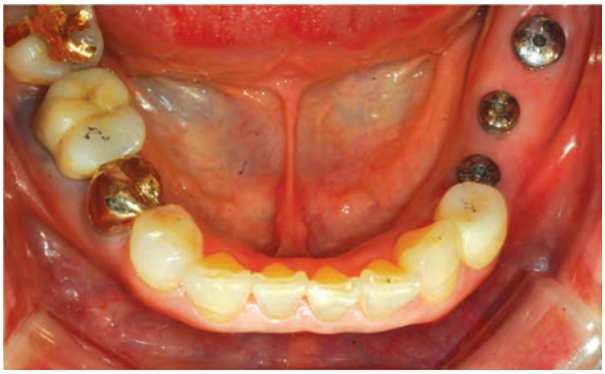


Fig. 2-36. Implants are placed with flapless technique.

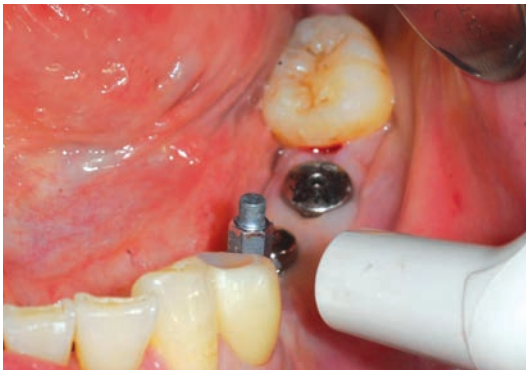


Fig. 2-37. Just after implantation, ISQ value measured by Osstel Mento showed high as 70~75 ISQ

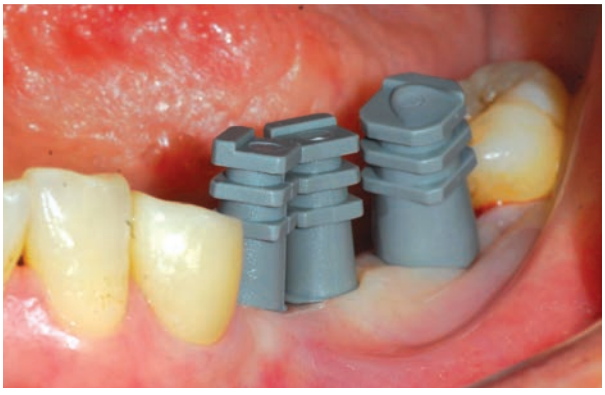


Fig. 2-38. Just after implantation, impression was taken using impression coping after connecting transfer abutment.

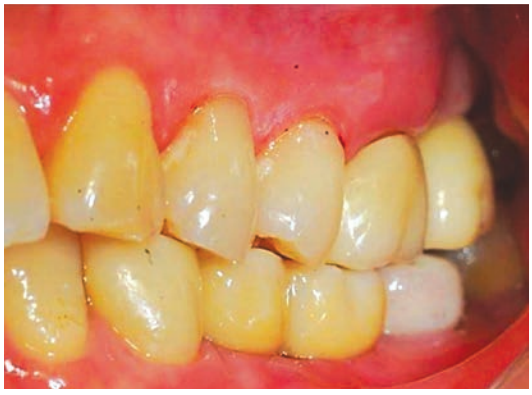


Fig. 2-39. Definite and provisional restoration were delivered.

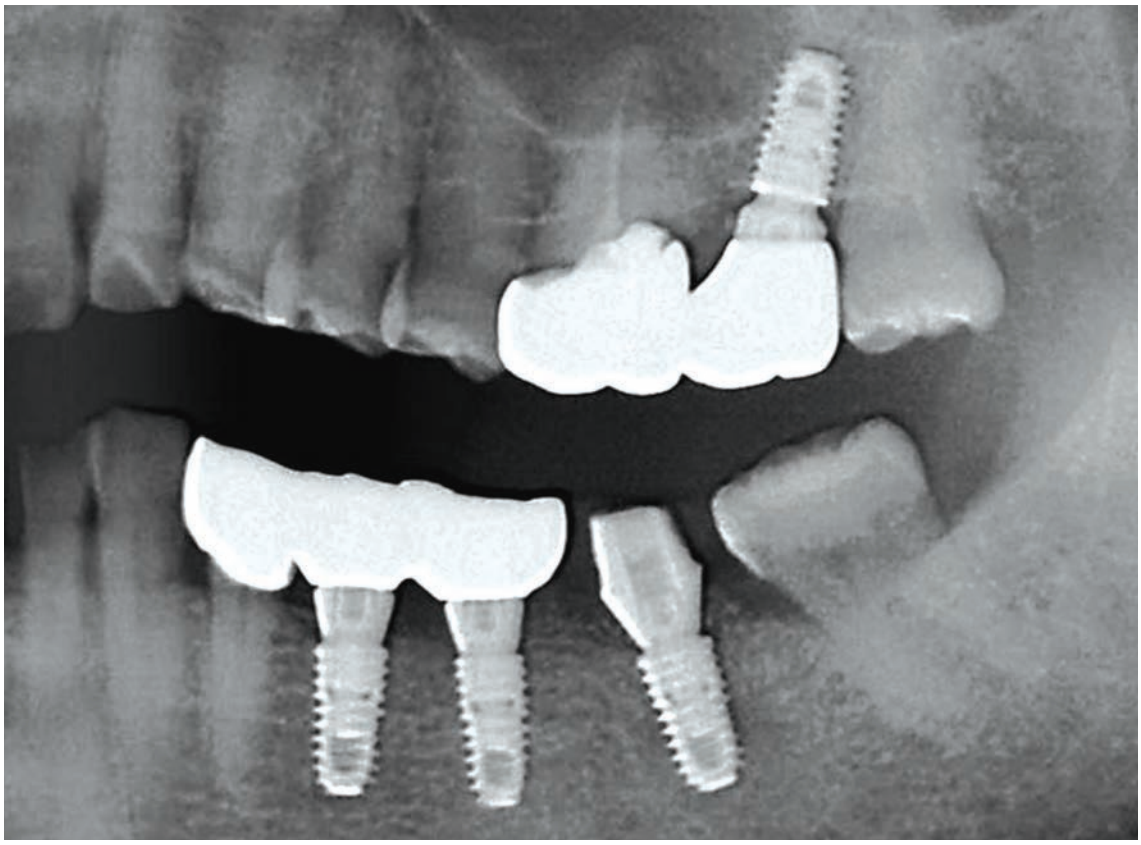


Fig. 2-40. Radiogram after delivery of definite and provisional restoration.

2013

Osstem Implant System

III Implant Surgery

- By Dr. Cho, Yong-Seok
- By Dr. Lee, Dae-Hee

OSSTEM IMPLANT

1. Surgical Guideline of Osstem Implant Systems – By Dr. Cho, Yong-Seok

1) TSIII SA Implant System

Surgical method using the TSIII SA Implant system can also follow general implant surgery protocol. It is important to select adequate diameter/width of fixture, drill with minimum damage to bone tissue, place in precise location, direction, and depth. Moreover, acceptable stability needs to be present in implant surgeries. TSIII SA implant system can be installed using straight drills in the Hanaro Kit and tapered drills in the Taper Kit. The final drill is selected based on the bone quality when drilling. In installing TSIII SA fixture, the balance between drill and fixture design yields 30Ncm of torque. Use undersized drill in soft bone density, and use the Cortical drill to grind enough cortical bone in hard bone density to avoid overload. Initial stability less than 40Ncm is recommended when installing TSIII SA fixture.
Although controversial, excessive insertion torque can lead to bone resorption and possiblely damage the sharp surface of TSIII SA fixture. Limit the surgical motor's maximum torque to 40Ncm when implantation. If the implant is stuck at maximum torque without advancing, reverse the motor direction and remove the implant. Then, enlarge with a wider drill and intstall again. However, when final torque exceeds 40Ncm when the implant is installed deeply to the end of the drill hole, not when the implant is stuck on the upper cortical bone, clinically it seems not so problematic. **(Fig. 3-1, 2)**

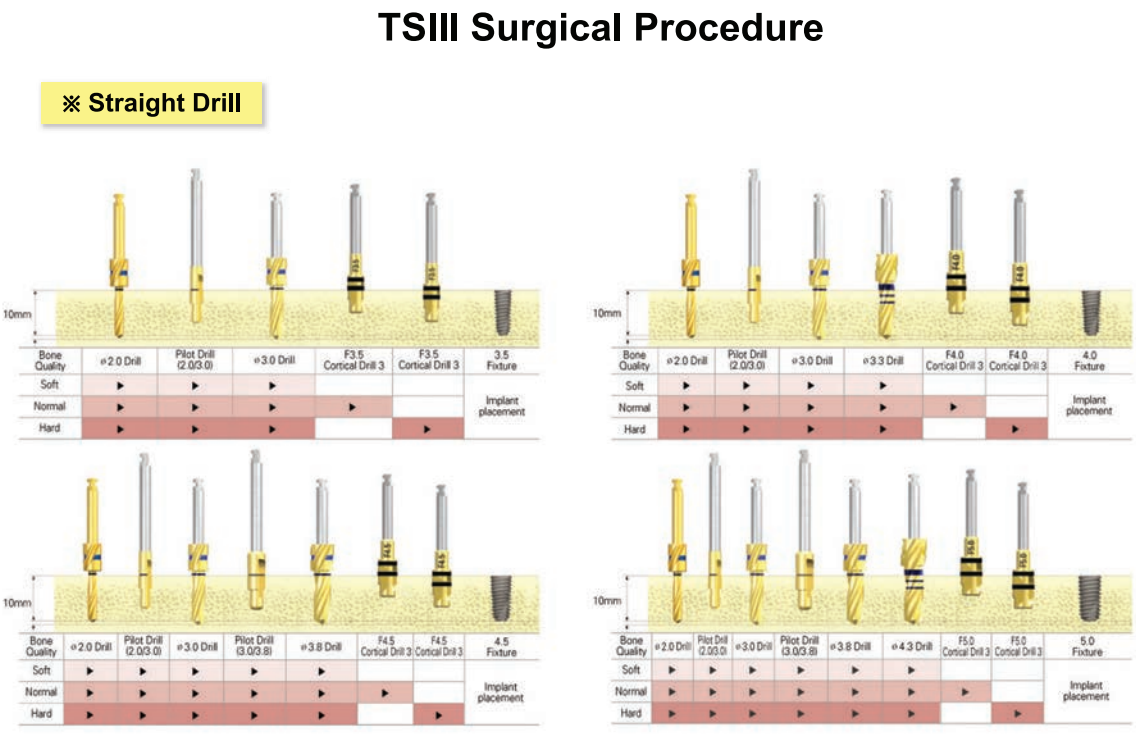


Fig. 3-1. Surgical procedure of TSIII SA fixture using the straight drill system

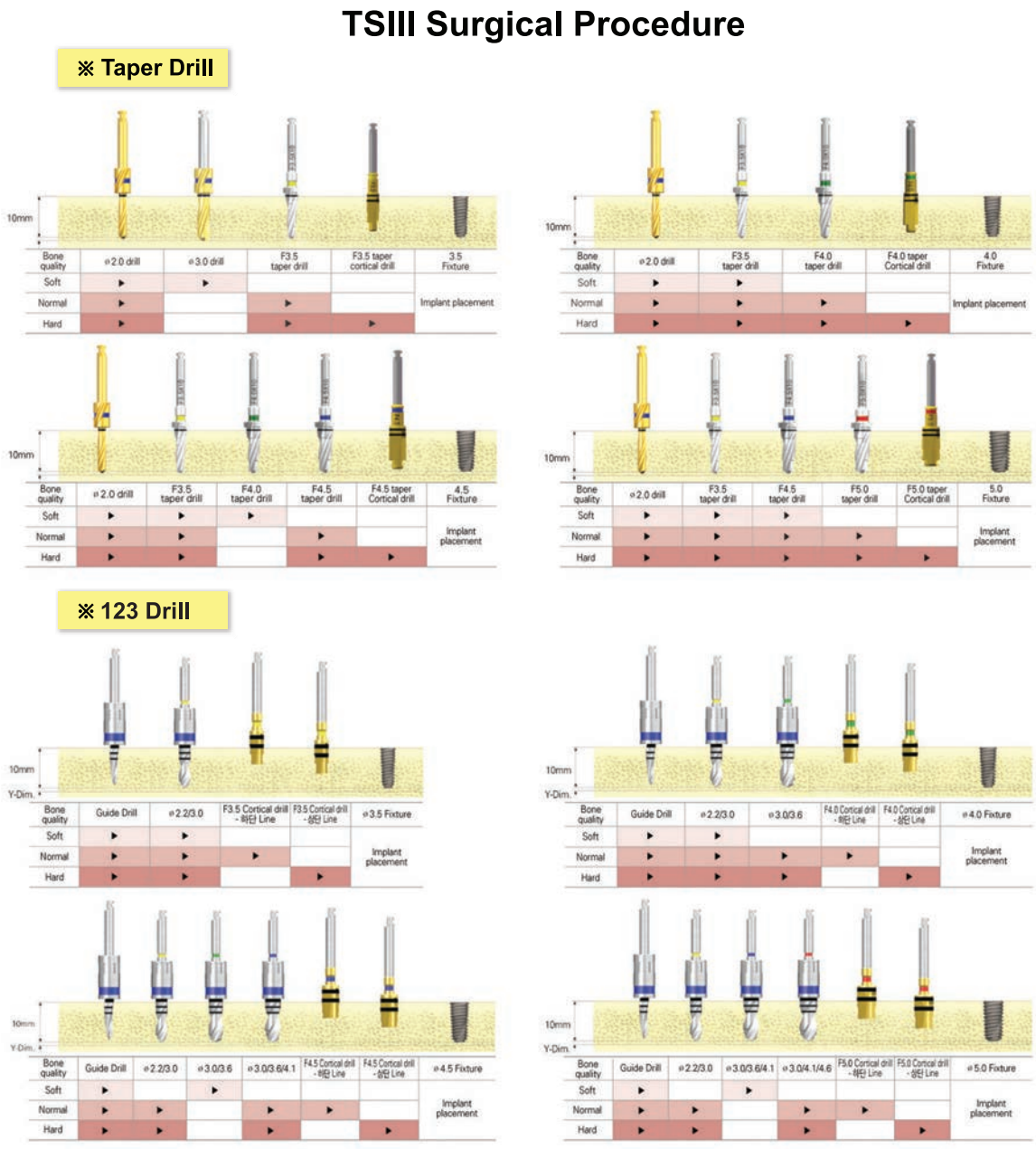


Fig. 3-2. Surgical procedure of TSIII SA fixture using the tapered drill system

(1) Position of implant installation

In the past to leave 2~3mm between natural tooth and implant and to leave 3~4mm between interimplants have been suggested when selecting the position of implant, but developments in inplant systems and surgical methods have rendered such standard no longer absolute. However, there is no argument against leaving some space for maintenance and prosthetic purposes. The position of an implant should be the center of the final restorative crown. This avoids creation of unnecessary mesiodistal cantilever. Utilizing a surgical guide fabricated based on the diagnostic wax-up that predicts the shape and position of final prosthesis from diagnostic model is recommended. Although it may not be often used in real operations, fabricating a surgical guide is strongly advised as it aids accurate diagnosis and establishment of proper treatment plans.

(2) Path of the implant

Implant is a structure corresponding the root part of natural tooth. Placing the implant in the direction of natural teeth is the basic pronciple. This avoids problems in relations with adjacent roots, and is mechanically advantageous as the final prosthesis undertakes axial occlusal load.

Carefully examine the direction of adjacent roots and determine the direction of implant. The buccolingual axis of natural teeth points the functional cusp of opposing tooth. The maxillary teeth are tilted bucally, the mandibular teeth to lingually. When placing implants, watch the fixture mount and set it to point between the central fossa and the functional cusp. **(Fig. 3-3)**

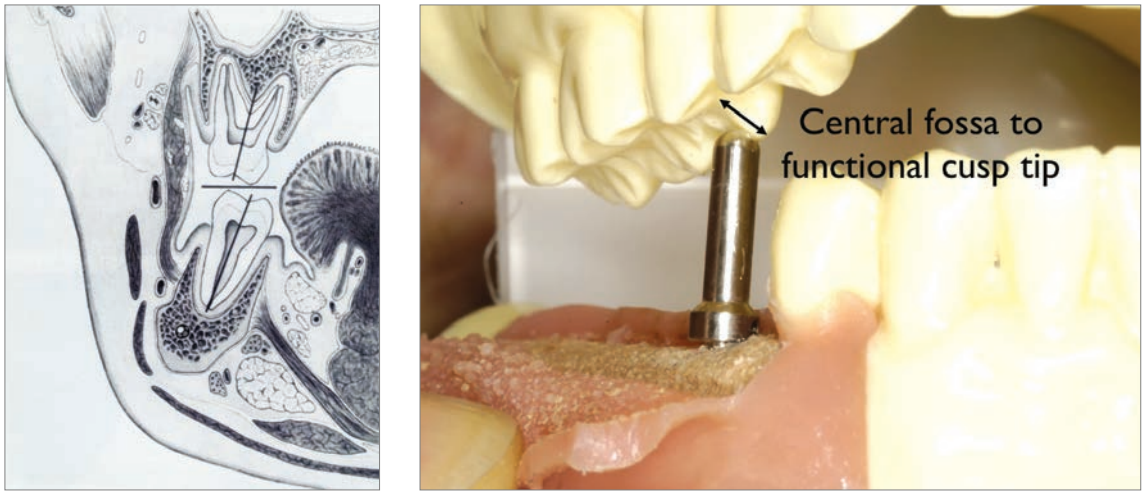


Fig. 3-3. Let buccolingual path of implant points between the central fossa and the functional cusp.

When we consider mesiodistal axis, generally maxillary anterior teeth roots have slightly distal curvature, mandibular anterior teeth toots have vertical direction, and both posterior teeth roots have distal curvature. Roots of mandibular posteror teeth are especially curved distally, and require painstaking consideration for direction of implant. **(Fig. 3-4)**

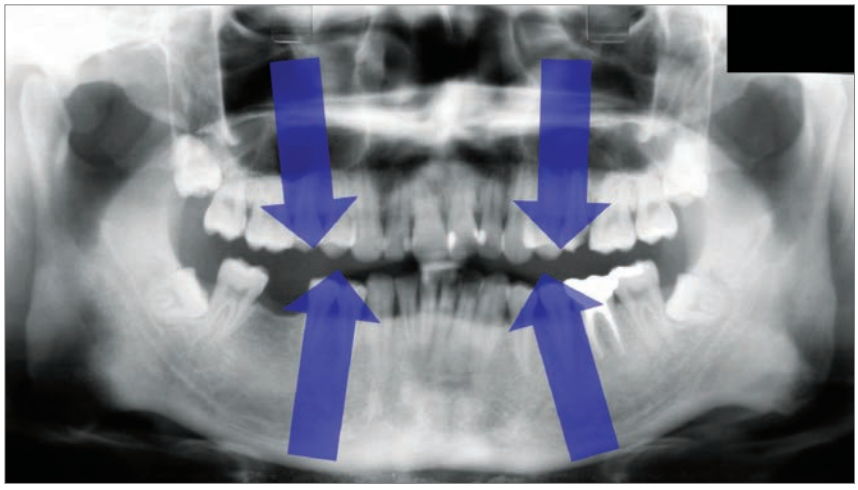


Fig. 3-4. Generally, axis of natural teeth is mesially inclined.

Lots of experience is required in choosing the proper direction in real clinical situations, and beginners are likely to make mistakes. The direction needs to be in consideration when drilling. The distal curvature of the roots must be in mind, and the drill should be slanted mesially.
Such situation is common when placing implants close to natural teeth. Confusion caused by natural tooth crown slope, and interference caused by the handpiece may slant the drill direction distally. **(Fig. 3-5)**

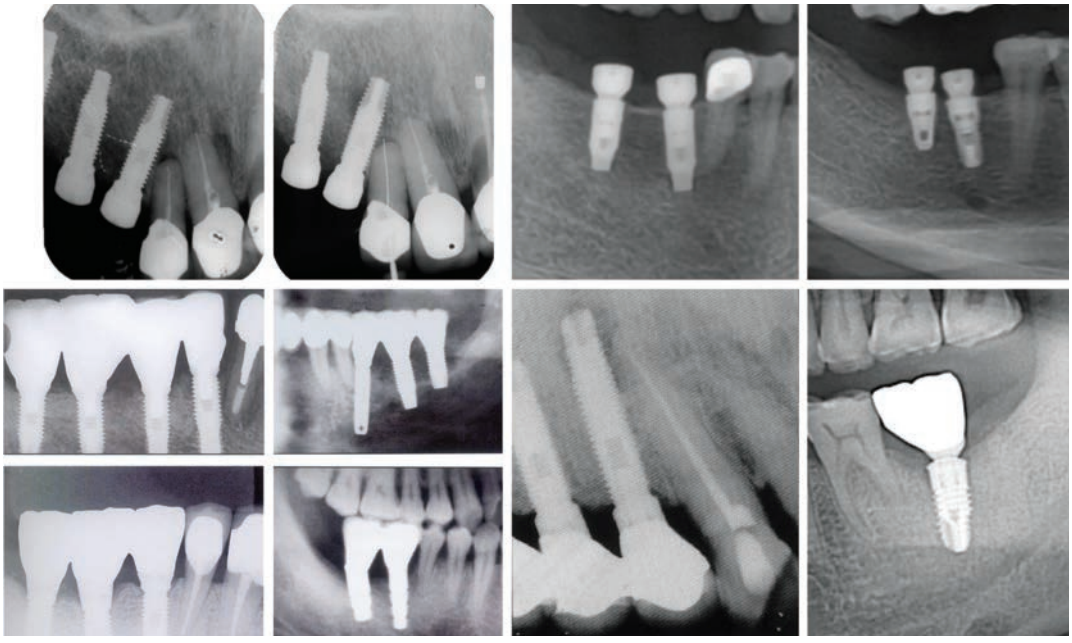


Fig. 3-5. Poor implant path may arise damage of adjacent tooth root or risk or cantilevering in superstructure.

To avoid such situations when installing implants near natural teeth, actively using Drill extensions and elongating the drill is recommended. Surgical guides do not help much in such situations and therefore improving sense of implant axis is advised. **(Fig. 3-6)**

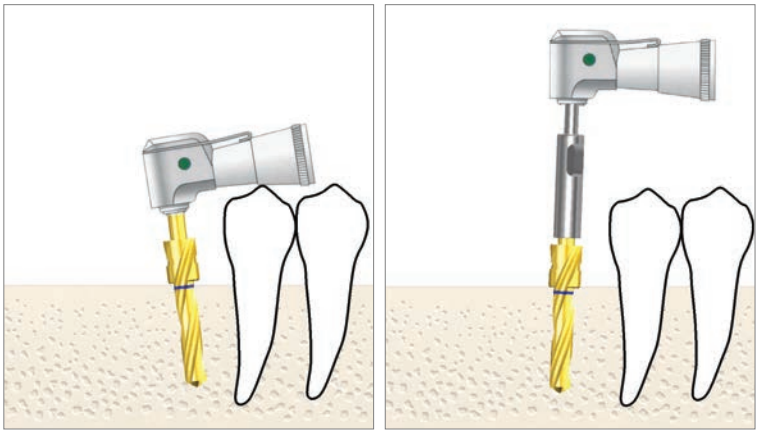


Fig. 3-6. When installing implants near natural teeth, actively use drill extensions to elongate drill.

(3) Depth control of TS Implant System

Depth control is especially important for TS implant system with internal rigid connection that will be placed in bone level. Osstem implant system's Stopper drill has its upper part and lower part 1.0mm longer than labelled, and thus creates a drill hole approximately 2.0mm deeper. **(Fig. 3-7)** The difference between length of the fixture and depth of drill hole can be used to control depth of the fixture.

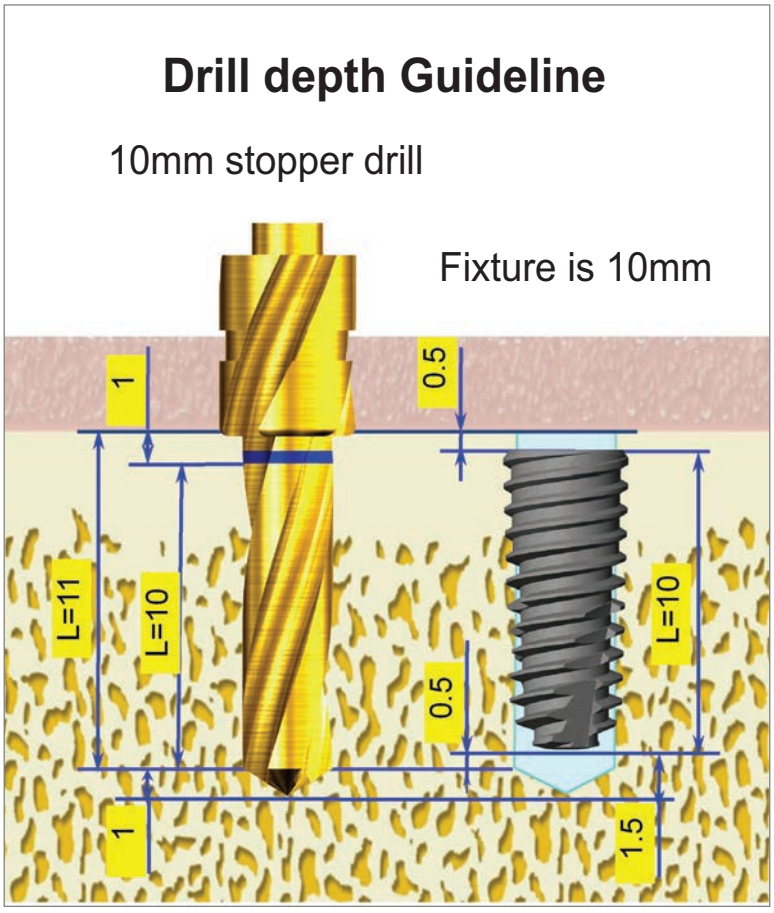


Fig. 3-7. Actual drilling depth is 12.0mm after using 10.0mm Stopper drill.

Biologic width needs to be considered depending on the clinical situation to select the proper depth of fixture installation. Biologic width is the soft tissue thickness that protects the inside from outside invasion. It has been reported that minimum 3.0mm of healthy soft tissue is required around natural tooth and impants. **(Fig. 3-8)**

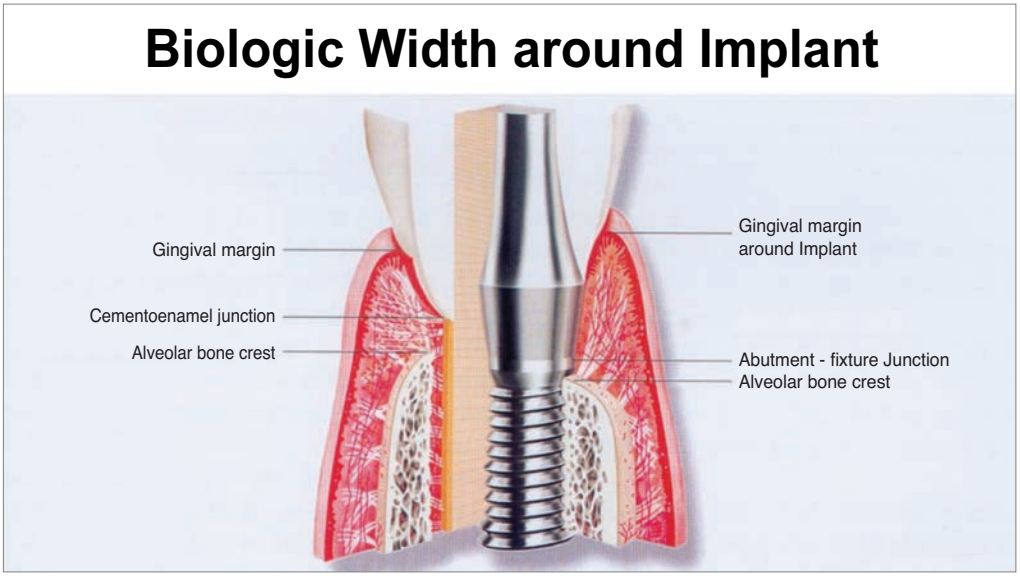


Fig. 3-8. Biologic width around implant (Quote from Ericsson, 1994)

The depth of implant may be controlled depending on the type of fixture, as the location for formation of biologic width differ each fixture. For TS implant system, the biologic width is created above the border between fixture and abutment. While installing an implant, the sum of soft and hard tissue above the fixture needs to be over 3.0mm, in real clinical situations, 4.0mm ±1.0mm is recommended. **(Fig. 3-9)**

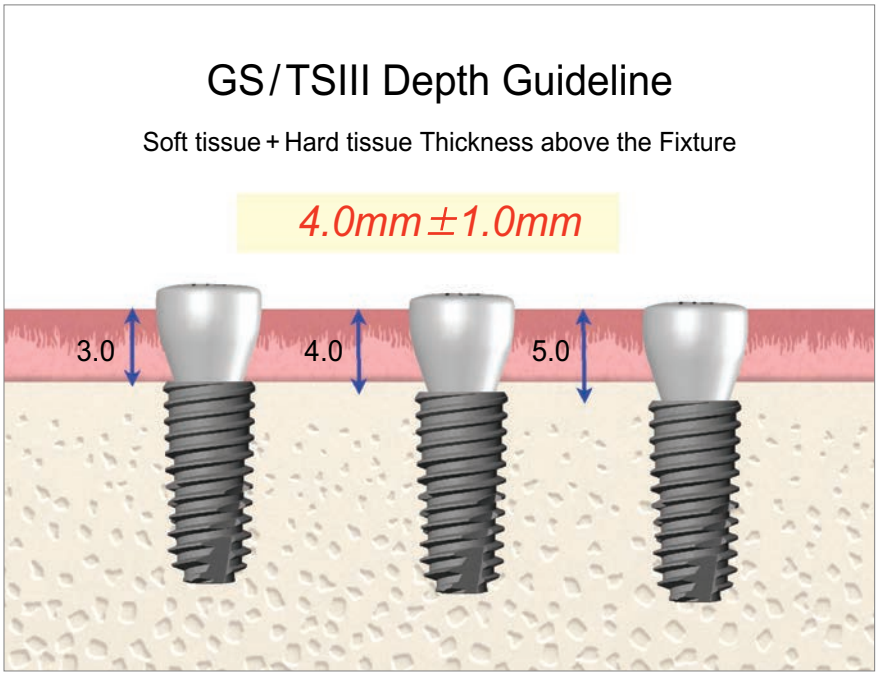


Fig. 3-9. While installing an implant, the sum of soft and hard tissue above the fixture needs to be 4.0mm±1.0mm.

The Healing abutment can be a simple and usful guide for implant depth control. The method is to connect a 5.0mm height Healing abutment, and to control the depth accordingly to the exposed height above the gingiva when suturing. If the 5.0mm Healing abutment is exposed over 3.0mm above gingiva, the implant needs to be installed deeper. Exposure above 2.0mm is acceptable as the installation depth is 3.0mm. However, in actual clinical situations, 1.0mm~0.0mm exposure, i.e. 4.0~5.0mm deep, is recommended.**(Fig. 3-10)**

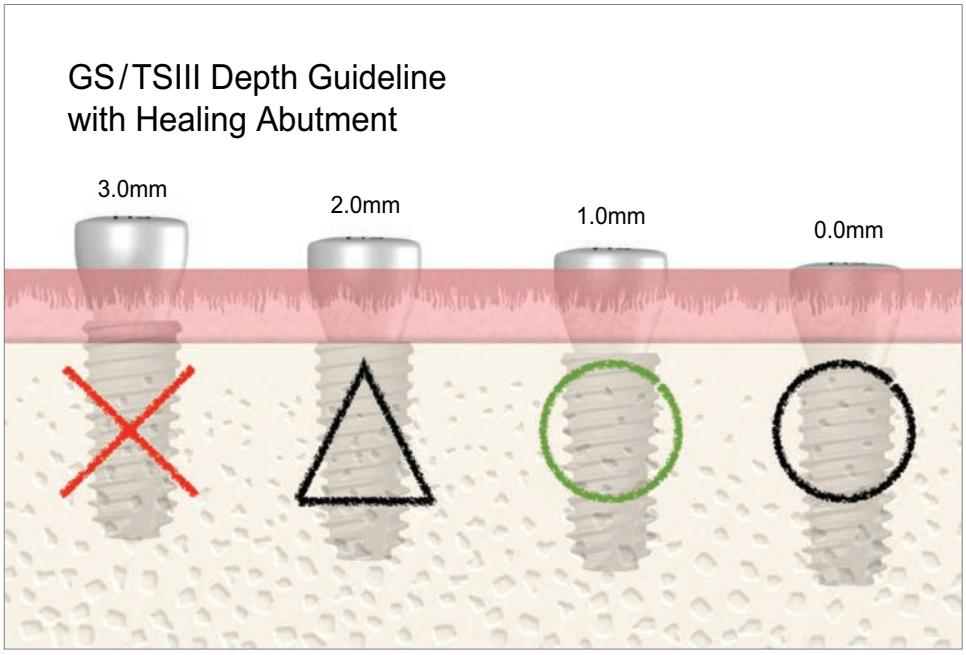


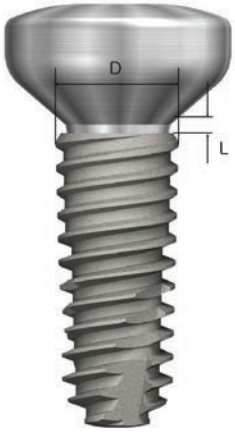
Fig. 3-10. Implant depth can be controlled using healing abutment of 5.0mm height.

To apply such standards, the depth of installation needs to depend on the patient's gingival height. In thick gingiva cases, there is enough soft tissue to create biologic width. Therefore, there is no need to install deep in the bone. Considering the natural bone resoprtion caused by trauma of flap elevation, installing below 0.5mm of bone is suggested. However, in thin gingiva cases, there is not enough soft tissue to create sufficient biologic width. Hence, it needs to be deeply installed to cause bone resorption that will convert to soft tissue and form biologic width. **(Fig. 3-11)**

Fig. 3-11. Implant depth will be controlled considering gingival thickness.

Complete seating of healing abutment may not occur if the implant is placed too deep. Height of bone interference in healing abutmentis related to implant diameter and abutment diameter and height. For example, Height of bone interference is 1.7mm when 4.5mm TSIII SA fixture is installed with 5.0mm x 5.0mm Healing abutment. If the implant is placed deeper, the upper bone needs to be cut away a little or instead use a 7.0mm healing abutment to avoid bone interference. **(Fig. 3-12)**

Healing Abutment



Height by diameter (L)

Healing ABT.		Fixture Diameter (D)		
ø	H	ø 4	ø 4.5	ø 5
ø 4	3	0.69		
	4	1.4		
	5	2		
	7	3.34		
ø 5	3	0.38	0.56	0.85
	4	0.68	1.11	1.71
	5	1	1.7	2.48
	7	1.62	2.86	4.1
ø 6	3	0.29	0.38	0.47
	4	0.51	0.79	1.08
	5	0.72	1.19	1.65
	7	1.13	1.95	2.76
ø 7	3	0.25	0.31	0.57
	4	0.42	0.63	0.84
	5	0.58	0.92	1.27
	7	0.88	1.49	20.9

Fig. 3-12. Height of bone interference in healing abutment is related to implant diameter and abutment diameter and height.

The mandible generally possesses thinner gingiva than the maxilla, and often requires implants to be installed deeper. Implants with insufficient depth may lead to marginal bone resorption after deliver prosthesis.
Depth control becomes easier when applying this principle, if performing flapless surgery or immediate implant after extraction. Gingival scalloping of the maxillary anterior teeth makes it difficult to find a focal point. Hence, implants can be installed deeper than other parts so installing 4.0~5.0mm below free gingival margin is recommended. **(Fig. 3-13)**

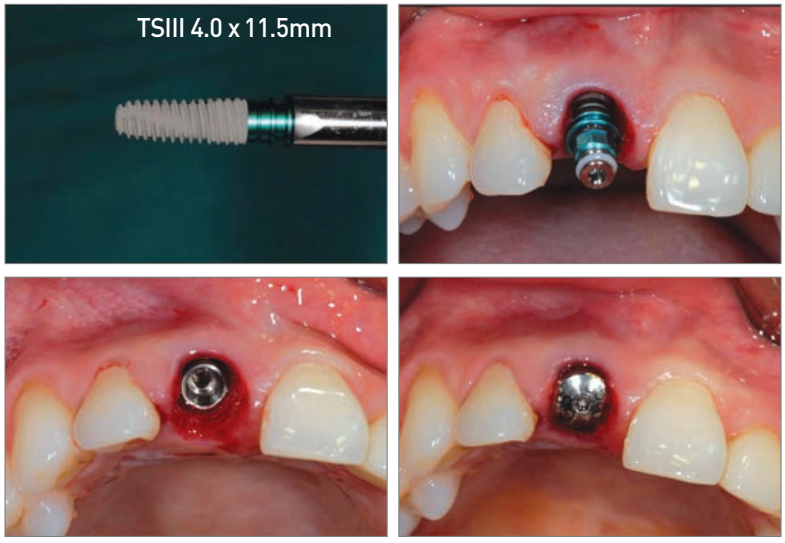


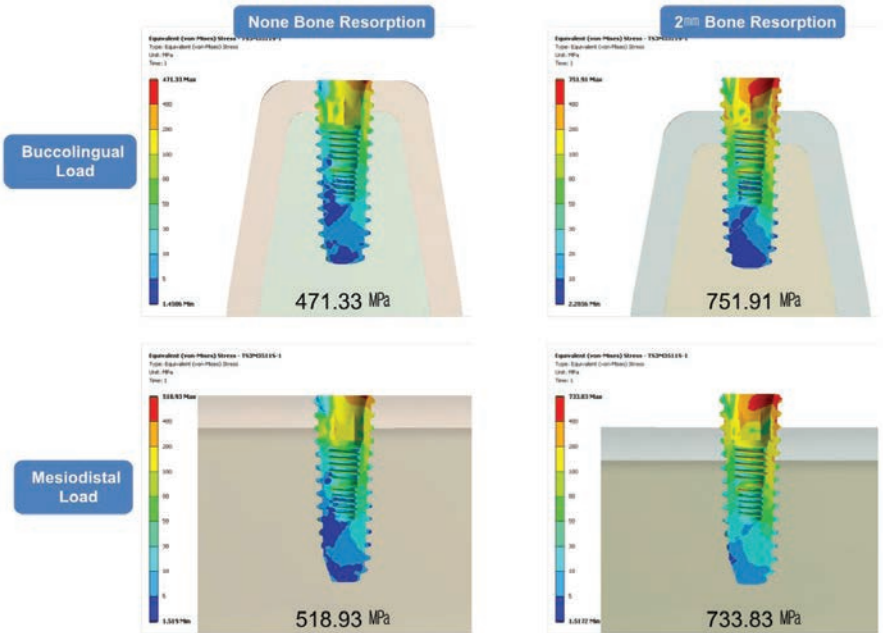
Fig. 3-13. At maxillary anterior region, implant is positioned 4.0~5.0mm apically from the free gingival margin.

Some benefits of deeply placed implants are: prevented bone resorption and increase yield strength of implant, reduced potential for peri-implantitis, and favorable creation of emergence profile. A disadvantage is that the crown length increases and becomes mechanically disadvantageous. Hence, the benefits need to be weighed accordingly.

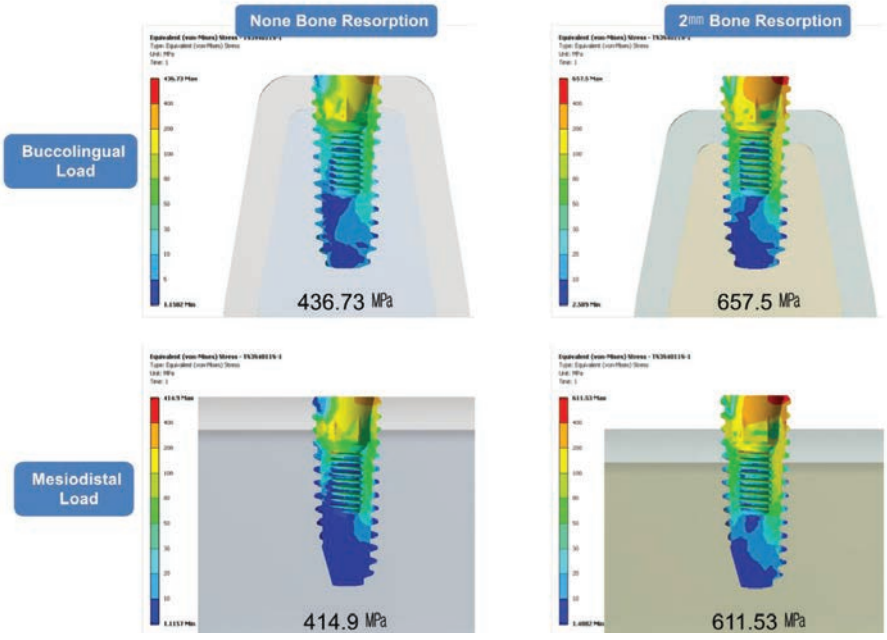
(4) Selecting width of the TS Implant System

While research suggests proportional increase in strength, great disparity is reported when the implant is fully submerged in bone or is partially exposed by bone resorption.
Strength according to diameter is as follows: ø3.5 < ø4.0 < ø4.5 < ø5.0. Negligible difference is observed without bone resoprtion (average 7.5%), but significant difference is observed with bone resoprtion (average 16.3%). Without bone resoprtion, greatest increase in strength is observed when increasing the diameter from ø3.5 to ø4.0 in mesiodistal load, and the latter increases yield minor strength changes (maximum 9%). With bone resoprtion, most increase occurred in both buccolingual and mesiodistal as diameter increased from ø4.0 to ø4.5 (maximum 24%, buccolingual). **(Fig. 3-14)**

Analysis of stress - Ø 3.5 Fixture



Analysis of stress - Ø 4.0 Fixture



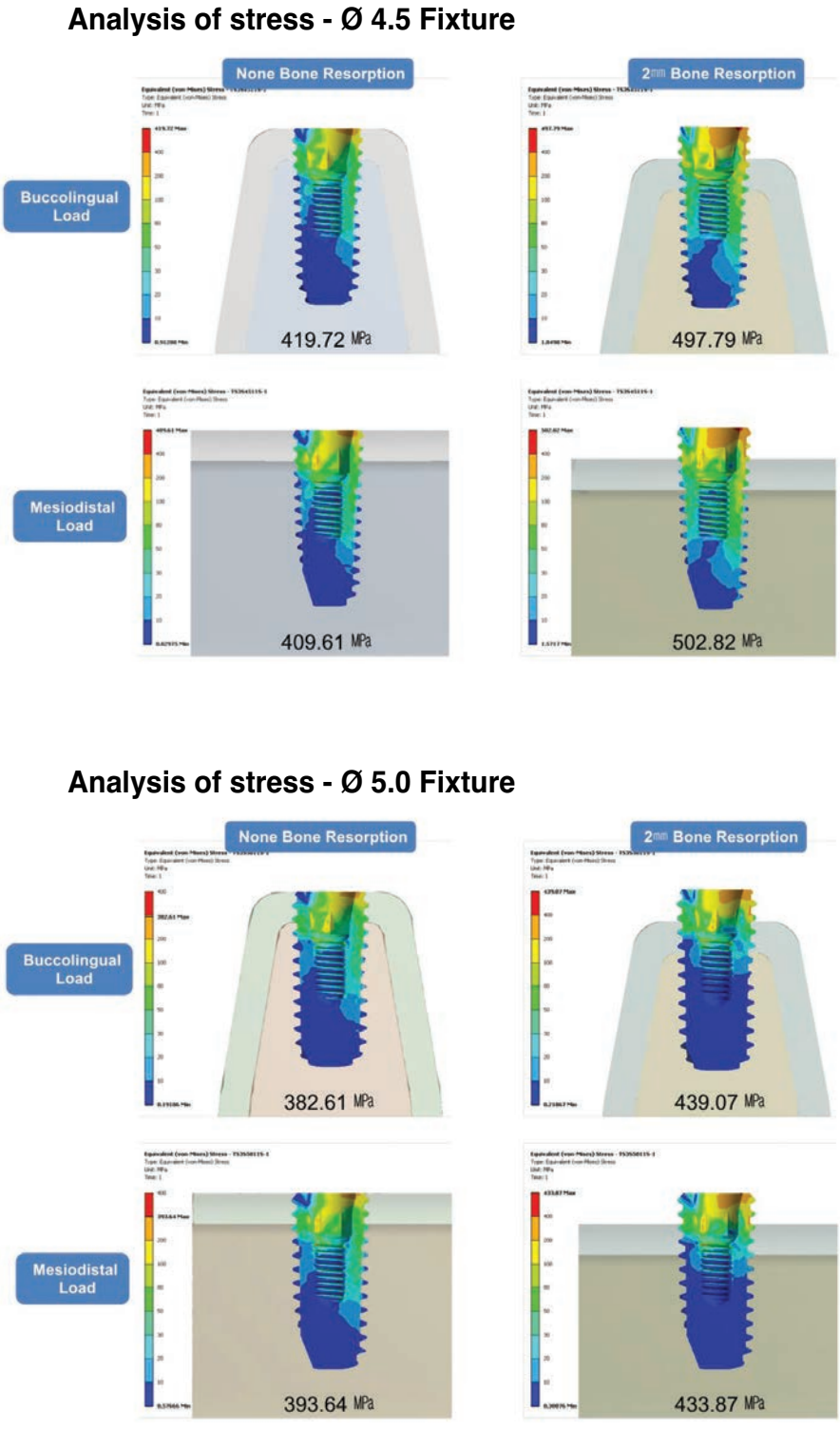


Fig. 3-14. Analysis of stress distribution depends on implant diameter using finite element method.

While the strength is proportional to diameter of implant, the size of implants are nevertheless limited by the bone width in real clinical circumstances. Hence, it is wise to install implants that are narrow but unlikely to fracture. Because ø3.5 implants are weak, their usage should be limited to mandibular anterior teeth or maxillary lateral incisor area where occlusal load is not heavy. MS implant is the optimal choice for mandibular anterior teeth. ø4.0 implant is the first choice in maxillary anterior teeth or both premolar teeth area. Minimum size of ø4.5 implant is recommended if replacing both molar teeth. While placing ø5.0 implant is possible in wide bones, primarily placing ø4.5 implants in molar regions is suggested when considering surgical convinence or problem solving. **(Fig. 3-15)**

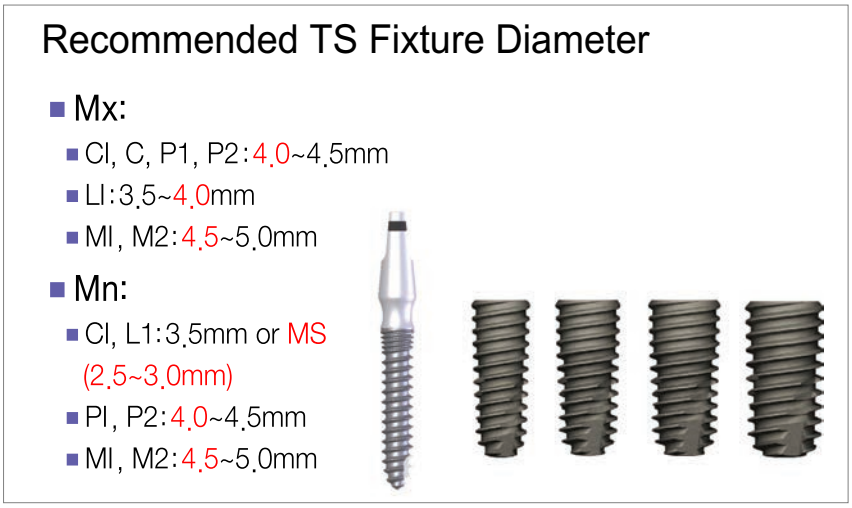


Fig. 3-15. Guideline of selecting implant diameter depends on implant position.

(5) Selecting length of the TS Implant System

Opinions regarding length of Implant are quickly changing. Long implants over 10.0mm have been favored in the past, but shorter implants are increasingly preferred. Evolution of implant surface, adoption of wide diameter implants, changes in macro/micro designs in implants have significantly increased clinical success rates for short implant. The acceptable minimu length for an implant is unclear. Affecting factors include: the patient's bone quality, occlusion, bite force, the implant diameter, design, direction and location of occlusal load, and number of splinting implants. There are plenty positive opinions regarding the controversy on the use of implants shorter than 6.0mm. Installing long implants if the remaining bone height is sufficient is possible, but it is difficult to claim definite benefits for long implants over 10.0mm.
Agreeing on such plausible benefits as production of initial stability, applying of early loading, increase in surface area due to increased length, improved crown-implant ratio, etc. is difficult. While long implants over 11.5mm can be installed for initial stability if implant is placed immediately after extraction, common cases do not require implants over 10.0mm. Because short implants of 8.5mm, 7.0mm and even 6.0mm demonstrate similar clinical success rates to long implants, there is no reason to overextend the length.
Especially for cases in which the mandibular posterior region where bone quality is good and nerve damage is likely, utilizing short implants can be a wise decision. The minimum implant approved by the KFDA (Korea Food & Drug Administration) is 5.0 x 6.0mm, and experience suggests no difference in success rate with such short implants. **(Fig. 3-16)**

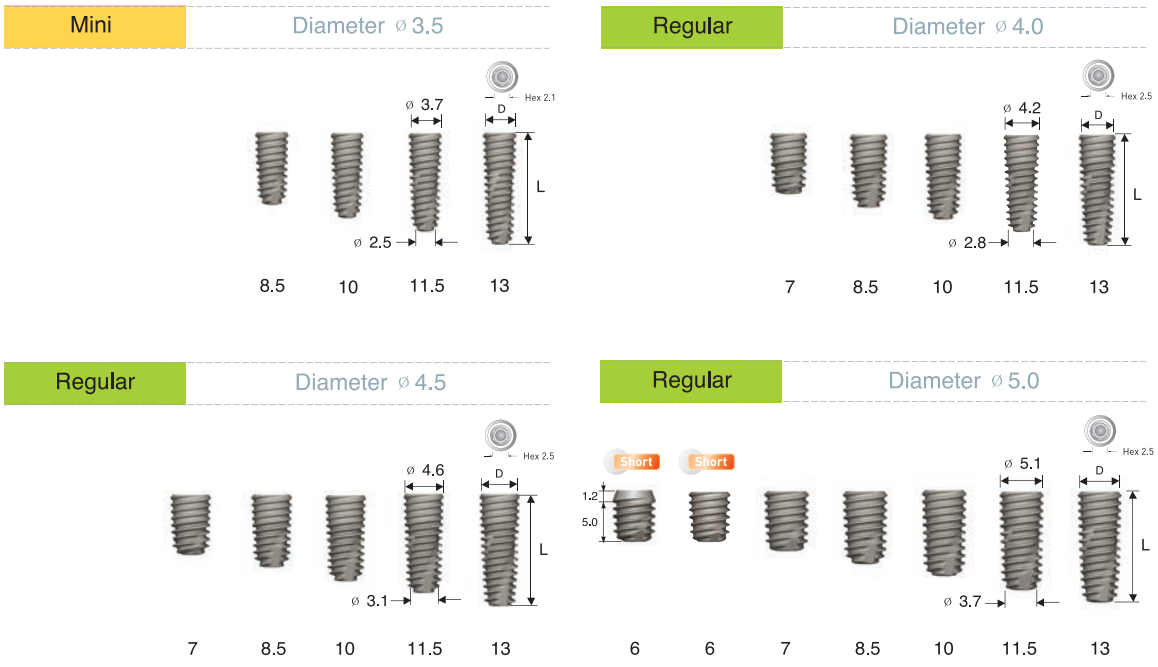


Fig. 3-16. Available length of TSIII SA implant system. Recently, short implant is preferred.

2) MS Implant System

The mandibular anterior teeth region possess narrow interdental space, narrow bone width, is prone to crowding, and frequently is involved in periodontal diseases **(Fig. 3-17)**

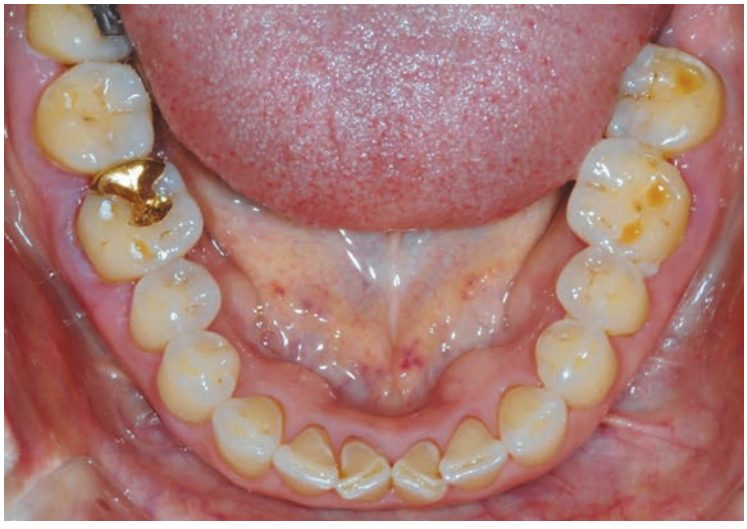


Fig. 3-17. Mandibular anterior region is characterized as frequent crowding, narrow bone width, and narrow interdental space.

The reported interdental spaces in the mandibular anterior region are as follows: mandibular central incisor 5.0mm, mandibular lateral incisor 5.5mm. It is significantly narrower than those of mandibular premolar and molar, and when placing implants, this causes great difficulty in maintaining adequate space between teeth or adjacent implants.**(Table 1)**

Average crown diameter of teeth (mesio-distal)

	Maxilla (mm)		Mandible (mm)	
	Crown	Cervix	Crown	Cervix
Central incisor	8.5	7.0	5.0	3.5
Lateral incisor	6.5	5.0	5.5	4.0
Canine	7.5	5.5	7.0	5.0
Premolar	7.0	5.0	7.0	5.0
Molar	10.0	8.0	10.5	8.5

Table 1. Average crown diameter of teeth.

Difficulties in operation and prosthetics often arise because the space between implants may be too narrow when not only placing 4.0mm implants of standard diameter but also 3.5mm implants of smaller diameter.**(Fig. 3-18)**

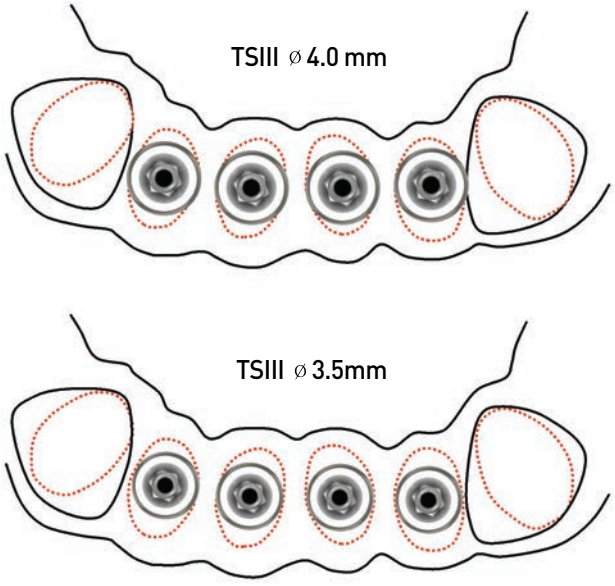
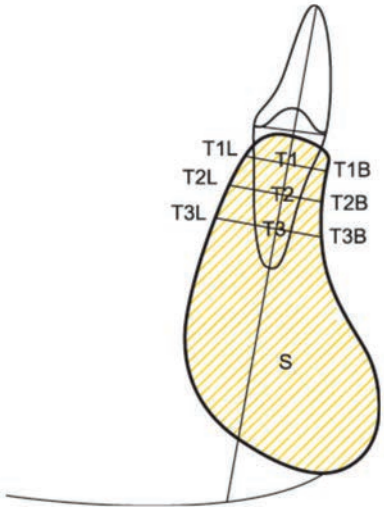


Fig. 3-18. Placing implant with diameter of 3.5mm, or 4.0mm in madibular anterior incisors may arises prosthetic problems.

The labio-lingual bone width is also narrow and thin, ranging from 5.5mm to 6.8mm. Bone width may be resorbed up to 50% after tooth extraction. In actuality, patients lacking mandibular anterior teeth often have remaining bone width less than 4.0mm. **(Fig. 3-19)**

Comparison of mandibular anterior alveolar bone thickness in different facial skeletal types

Kim YS et al. Korean JOrtod. 2010



Class I	Class II	Class III
6.00	6.45	5.72
6.60	6.86	5.76
5.90	6.42	5.44

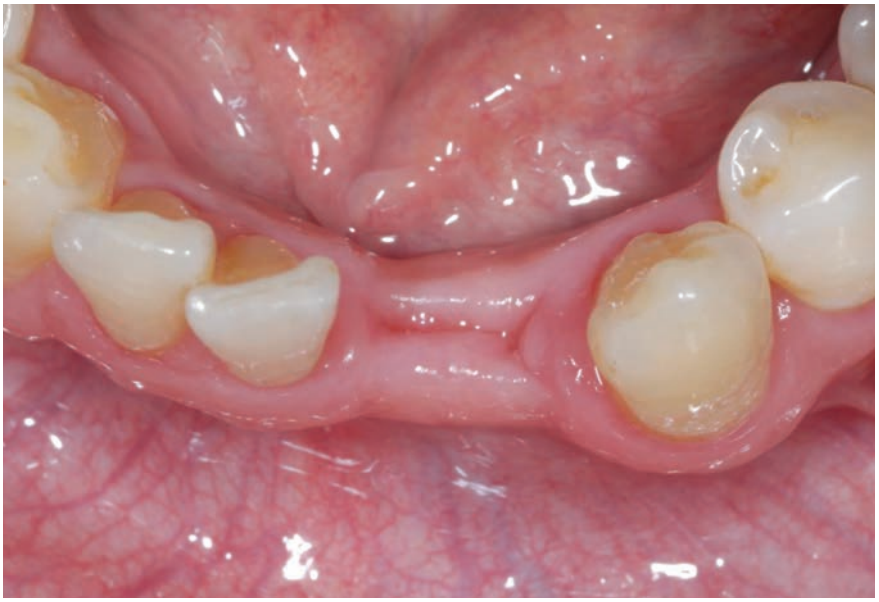
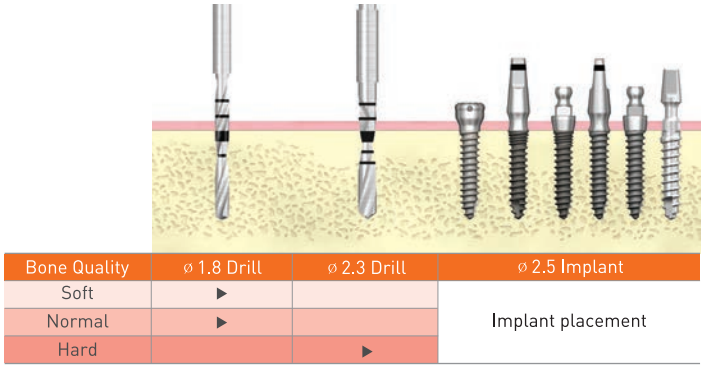


Fig. 3-19. Usually, remaining alveolar bone width is 4.0mm or less after loss of mandibular anterior teeth.

(1) Surgical guideline of MS Implant System

(ø 2.5) _Recommended insertion torque : 30Ncm



(ø 3.0) _Recommended insertion torque : 30Ncm

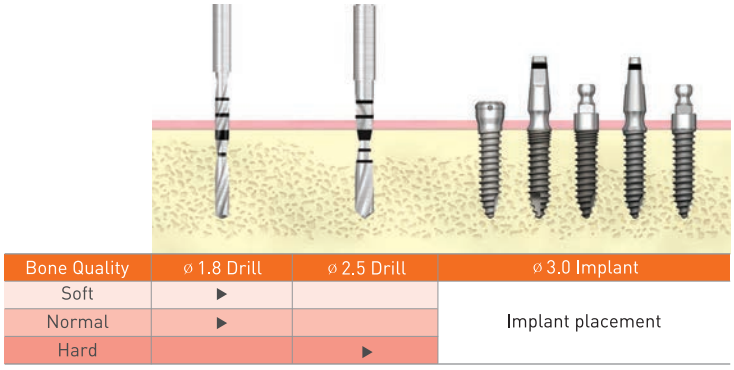


Fig. 3-20. Drilling guideline of MS implant system.

Because the diameter is small, the MS Implant system can be place immediately after simple drilling. For ø 2.5mm fixture, after Lance drilling, use ø 1.8mm, drill in soft & normal bone, and ø 2.3mm in hard bone as a final drill. For ø 3.0mm fixture, after Lance drilling, use ø 1.8mm, drill in soft & normal bone, and ø 2.3mm in hard bone as a final drill. **(Fig. 3-20)** After using the Lance drill, insert the parallel pin to examine the labio-lingual and mesiodistal path. Determine accurate implant path at this stage because drill step is very simple and less chance to correct it. The implant in mesiodistal path should be installed parallel to nearby tooth root axis. Commonly in mandibular anterior teeth, they are positioned upright.

Basically labio-lingual path of the upper part should be same as natural tooth crown. However, characteristics of the one-body implant and final prosthesis should be taken into consideration to meticulously choose the path. In case of natural tooth, the crown axis and the root axis slightly differ. Because the MS fixture cannot bend its neck to modify directions, the difference needs to be carefully managed. Ideal path for abutment part of MS fixture, when taking into account esthetic factors for the final prosthesis, is slightly directed to the lingual side than to the incisal edge. This is because the labial side requires more space for the buildup of the porceline than the lingual side, when processing the final prosthesis to PFM. Increase in tolerance in cases of deep installations makes this easy, but caution is advised in shallow installations of the MS fixture. **(Fig. 3-21)**

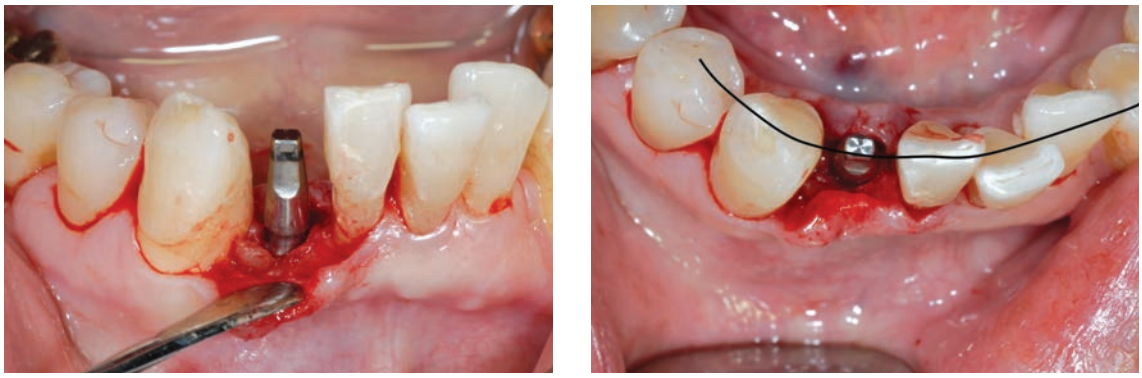


Fig. 3-21. Path of MS fixture is slightly directed to the lingual side than to the incisal side.

The axis of mandibular anterior alveolar bone also bends away from the labial side. Focusing on placing the fixture in the alveolar bone without exposure may result in imperfect path of the implant crown. Tilting lingually should resolve this issue. The unideal labio-lingual path may be resolved prosthetically, but installing with proper path may simplify the prosthetic procedure and yields excellent aesthetic results. Hence, the path of the fixture should be carefully considered. In principle, the final drill's depth should match the fixture's length, but MS fixture's excellent self-tapping ability allows installation without full depth drilling. Begin with low speed below 50rpm, connected to the MS fixture exclusive mount driver to install using motor, then connect the MS fixture exclusive mount extension and lastly manage the final depth by hand using the Ratchet wrench. It is common to point the triangular marks on the MS fixture exclusive mount driver and mount extension to the labial surface, placing the MS fixture's crown part where it can be viewed widely. However, if the mesodistal width is too narrow, the narrow crown part can point to the labial direction and obliquely positioned taking into account the arrangement of adjacent teeth. **(Fig. 3-22)**

Fig. 3-22. Direction of abutment in MS implant is controlled considering clinical situations.

The depth of the MS fixture is controlled considering the bone and gingival height. The rough surface root part of the MS fixture needs to be buried in bone. Control the fixture depth so that the gingiva is located at lower 3.0mm area of the abutment where the crown margin will be located. The MS fixture has two kinds of neck height, 2.5mm and 4.0mm, which can be selected considering soft tissue thickness. **(Fig. 3-23)**

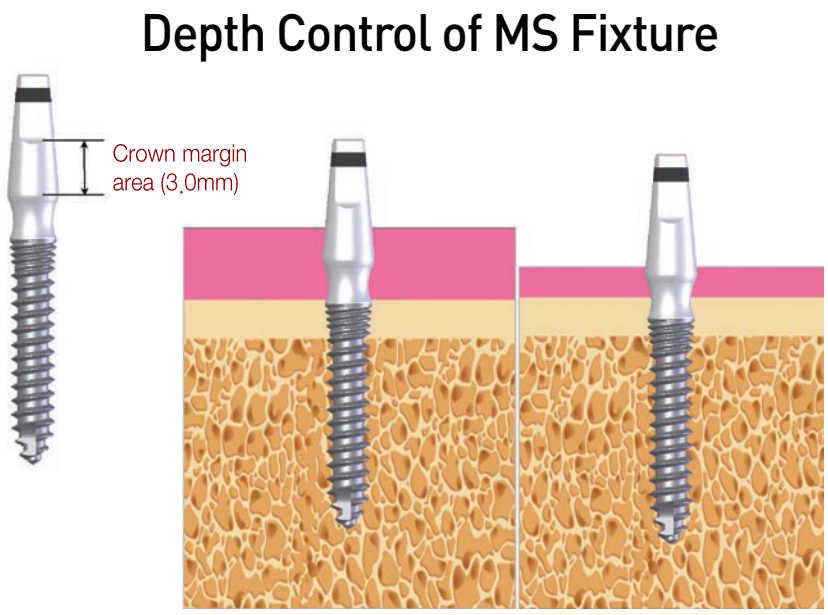


Fig. 3-23. Depth control of MS implant system considering gingival depth.

(2) Prosthetic procedure of MS implant system

The standard prosthetics procedure for the MS implant system is as follows. Immediately after installation, fabricate and deliver temporary crown using temporary cap. The self-retention of the temporary cap is excellent, and requires no cementation when deliver the crown. Make the disclusion of the temporary crown and ask patient not to bite with anterior teeth. Usually about 2 months after healing, remove the temporary crown and connect impression cap and take pick-up impression.

When this impression body is sent to the laboratory room, technician connects the lab analog and fabricates a master model. Then, through lab-work, fabricate the final crown. The final crown is commonly cemented with temporary cement, but may apply permanent cement depending on the circumstance.

Using standard prosthetic procedure is the simplest way to utilize the MS implant system. Modifying the abutment part before final impression complicates standard protocol and lead to complex prosthetic process. Until making and deliver the final prosthesis, try not to adjust or modify the crown part and follow standard methods to impression taking and prosthetic procedure. Then, if necessary, modify the abutment part of MS fixture in laboratory room to create final prosthesis. To allow identification of the modified part, let the technician fabricate a Jig. When deliver the prosthesis, connect the Jig to the abutment of the MS fixture in the actual patient and adjust the abutment as much as needed. Hence, the final prosthesis can be used as it is. **(Fig. 3-24)**

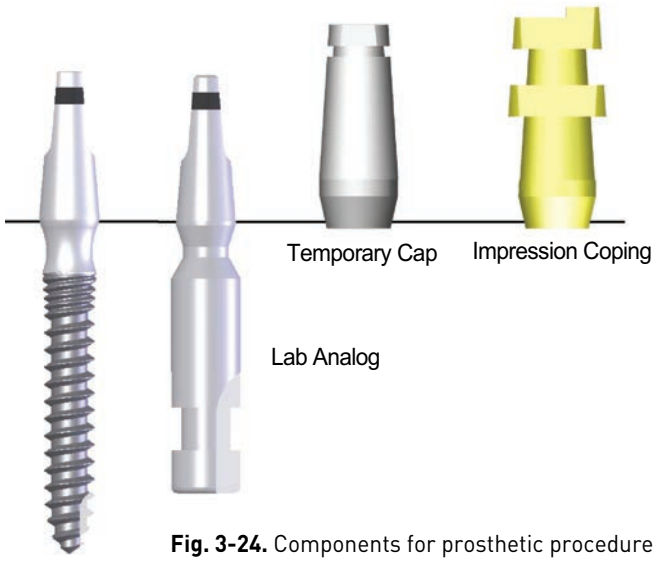


Fig. 3-24. Components for prosthetic procedure of MS implant system.

(3) Treatment Planning

If missing a single tooth in the mandibular anterior, using one MS fixture is the standard protocol. However, when two mandibular anterior teeth are missing continuously, installing only one and cantilevering the adjacent with pontic is possible. If missing three of four teeth, install two MS fixtures and make a bridge type prosthesis. The taperness of the MS fixture abutment is 5° degrees to the unilateral side, so install parallelly as possible.**(Fig. 3-25, 26)**

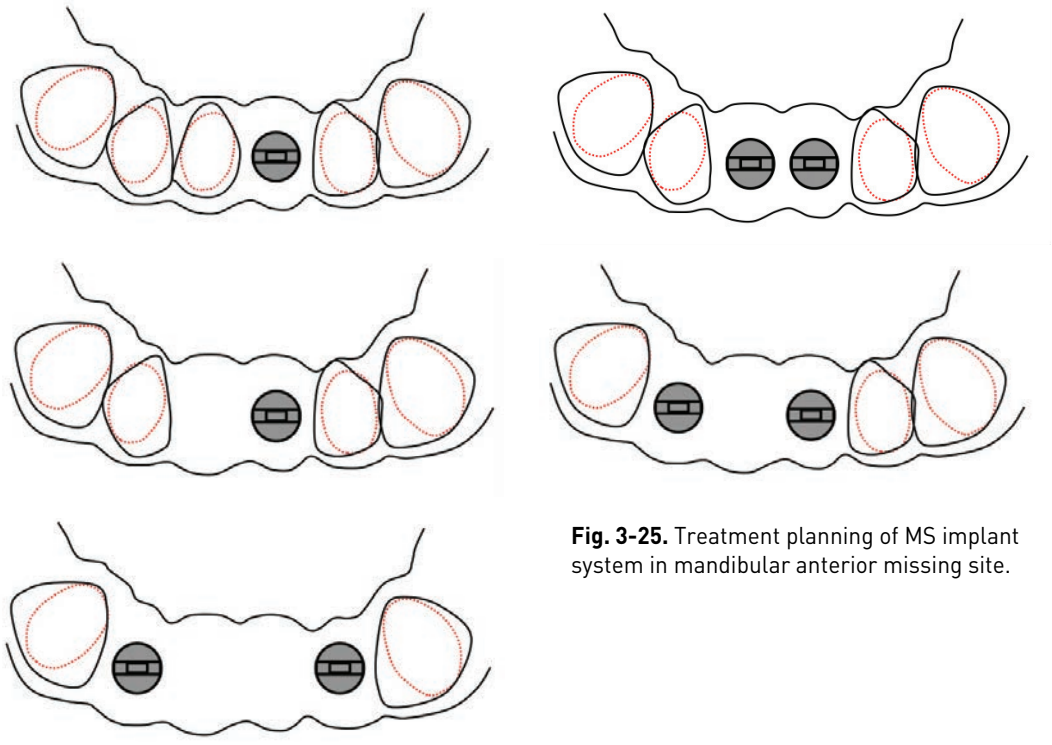


Fig. 3-25. Treatment planning of MS implant system in mandibular anterior missing site.

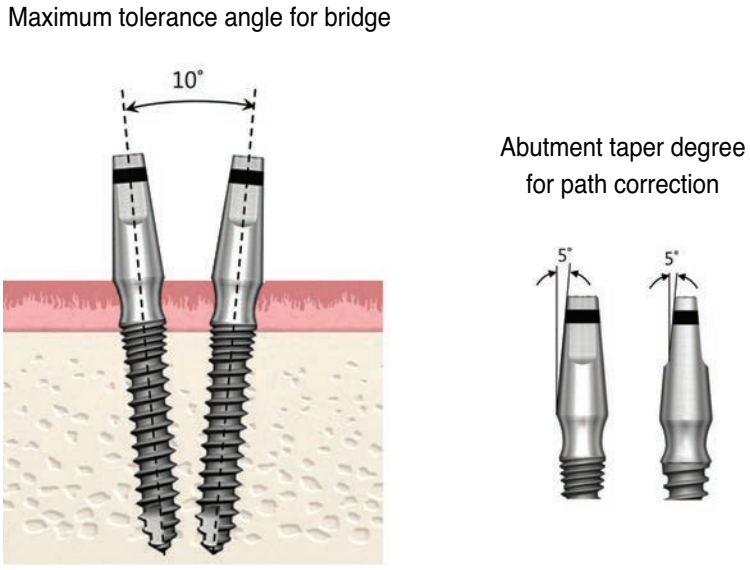


Fig. 3-26. The taper of MS fixture abutment is 5 degrees to the unilateral side, so in bridge case install MS fixtures parallel as possible

In general, installing MS fixture immediately after extaction allows sufficient bone width for 3.0mm fixture. However, the alveolar bone width may decrease after some time of extraction, and may require ø2.5mm fixtures to be placed. The MS implant system requires a superstructure immediately after installation of the fixture, and therefore initial stability is needed. ø3.0mm fixture generally provides more stability than ø2.5mm fixtures, but insufficient drilling and length of 13.0mm also provies acceptable stability. I personally favor ø2.5mmx13.0mm fixture.

MS implant system for Narrow ridge has been developed to manage mandibular anterior teeth deficiencies, but can be used in other situations. Limited use is possible in premolar areas where interdental space is extremely narrow, and also to support long bridges. It can also be used in maxillary lateral incisor missing site, where interdental space is also narrow. Determination of the MS implant path is difficult in maxillary lateral incisor because of different crown axis and root axis. So the path of the fixture is compromised between crown and root axis and the abutment part may be modified during the prosthetic procedure.**(Fig. 3-27)**

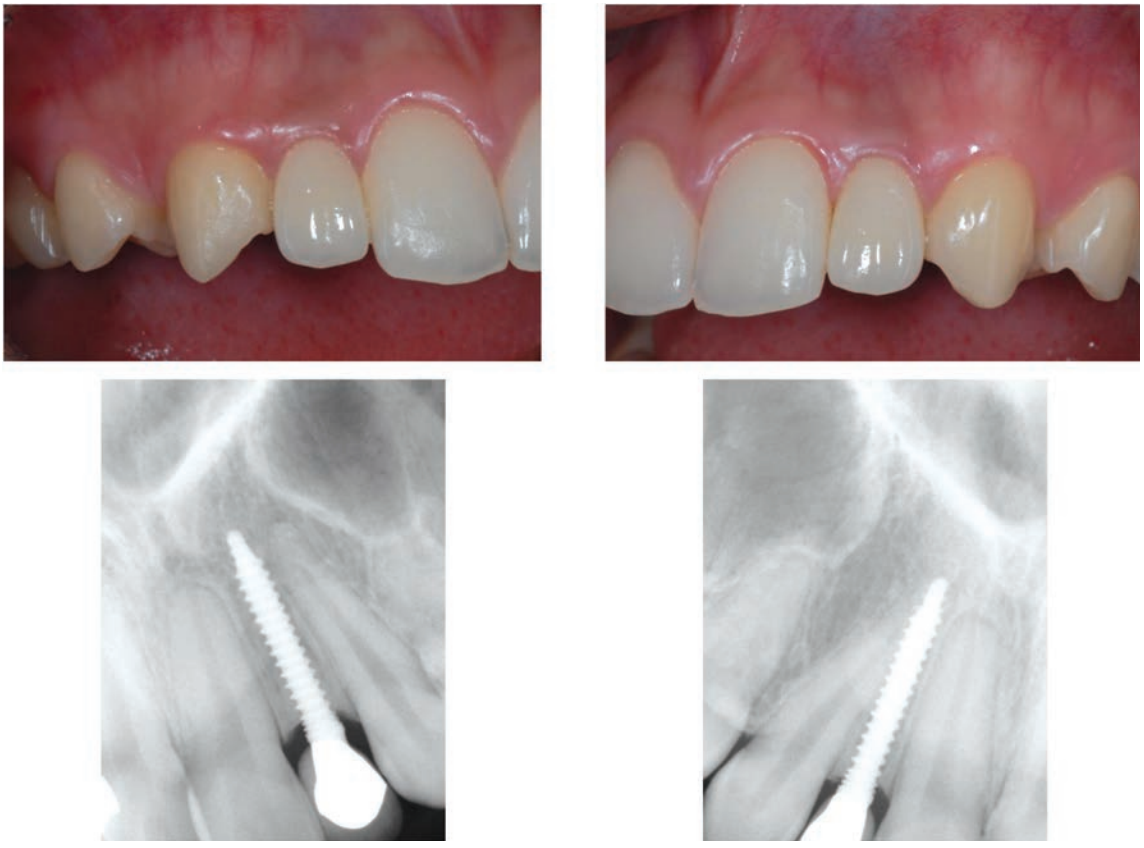
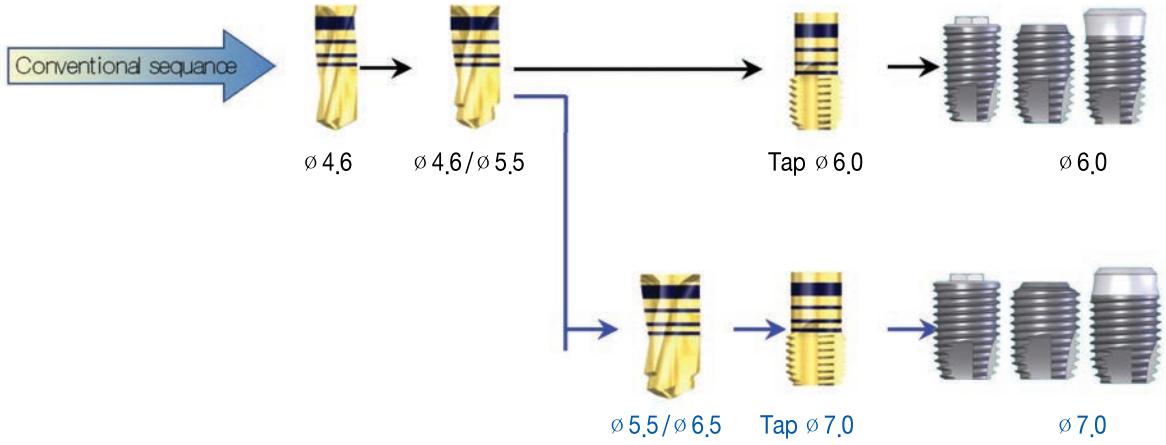


Fig. 3-27. MS implant case replacing both maxillary lateral incisors.

3) Ultra-Wide Implant System

Ultra-Wide implant can be placed with three kinds of methods. Implantation after conventional drilling and addititionally using a drill with larger diameter, implantation after using trephine bur and additionally using a drill with larger diameter, and implantation without drilling after removing a failed implant and selecting an implant with adequate diameter. The trephine bur technique can be used to remove the septal bone in case of immediate implant placement after extraction and to remove osseointegrated implant which is ailing or failed. **(Fig. 3-28~32)**

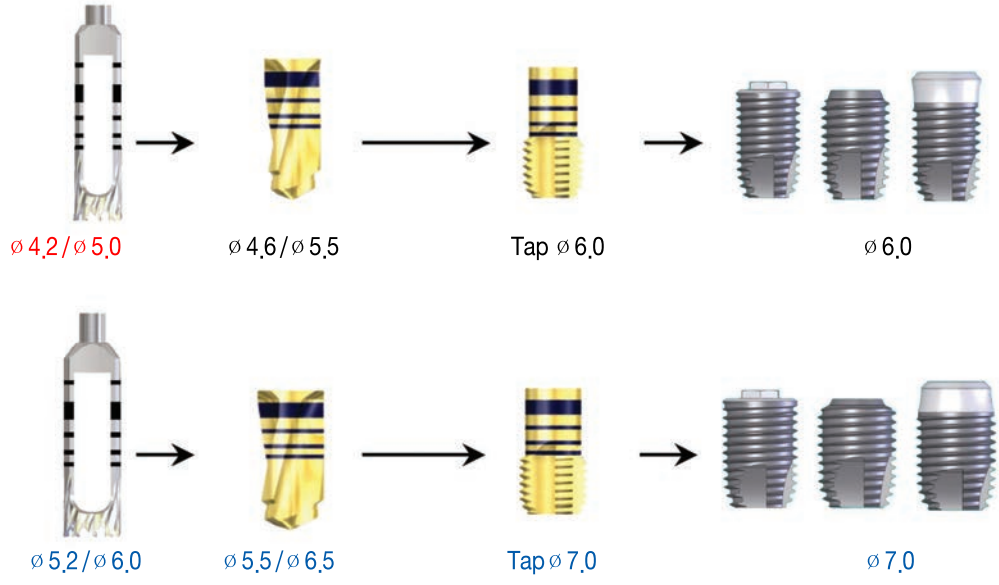
Conventional Drilling Sequence



※ When bone is especially hard like mandible (D1), you must use Surgical Tap finally.

Fig. 3-28. Conventional drilling procedure

Drilling Sequence with Trephine



※ When bone is especially hard like mandible (D1), you must use Surgical Tap finally.

Fig. 3-29. Drilling procedure using trephine bur

Delayed Case ; Fixture ø 6.0 × 10mm

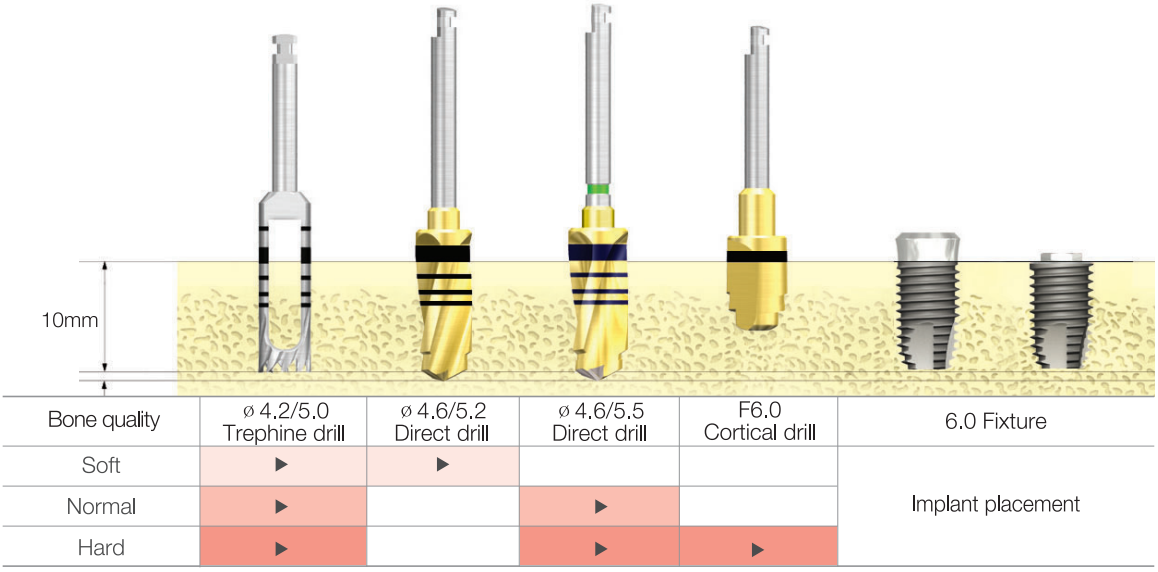


Fig. 3-30. Surgical procedure to place Ultra-Wide implant in hard bone case using trephine bur, wide drill, and tap.

Immediate Case ; Fixture ø 6.0 × 10mm

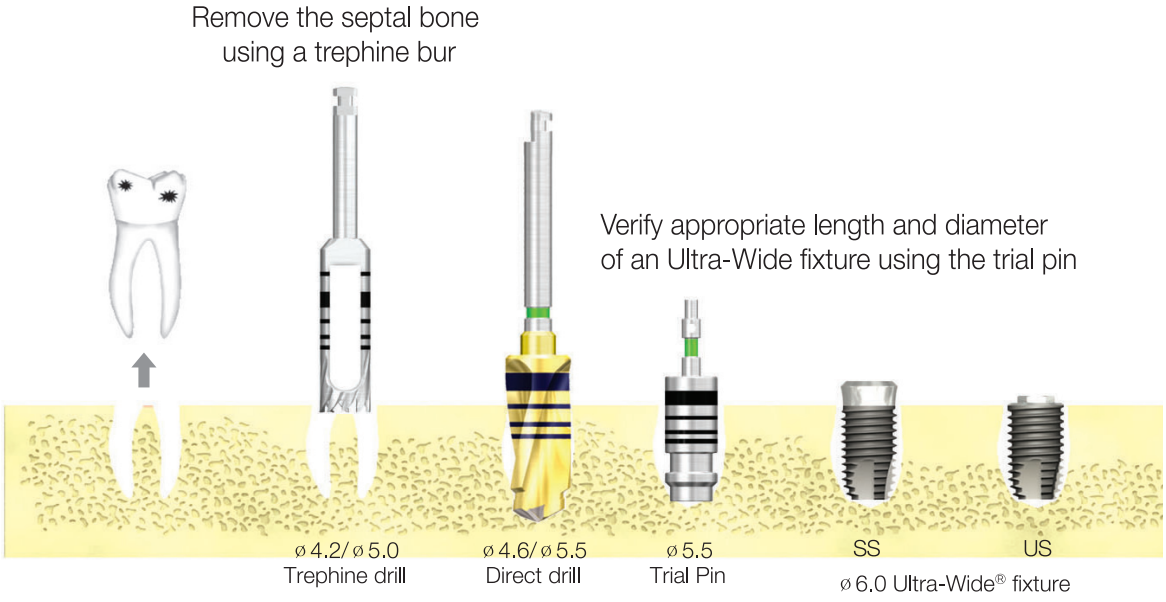


Fig. 3-31. After extraction, septal bone is removed with trephine bur to place Ultra-Wide implant.

Failed Implant Case ; Fixture ø6.0×10mm

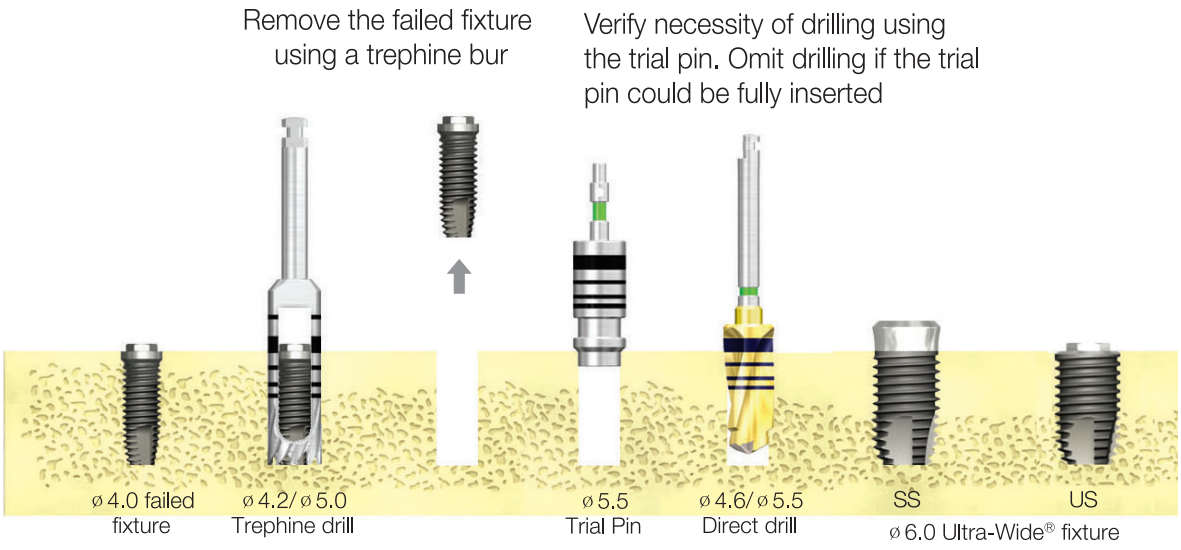


Fig. 3-32. Ultra-Wide implant is placed after retrieval of failed implant with trephine bur.
Use tap drill in case of hard bone density.

■ Indications of Ultra-Wide implant system

Ultra-Wide Implant can be used to immediately install implants after extractin of the molar, to immediately rescue a failed implant, and to increase the surface area when placing short implants becase of insufficient remaining bone height.

Because the diameter of upper part of extraction socket is as large as 7.0~10.mm after extraction in the molar region, placing implants with diameters of 4.5mm or 5.0mm leave space between fixture and extraction socket. Using Ultra-wide implant with a bigger diameter can reduce such space. **(Fig. 3-33)**

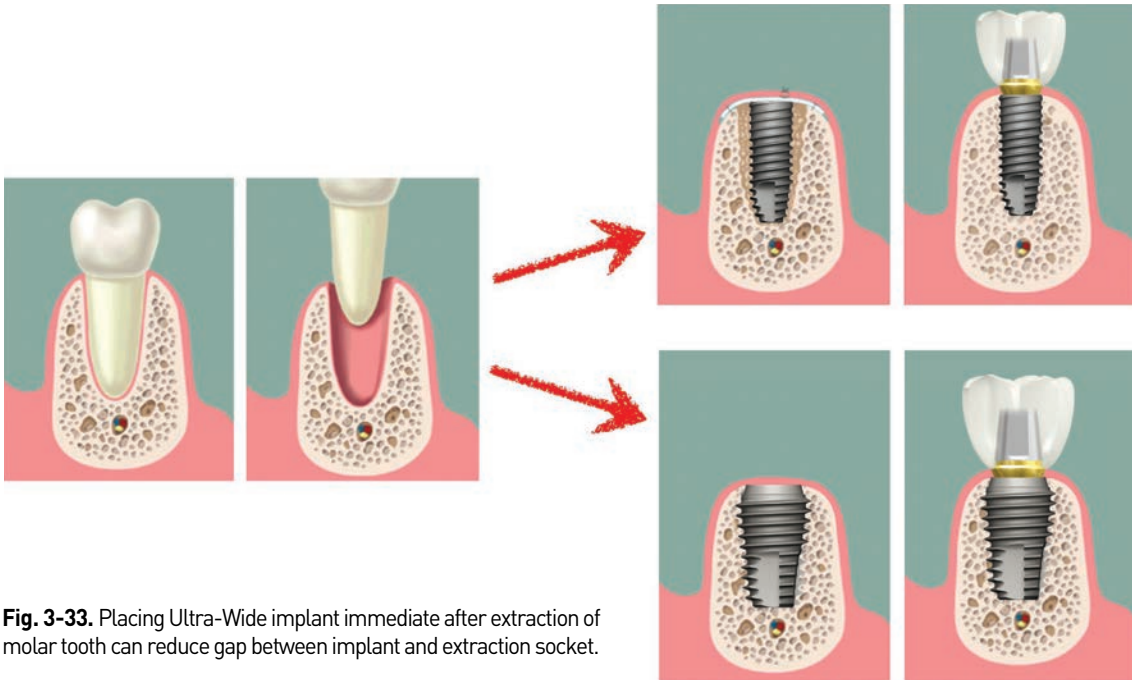


Fig. 3-33. Placing Ultra-Wide implant immediate after extraction of molar tooth can reduce gap between implant and extraction socket.

For implant placed immediately after extraction to have enough stability, it needs to pass 3~5mm of the lower part of the extraction socket. However, if the remaining bone height up to the mandibular canal or the maxiallary sinus floor is insufficient, it could be invasive. Because of its wide diameter, Ultra-Wide implant provides opportunity to get stability without deep installation. **(Fig. 3-34)**

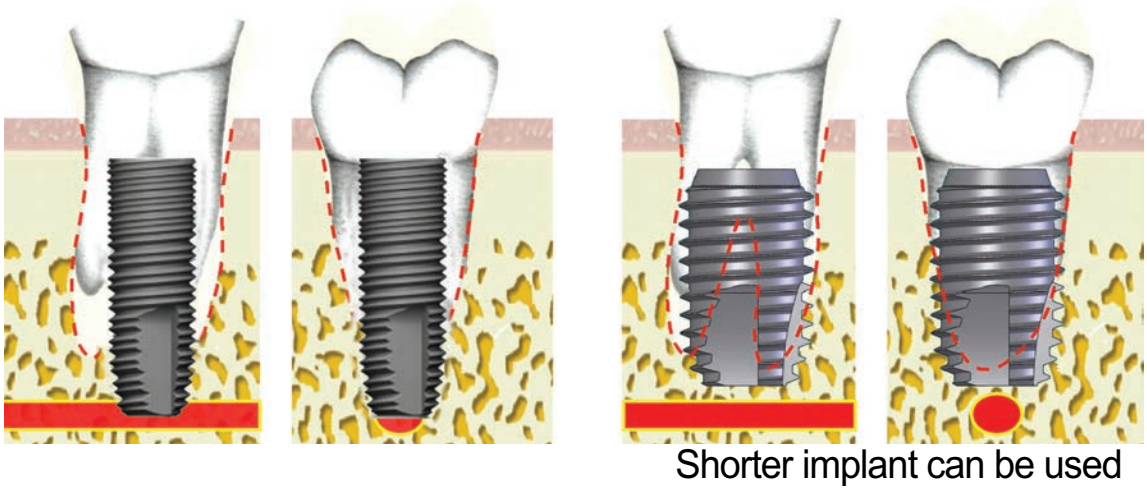


Fig. 3-34. Ultra-Wide implant can be a good choice to overcome insufficient alveolar bone height.

Retrieval of implant because of peri-implntitis or failed osseointegration or prosthetic problems requires swift and pertinent solutions to maintain proper relationship with the patient. After removal of standard diameter or wide diameter implants, healing term of 3~6 months is needed depending on the circumstances to install an implant with same diameter. To immediately replace an implant, performing inaly bone graft and simultaneously placing an implant of same diameter is possible. However, utilizing Ultra-Wide implant can simplify the process. **(Fig. 3-35)** Depending on the condition of the failed implant, a suitable diameter needs to be selected for Ultra-Wide implant. Generally, if the failed implant shows mobility, 1.5mm or bigger sized Ultra-Wide implant to be replaced should be selected to get primary stability. Also, decreasing the length a step (1~1.5mm shorter) avoids depth control issues. **(Fig. 3-36)**

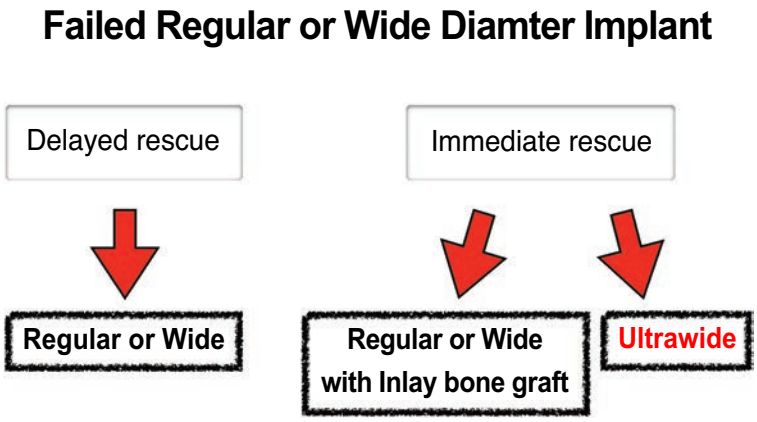


Fig. 3-35. Select proper diameter of implant depends on timing of re-installation during the rescue of failed implant to get primary stability.

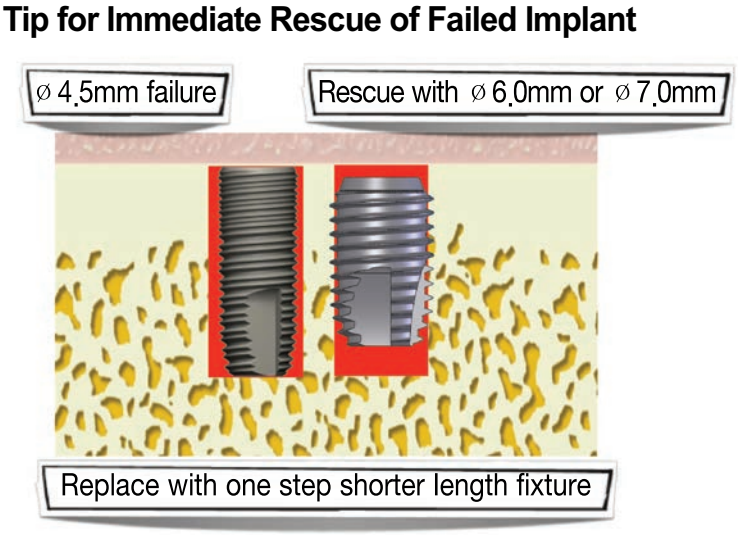


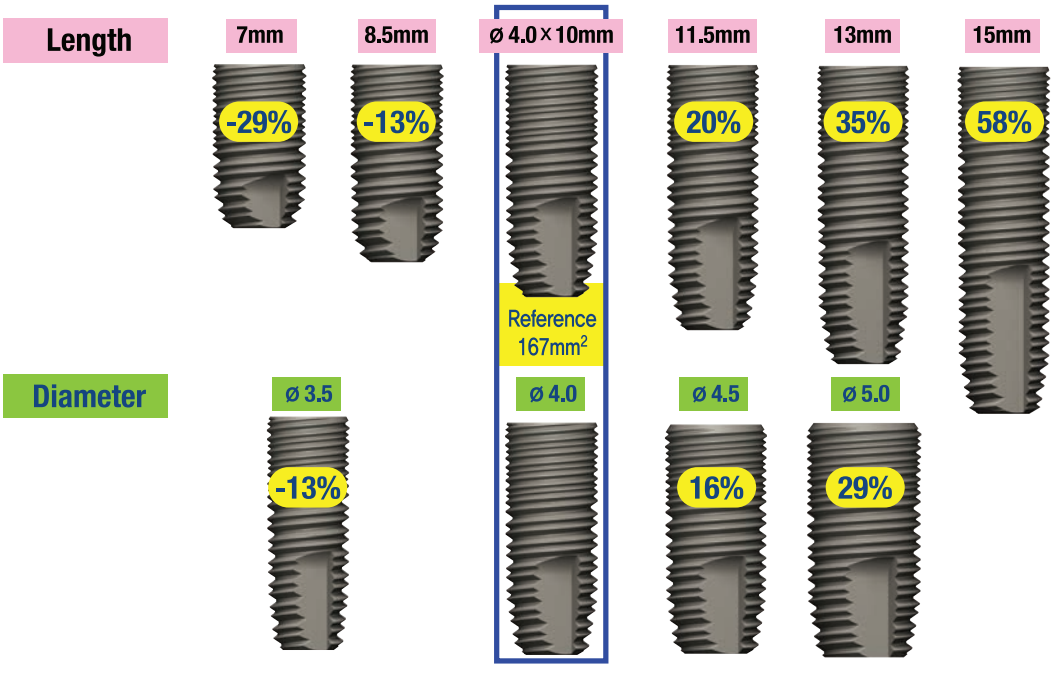
Fig. 3-36. If the failed implant shows mobility, 1.5mm or more big sized and 1~1.5mm short Ultra-Wide implant to be replaced should be selected.

Wider implants may be used to compensate for decreased surface area when placing short implants because of insufficient remaining bone height. It has been reported that in cylindrical implants, change in 3.0mm of length can lead to over 10% change in surface area. 0.25mm change in diameter leads to 5~8% change in surface area. The change in surface area according to diameter and length may differ bettwen implant designs, but it is undoubtedly proportional.

Osstem's ø6.0mm USII Ultra-Wide fixture of length 8.5mm has 1.6 times more surface area than ø4.0mm USII regular fixture, and 1.3 times more surface area than ø5.0mm USII wide fixture.

Ultra-Wide Regular or Wide with Inlay bone graft Delayed rescueImmediate rescue Regular or Wide Failed Regular or Wide Diamter Implant Tip for Immediate Rescue of Failed Implant ø4.5mm failure Rescue with ø6.0mm or ø7.0mm Replace with one step shorter length fixture**(Fig. 3-37)** Optimal minimum length and diameter of implant to withstand bite force and function long period is still controversial, but selecting wide diameters for short implants is regarded a relatively reasonable choice. However, it is important to carefully weight the benefits when using wide implants to compensate for their short length, as the remaining bone width in the buccolingual side will decrease and require consideration of long term prognosis.

Surface area change accordung to chang Fixture(GSII) diameter & Length



Surface Area by Diameter

USII Fixture:8.5mm length

Diameter	ø 3.3	ø 3.75	ø 4.0	ø 5.0	ø 6.0	ø 7.0
Surface area (mm^3)	111.5	128.1	138.2	178.5	224.4	269.6

◆ Surface area of Ultra-Wide ø 6.0 Fixture

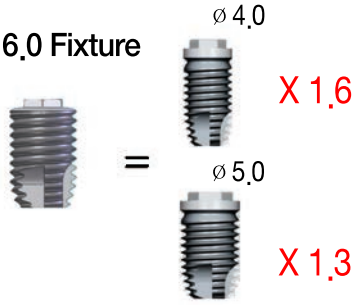


Fig. 3-37. The change in surface area according to diameter and length of implant is proportional.

2. Surgical kits for sinus bone graft – By Dr. Cho, Yong-Seok

1. The CAS (Crestal Approach Sinus)-KIT

There are two most important considerations when placing implants in the maxillary posterior region. First is the decrease of implants success rate due to the difficulty of achieving initial stability in poor bone quality. Second is the lack of remaining available bone height caused by the pneumatization of the maxillary sinus or resorption of the residual alveolar bone which requires such advanced surgical techniques as maxillary sinus bone grafting or guided bone regeneration to place adequately sized implants.
The technique of maxillary sinus bone grafting to ensure sufficient bone height and placing enough long implant has been developed for decades, and is considered a very predictable surgical method. The surgical method was once considered very difficult, but with the generalization of implant therapies dentists are increasingly learning and challenging themselves. Maxillary sinus bone grafting can be divided into two main techniques. One is the lateral window approach sinus bone graft technique, in which the maxillary sinus is approached laterally through opening a bone window, the sinus membrane elevated, and then the bone grafted. The other is the crestal approach sinus bone graft technique, in which the maxillary sinus is approached through crest of the residual alveolar bone and drilled, the sinus floor fractured, and then the bone grafted. **(Fig. 3-38)**

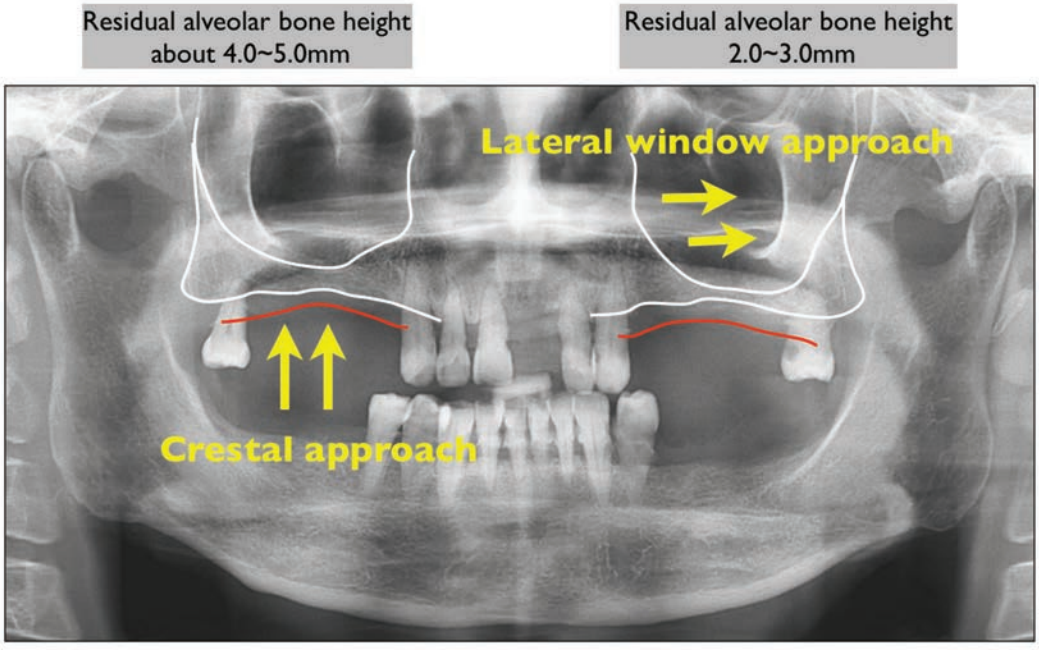


Fig. 3-38. Generally, sinus bone graft can be performed via lateral or crestal approach technique depends on height of residual alveolar bone.

There are multiple variables in choosing which technique to use, but the residual alveolar bone height is the most common deciding factor. Generally, the crestal approach sinus bone graft technique is used for residual alveolar bone heights of over 5.0mm, and lateral approach sinus bone graft technique for heights less than 4.0mm. However, the operator's surgical skills are significant in real clinical situations and other variables as uncertainties in residual alveolar bone height, potential, risk of bleeding, and presences of lesions in the maxillary sinus may affect ones's choice.
General practitioners tend to avoid complex or risky surgical methods, and therefore favor crestal approach sinus bone graft technique over lateral window approach sinus bone graft tenchique. Crestal approach sinus bone graft technique using osteotome was introduced in 1994 by Summers, and has been widely used as the most popular method. **(Fig. 3-39)**

Fig. 3-39. Conventional crestal approach sinus bone graft technique using osteotome.

For this method to be successful, the sinus floor must be fractured without damaging the sinus membrane and sufficient amount of bone substitute must be inserted in the maxillary sinus and widly grafted. Although conventional crestal approach sinus bone graft using the osteotome has been progressed and regarded as relatively simple and effective method it still has many limitations. Because it is basically a blind technique, checking progress during operation is difficult. Whether drilling to the sinus floor is precise, the sinus floor is fractured properly using the osteotome, and adequate amount of bone graft material has been grafted is difficult to check during operation, and thus becomes stressful and time consuming.There are occasions when X-rays taken after the operation without any checkups during the procedure reveal unsatisfactory results. Such surgical method depends heavily on skill, experience, and senses of the operator, and therefore lacks predictictablilty. The osteotome technique accurately measures the residual alveolar bone height and allows drilling 1-2mm shorter before fracturing the sinus floor. However, it can be difficult to measure the residual alveolar bone height precisely in real clinical situations. We can use panoramic views or CT images to measure the available bone height, but actual drilling height may be significantly different and depend on the location and direction of drilling. In result, the remaining bone may be too thick to allow easy fracturing of the sinus floor, or the remaining bone may be too thin and the drill may penetrate the sinus floor directly, perforating the sinus membrane.

Moreover, the osteotome technique uses malleting to fracture the sinus floor, and the patient may feel discomfort during the operation. Patients with of hard bone density or insufficient drilling depth, which results in excess bone between the sinus floor and the drilled hole, require heavy malletting. While it depends on the sensitivity of the patient, the feeling has been reported to be very uncomfortable. Severe malletting during crestal approach sinus bone graft using osteotome, in rare cases, may result in symptoms of dizziness from benign paroxysmal positional vertigo.

In the past, importance of sufficient membrane separation was neglected commonly during crestal approach sinus bone graft technique using osteotome. Except for autogenic bone and some allogenic bone substitutes which have osteoinductivity, many bone materials grafted in the maxillary sinus generally produce new vital bone by osteoconduction. Therefore, it is important to increase contact of graft material

with the original host bone. In sinus elevation, if the membrane is not separated enough and only the base is narrowly elevated convexly, it is highly likely that the grafted bone substitute cannot perform osteoconduction and new vital bone regenration is hindered. Widely separating the sinus membrane in osteotome technique is not predictable. Regardless of the surgical skill of the operator, separation of the membrane can be wide or narrow depending on the condition of the patient's sinus membrane. The biggest disadvantage to crestal approach sinus bone graft technique using the osteotome is the operator's inability to control the separation of the membrane.

Missing hidden infection sources are also a problem. While performing sinus bone graft using lateral window approach allows checking of the sinus membrane under direct vision and immediate adequate management, infection sources cannot be seen when performing sinus bone graft using crestal approach. Panorama radiography makes it difficult to diagnose the conditions of the membrane, especially pathologic conditions. CT imaging allows more accurate diagnosis, but complete prehension of the membrane is troublesome. Failing to notice hidden infection sources increase the possibility of postoperative infection, and makes it difficult to identify the source of infection. Crestal approach sinus bone graft technique is also inefficient in its bone grafting procedure. Pushing in the bone substitute through a small drilled hole is time consuming, and loss of bone substitute occurs as some may be scattered or dropped. In addition, bone substitute that contacted adjacent teeth or contaminated by saliva may be inserted to the maxillary sinus and become a source of postoperative infection.

To overcome such limitations of using the osteotome for crestal approach sinus bone graft technique, safer and highly predictable methods have started to develop. Many surgical tools with innovative designs and concepts have been made in Korea and overseas and are being introduced in the market. Consequently, sinus bone grafting through crestal approach has now become safer and easier. **(Fig. 3-40)**

Fig. 3-40. Various crestal approach sinus grafting instruments made in Korea and overseas are available.

Any tool can be said to be more advanced than conventional osteotome, but each tool possess advantages and disadvantages, not to mention the costly nature. A clinician cannot help but have trouble deciding which tool to purchase. An ideal crestal approach sinus lift kit must possess the following requirements:

1. A tool fit for sinus bone graft via crestal approach must have special drills that could safely and easily penetrate the sinus floor without damaging the sinus membrane.
2. A stopper system for easy force and depth control during drilling
3. A tool to safely and widely separate the sinus membrane after the sinus floor has been penetrated
4. In addition, the ability to collect autogenic bone and easily perform bone grafting is beneficial
5. The kit should be simple, easy to handle, durable, and affordable

It is difficult, even out of tens of different kits, to find a set of tools that fit the above criteria.
Osstem's CAS-KIT has been developed to meet all the requirements.

1) Composition and functions of the CAS-KIT

CAS-KIT consists of specially designed CAS-drills, Stopper system, Hydraulic lift system, 2.0mm twist drill, Depth gauge, Bone spreader, Bone carrier, and Bone condenser. **(Fig. 3-41)**

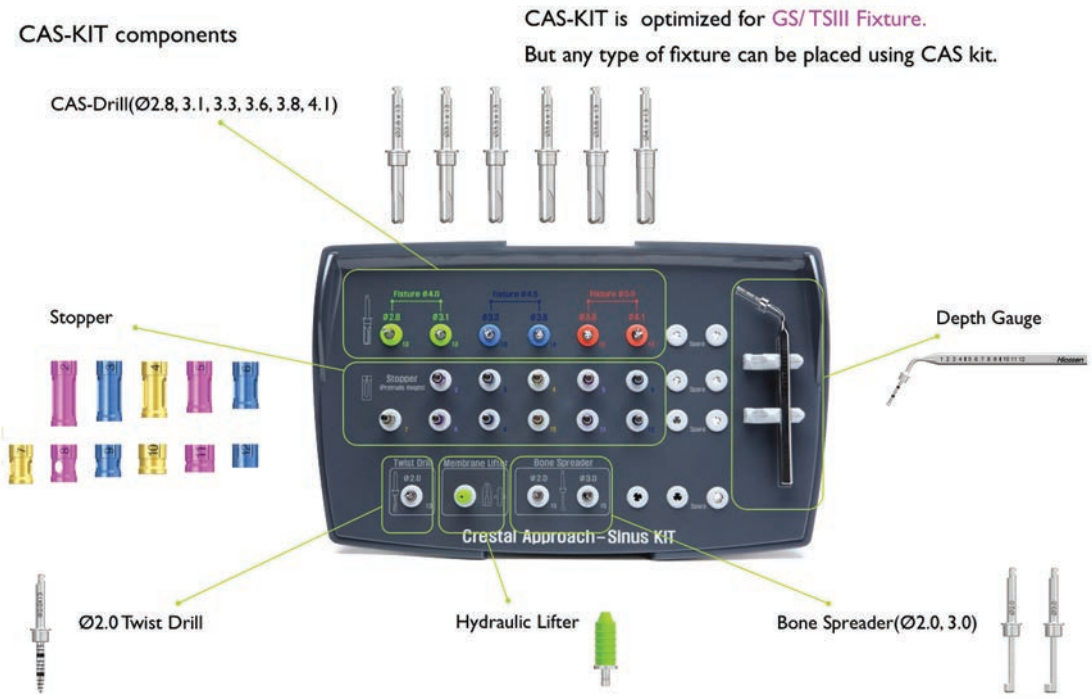


Fig. 3-41. Components of the CAS-KIT

(1) The CAS-drills

The CAS-drill has been designed to safely and rapidly penetrate the sinus floor. The end of the drill consists of four special forms of blades. The excellent cutting efficiency allows rapid penetration of the cortical bone of the sinus floor, while its round edge decreases the potential of damaging the membrane high speed drilling at 800rpm for bone cutting is possible, and safe, low speed drilling less than 100rpm still allows easy penetration of the sinus floor. Also, the concave end of the drill creates a cornical bone lid during the penetration of the sinus floor. The bone lid pushes the sinus membrane, preventing direct contact between the drill and the membrane, as well as decreasing the risk of membrane perforation. **(Fig. 3-42)**

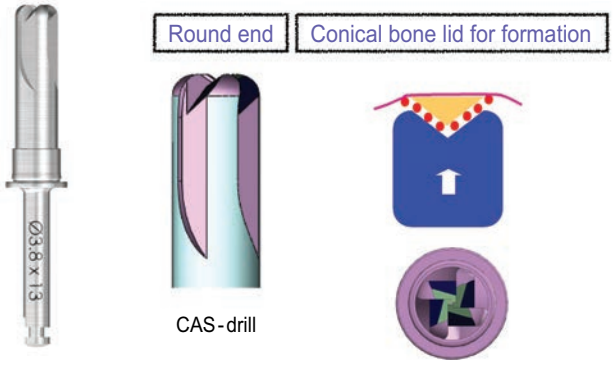


Fig. 3-42. Characteristics of the CAS-drill

The CAS-drill is a straight type drill with connected upper and lower part, and thus vibration is little and stable. The deep grooves on the side of the drill aloows efficient ejection of bone particles during bone cutting. The bone chips gathered can later even be used for bone grafting. **(Fig. 3-43)**

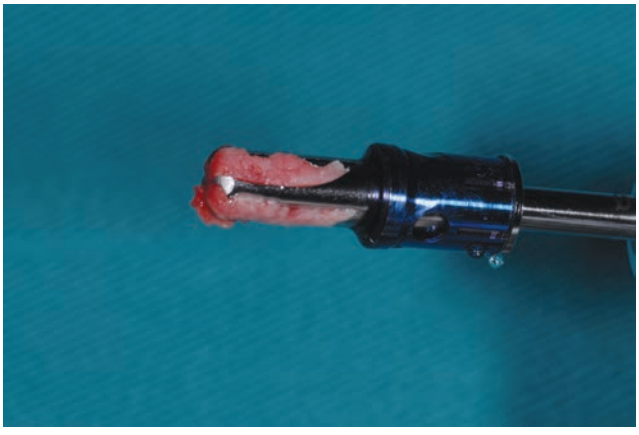


Fig. 3-43. The CAS-drill can collect bone chip.

There are six different diameters for CAS-drills: 2.8mm, 3.1mm, 3.3mm, 3.6mm, 3.8mm, and 4.1mm.
The operator may choose the diameter of the final drill after considering the implant diameter and the bone quality. **(Fig. 3-44)**

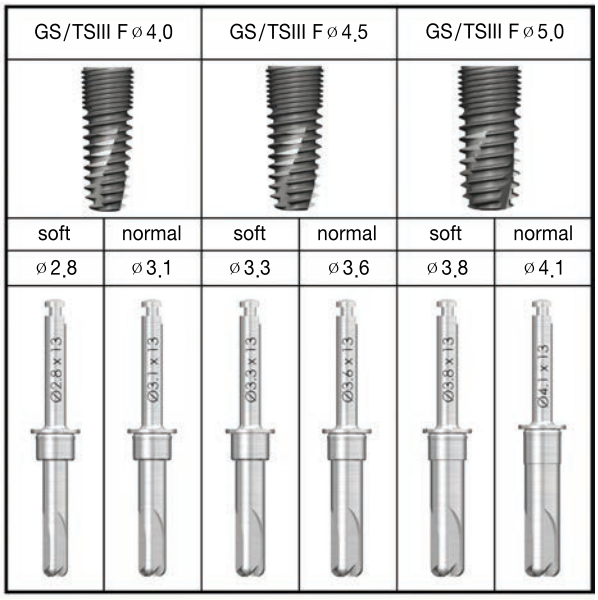


Fig. 3-44. Select final CAS-drill depends on implant diameter to be placed and bone density.

① 2.0mm twist drill

The initial 2.0mm twist drill is designed to allow efficient bone cutting and advancing for initial drilling. Being able to connect the stopper provides safety. **(Fig. 3-45)**

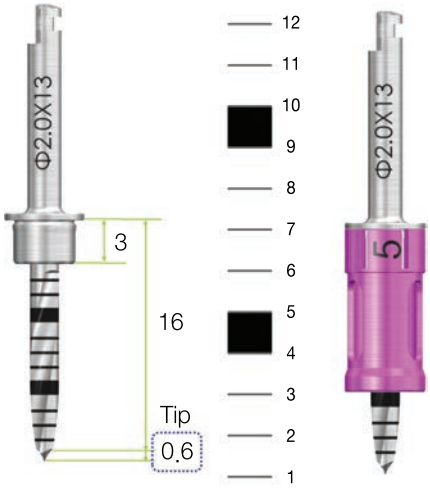


Fig. 3-45. Features of 2.0mm twist drill.

② Stopper system

The stoppers are an essential component for force and depth control during drilling. Depending on the length of protrusion of the lower part of the CAS-drill when the stopper is connected, there are 11 types from 2.0mm to 12.0mm, with 1.0mm intervals. For distinction purposes, they have also been color coded. The stopper can be connected not only to CAS-drill, but also to 2.0mm twist drill, to Depth gauage, to Bone spreader, and to Bone condenser and support each tool. **(Fig. 3-46)**

Fig. 3-46. The CAS-KIT has 11 types of stoppers from 2.0mm to 12.0mm, with 1.0mm intervals.

③ Hydraulic lift system

This component uses hydraulic pressure to widely separate the sinus membrane and drastically increase contact area between bone substitute and original host bone. CAS-Kit's hydraulic lift system is simple in composition, easy to manipulate, and allow efficient separation of the membrane. The silicone Membrane lifter presses against the hole of the drill prevents leakage. The silicone tube connects the Membrane lifter and the disposable syringe, and allows sterilization with autoclave. A disposable syringe with capacity of 3.0cc is suitable. **(Fig. 3-47)**

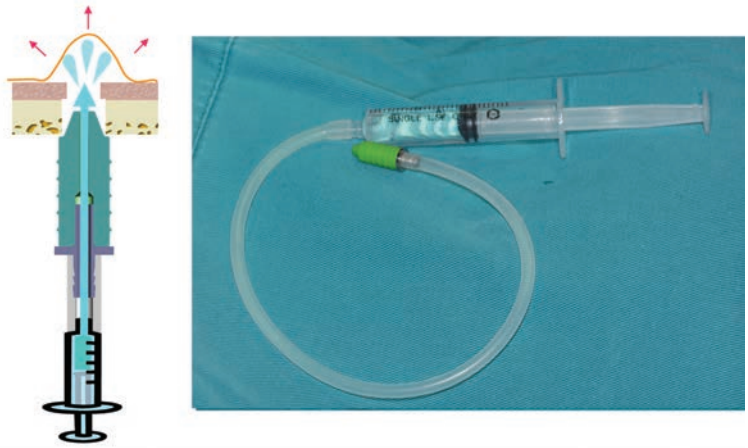


Fig. 3-47. Hydraulic lift system in the CAS-KIT is very simple and effective.

④ Depth gauge

The Depth gauge is used to check the penetration of the sinus floor and the perforation of the membrane. The stopper connected provides safety. The diameter of the lower part is slightly bigger, and can be caught in the sinus floor margin. Hence, whether the sinus floor has been penetrated becomes easy to check, and its round tip decreases the risk of perforation even when directly contacting with the membrane. **(Fig. 3-48)**

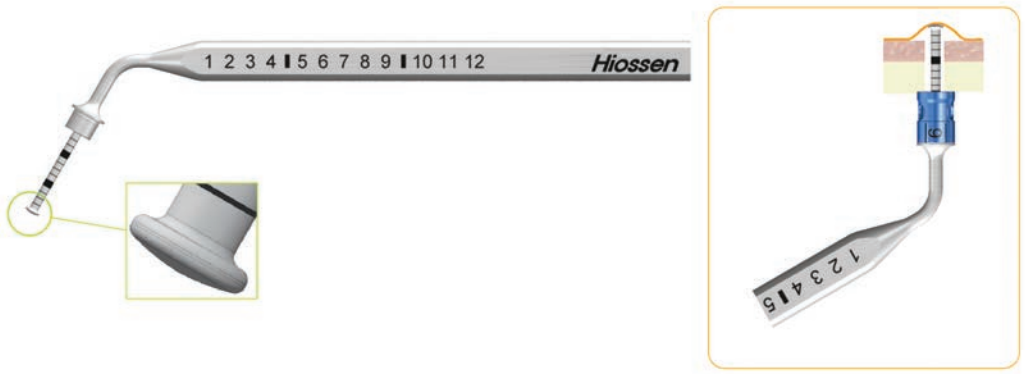


Fig. 3-48. Depth gauge to check the penetration of the sinus floor

⑤ Bone spreader

The bone spreader is used to widely spread the grafted bone substitute in the maxillary sinus. The rotation of the flag attached in the unilateral side spreads the bone substitute sideways. Connect the same stopper which was used to penetrate the sinus floor. Slow speed of 50~100rpm is recommended. The use of Bone spreader becomes optional if the hydraulic lift system successfully widely separates the membrane, because the bone substitute is likely to spread sideways on its own. **(Fig. 3-49)**

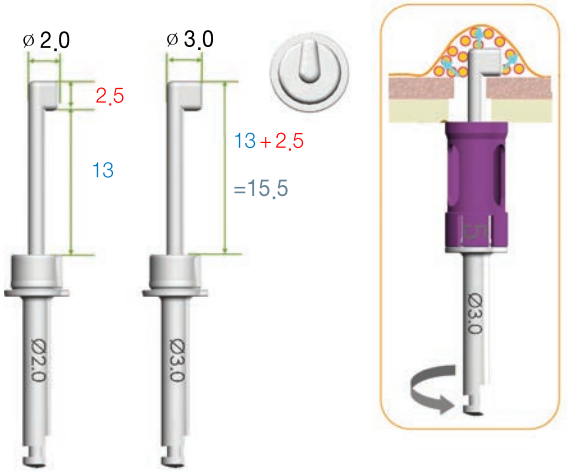


Fig. 3-49. Bone spreader to spread bone graft material.

⑥ **Bone carrier & Bone condenser**

This tool inserts bone substitute to the maxillary sinus, and is located at the lower floor of the CAS-KIT. The stopper used during the penetration of sinus floor should be connected for safe and effective bone grafting. **(Fig. 3-50, 51)**

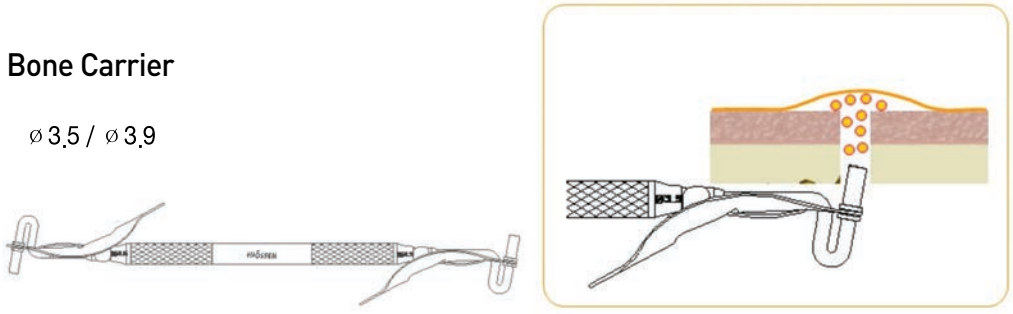


Fig. 3-50. Bone carrier.

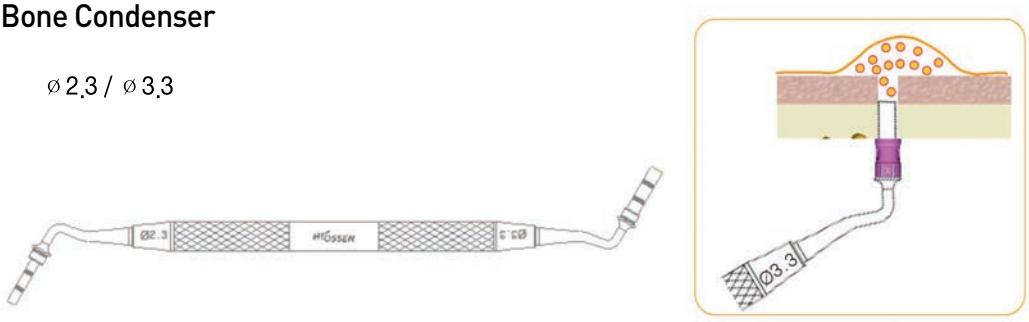
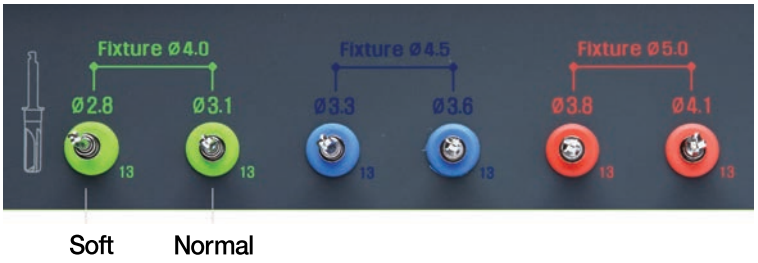


Fig. 3-51. Bone condenser.

2) Surgical procedure using the CAS-KIT

The procedure requires the selection of order and diameter of final drill depending on patient's bone quality and diameter of implant to be placed. The Guide drill marks the implant position, and 2.0mm twist drill is used first. In soft bone density, CAS-drills with diameters of 2.8mm, 3.3mm, and 3.8mm and in normal bone density CAS-drills with diameters of 3.1mm, 3.6mm, and 4.1mm are used. Consequently, the final drill's diameter is 1.2mm smaller than that of the implant in soft bone, and 0.9mm smaller in normal bone. Such recommendations are to avoid complications during operating procedures and easily drill, and are not strict necessities. The operator may adapt according to the type of implant and his/her judgment. **(Fig. 3-52)**



Fixture Selection		Twist Drill	CAS-Drill					
F(ø)	Bone Density	ø2.0	ø2.8	ø3.1	ø3.3	ø3.6	ø3.8	ø4.1
ø4.0	Soft	▶	▶					
ø4.5	Soft	▶	▶		▶			
ø5.0	Soft	▶	▶				▶	
ø4.0	Normal	▶		▶				
ø4.5	Normal	▶		▶		▶		
ø5.0	Normal	▶		▶				▶

Fig. 3-52. Surgical procedure requires the selection of order and diameter of the CAS-drill depending on patient's bone quality and implant diameter.

3) Example of Crestal approach sinus bone graft using the CAS-KIT

The following is an example treatment of left maxillary first molar missing case:

(1) Remaining bone height is determined via diagnosis with panoramic view or CT image. The bone height was 7.0mm in this example. It is better to be aware of the fact that the initial location and direction of the drill may affect the depth of drilling. **(Fig. 3-53)**

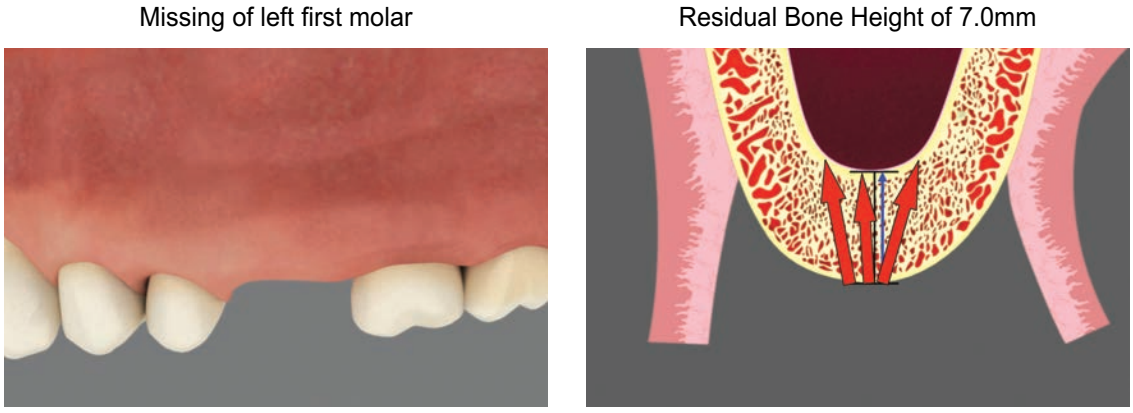
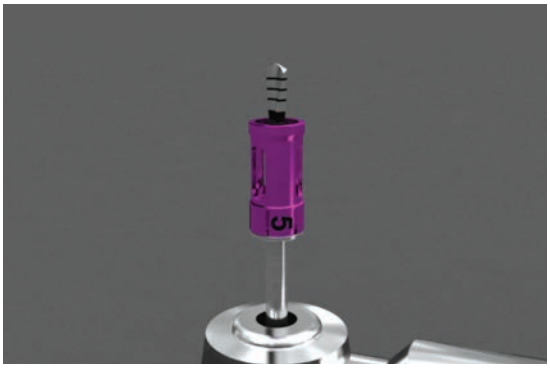


Fig. 3-53. Missing of left first molar with residual alveolar bone height of 7.0mm

(2) Marking with the guide drill, an adequately sized stopper is attached to the ø2.0mm twist drill. To ensure safety, the stopper length is 2.0mm shorter than the residual alveolar bone height. Therefore, 5.0mm Stopper was selected and connected to the ø2.0mm Twist drill. The recommended drilling speed is 800 rpm. **(Fig. 3-54)**

ø2.0 Twist Drill with 5.0 Stopper



ø2.0 Twist Drill with 5.0 Stopper (800~1,500rpm)

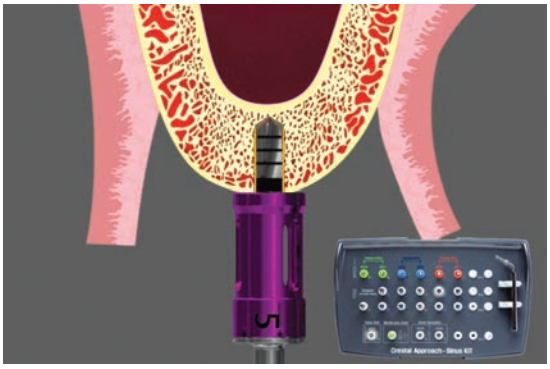
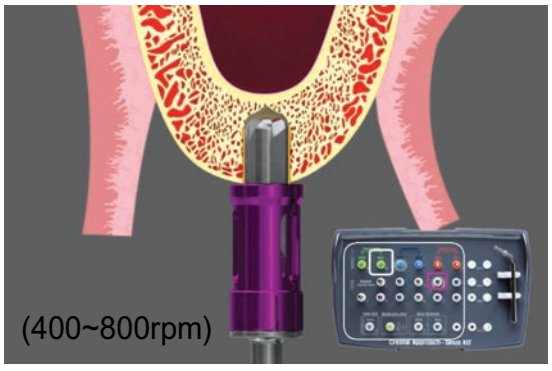


Fig. 3-54. For safety, 5.0mm Stopper was connected to the ø2.0mm Twist drill for initial drilling.

(3) Switch to 3.1mm CAS-drill, and attach 5.0mm Stopper to increase the diameter of the drill hole. Drilling speed of 800rpm is recommended. The suggested final drill diameter differs on the bone quality. Assuming normal bone density for demonstration purposes, the final drill is the ø3.6mm CAS-drill. Switch to ø3.6mm CAS-drill, connect 5.0mm Stopper, and enlarge the drill hole diameter. **(Fig. 3-55)**

ø3.1 CAS-Drill with 5.0 stopper



ø3.6 CAS-Drill with 5.0 stopper

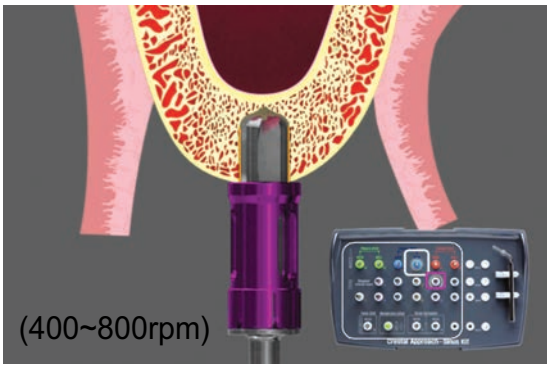


Fig. 3-55. Switch to ø3.1mm CAS-drill and ø3.6mm CAS-drill with 5.0mm Stopper to enlarge the drill hole.

(4) After enlargement using the final drill, the drill needs to be advanced to penetrate the sinus floor. 6.0mm Stopper is connected to the ø3.6mm CAS-drill, and 1.0mm is advanced. Drill may be high speed of 400~800rpm, or low speed of 50~100 rpm. High speed is recommended for rapid operation or cases with hard bone density, and low speed is recommended for securing safety and clearly feeling the penetration of sinus floor during operation. **(Fig. 3-56)**

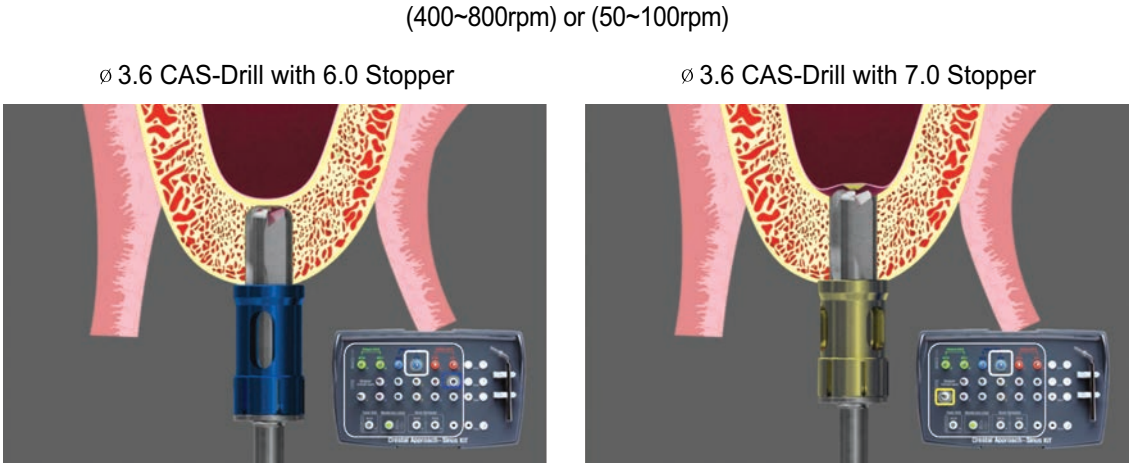


Fig. 3-56. After enlargement, change the stopper and advance the CAS-drill until penetrate the sinus floor.

(5) The operator should utilize Depth gauge during operation to ensure penetration of the sinus floor. Connecting the stopper is highly recommended for safety when using the Depth gauge. For precise examination, the stopper should be 1.0mm shorter than the one previously used for the CAS-drill. For example, if a 6.0mm Stopper was used for the CAS-drill, a 7.0mm Stopper for the Depth gauge is recommended. Advance the ø3.6mm CAS-drill with the Stopper increasing by 1.0mm until the sinus floor is penetrated. Experience suggests successful penetration with 8.0mm Stopper when radiographic imaging identifies the remaining bone height to be roughly 7.0mm. **(Fig. 3-57)**

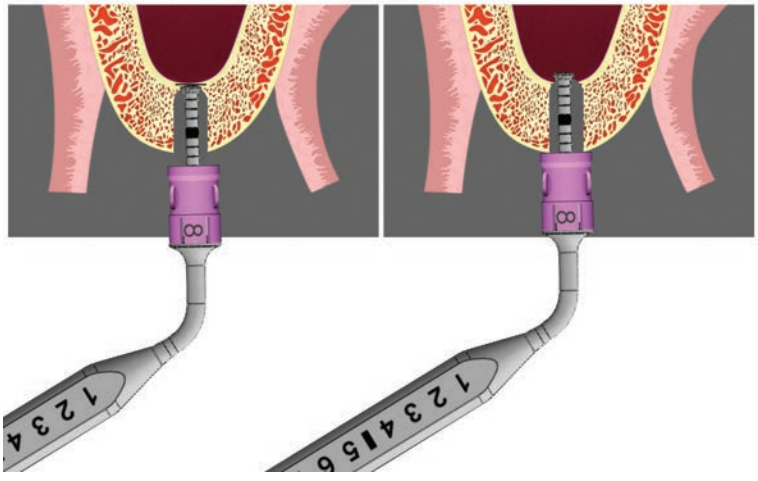


Fig. 3-57. Use depth gauge with stopper to check penetration of the sinus floor during advancement.

(6) When the sinus floor has been penetrated, check the sinus membrane for perforations. Valsalva's maneuver is commonly used. Pinch the patient's nose and ask the patient to blow his/her nose, and check if any air leaks. Crestal approach sinus bone graft can only be successful without perforation of the sinus membrane. **(Fig. 3-58)**

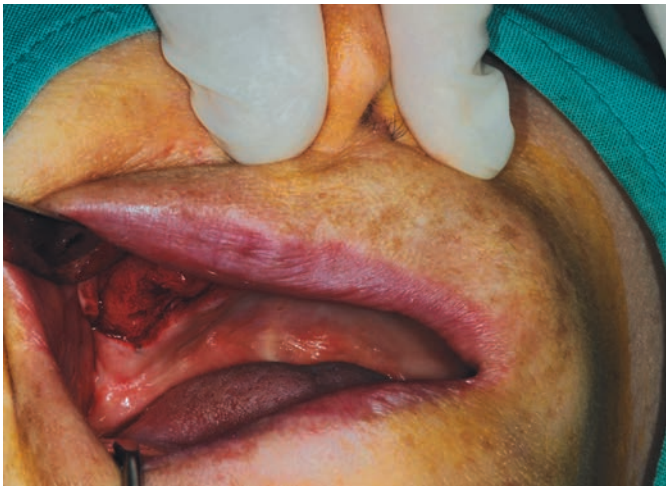


Fig. 3-58. Valsalva's maneuver to test membrane perforation.

(7) If the sinus floor has been penetrated and there is no perforation, use the hydraulic lift system to separate the sinus membrane. The sinus floor may be partially penetrated in inclined planes or septums, but hydraulic lifting is immediately performed regardless. A 3.0cc disposable syringe is filled with a moderate amount of normal saline or the patient's blood, leaving no room for air. Using 1.0~2.0cc for cases with single tooth missing, and 3.0cc for cases with multiple teeth missing is recommended. **(Fig. 3-59)**

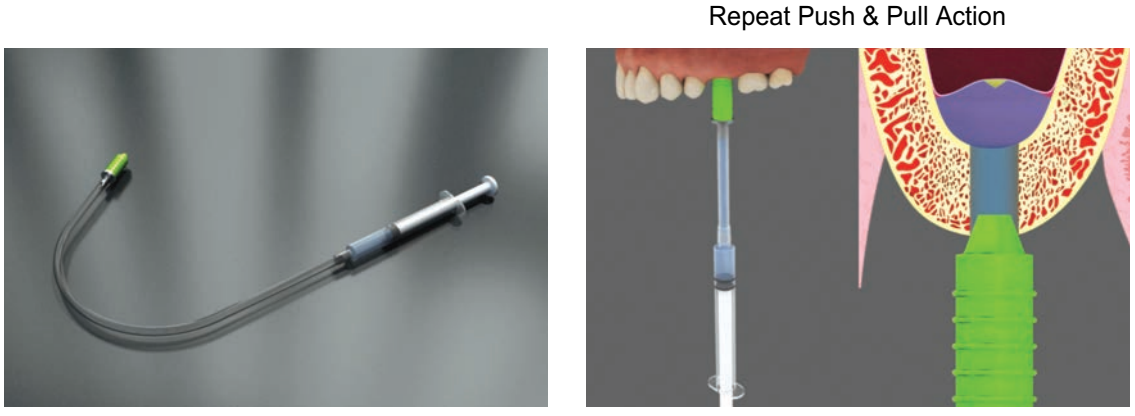


Fig. 3-59. Use the hydraulic lift system to separate the sinus membrane.

Press the Membrane lifter against the drill hole tightly, and slowly inject 0.5cc of normal saline. Then eject the saline. If all goes well, the saline should mix with blood and turn reddish when retrieving. **(Fig. 3-60)**

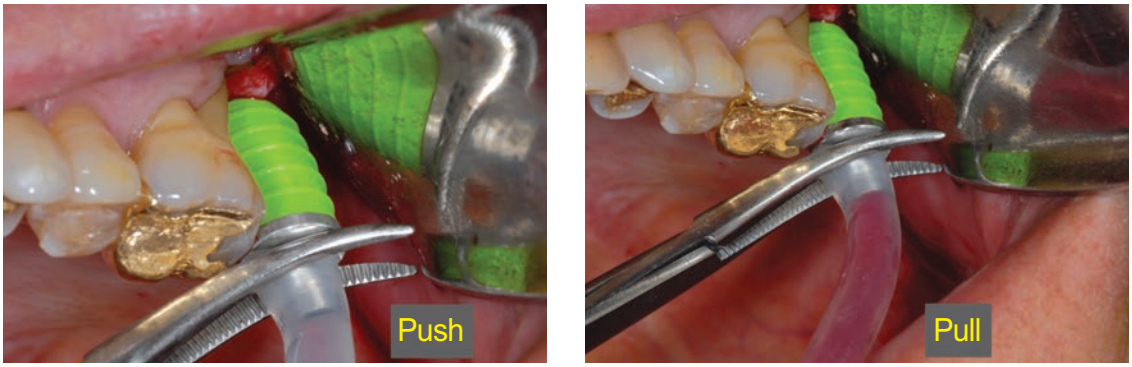


Fig. 3-60. Reddish discoloration of the saline indicates successful hydraulic lifting of the membrane.

If retrieval of saline fails, a leakage or a perforation in the sinus membrane can be suspected. Increase the amount to 1.0cc, slowly inject, and retrieve. Repeat the process increasing the amount of saline to slowly separate the sinus membrane. The membrane should be sufficiently elevated. Sometimes injecting too much saline can result in patients complaining pain, because the unanesthetized membrane may be elevated as well.

(8) Insert bone substitute after hydraulic lifting without any membrane perforations. Using the Bone carrier, graft adequate amount of bone substitute into the drill hole. The Bone condenser is used to push in the bone substitute, and is crucial to use the last stopper to ensure safety. The final graft material's height is decided not by the amount of saline, but by the amount of bone substitute. The amount of bone grafting depends on the patient's size of the maxillary sinus and structure, but elevating 1.0mm of the sinus floor generally requires 0.1~0.2cc of bone substitute. **(Fig. 3-61)**

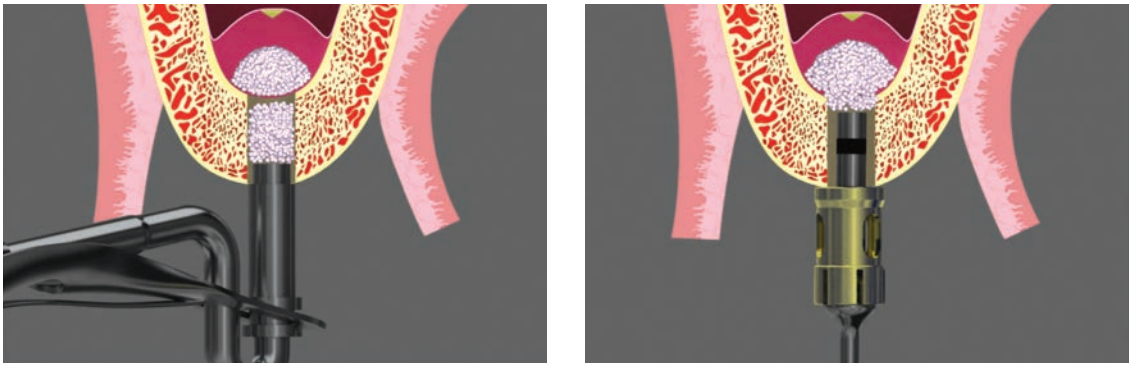


Fig. 3-61. Insert bone graft material in to the sinus.

(9) The bone spreader can be used to effectively spread the bone graft material. Connect the lastly used stopper, insert inside the maxillary sinus, and rotate in low speed (50~100rpm). This procedure is not necessary after sufficient elevation of the membrane using hydraulic pressure, but can be used to assist. **(Fig. 3-62)**

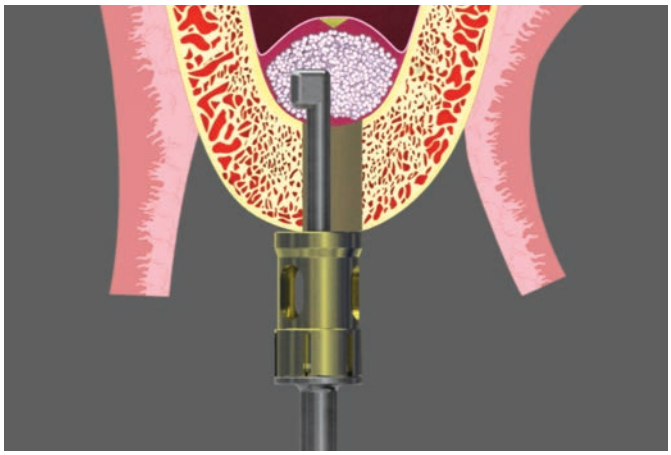


Fig. 3-62. Bone spread can spread graft material widely.

(10) Examine the amount of bone grafting. If lacking experience and confidence, take panoramic radiography to check the height of grafting. If sufficient bone has been grafted, install an implant with adequate length and diameter. I, the writer, personally favor TSIII SA 4.5x10.0mm at the molar region. Control the depth, connect the cover screw or the healing abutment, and suture the flap to finish the operation. **(Fig. 3-63)**

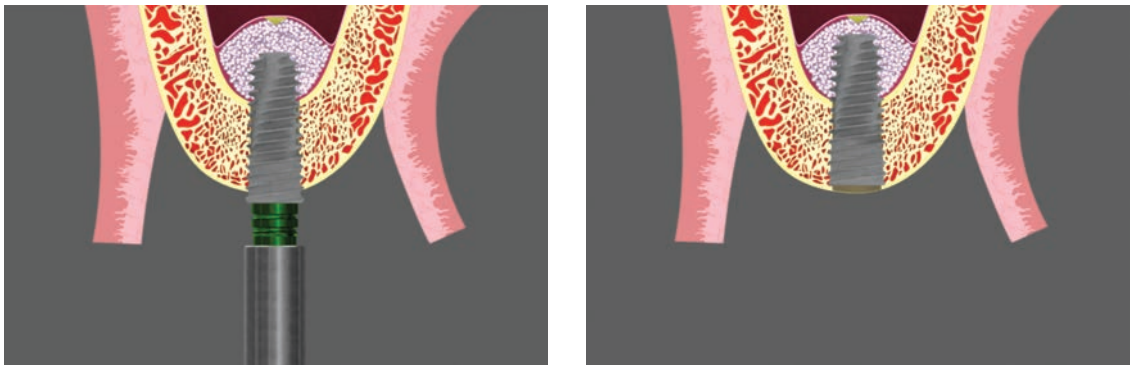
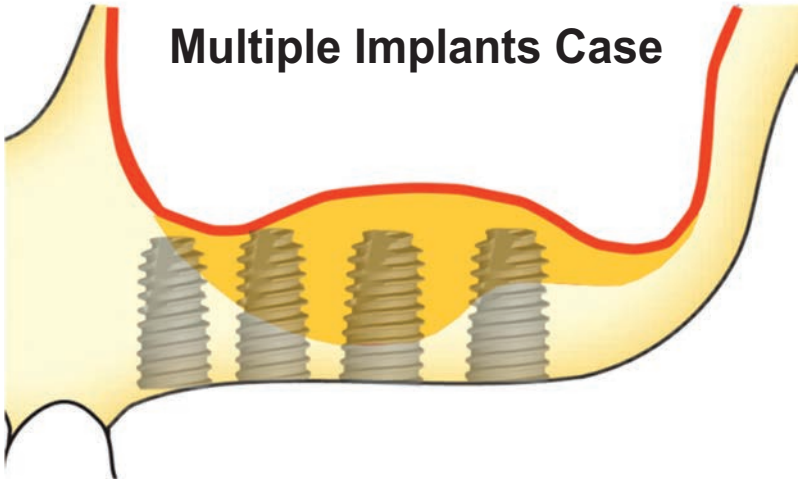


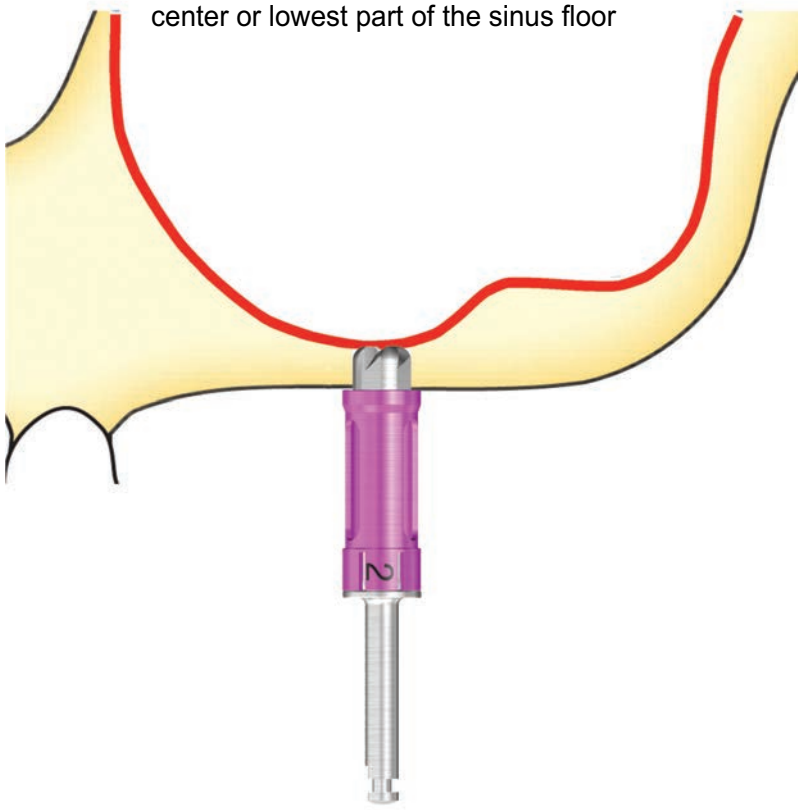
Fig. 3-63. Install appropriate implant after sufficient bone grafting.

4) Using the CAS-KIT in multiple implant placement cases

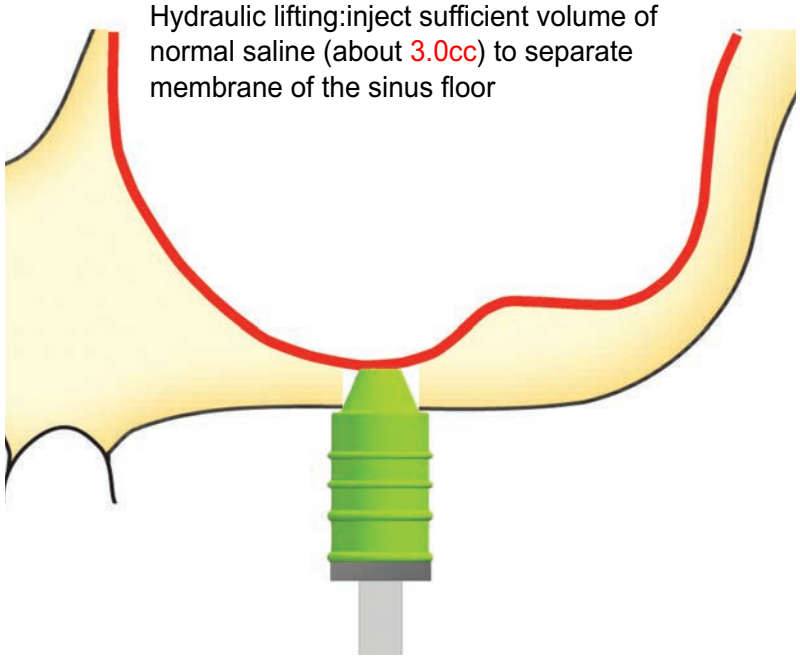
There are several tricks needed to most efficiently place multiple implants using the CAS-KIT. The sinus floor needs to be penetrated at a selected point using the CAS-KIT. After examining shape of the sinus floor, choose the lowest or the middle point for effective hydraulic lifting. Use the standard method to enlarge and advance the CAS-drill until the sinus floor is penetrated. After penetration, check for membrane perforations and proceed to hydraulic lifting. When performing hydraulic lifting, use enough saline to elevate the nearby membranes where the implants will be placed. For two or more implant placement, using over 3.0cc of normal saline is suggested. If the membrane has been sufficiently lifted, drill other implant placement sites. The CAS-drill, if possible, is a safe choice, and to speed things up, the simplified drilling technique can be adopted to swap both CAS-drill and Stopper simultaneously. In theory, if the first hydraulic lifting separates all membranes, there is no need to hydraulic lift in nearby holes. One can still perform hydraulic lift in other holes for safety measures, still. Check for membrane perforations, graft the bone substitute, and place an implant with adequate length and diameter. **(Fig. 3-64)**



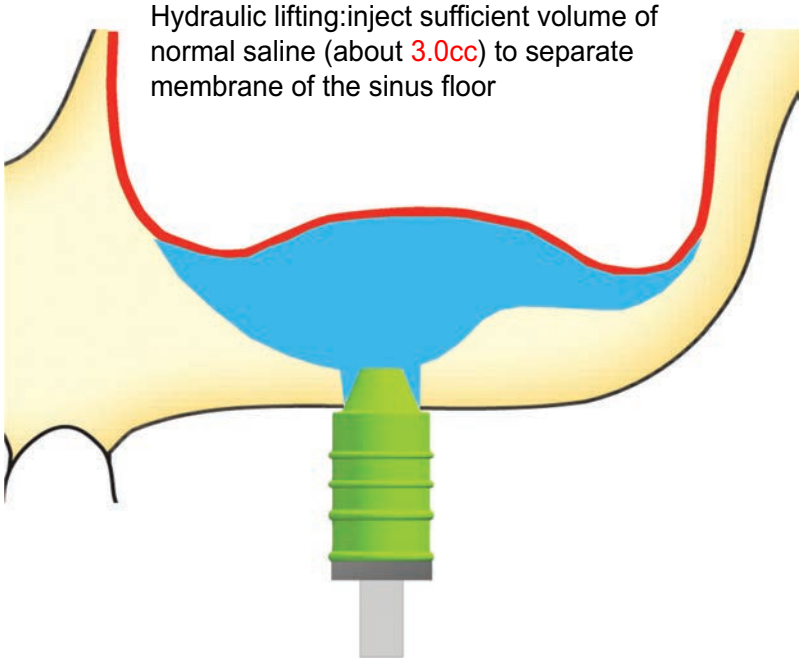
Initial drilling site can be positioned at the center or lowest part of the sinus floor



Hydraulic lifting:inject sufficient volume of normal saline (about 3.0cc) to separate membrane of the sinus floor

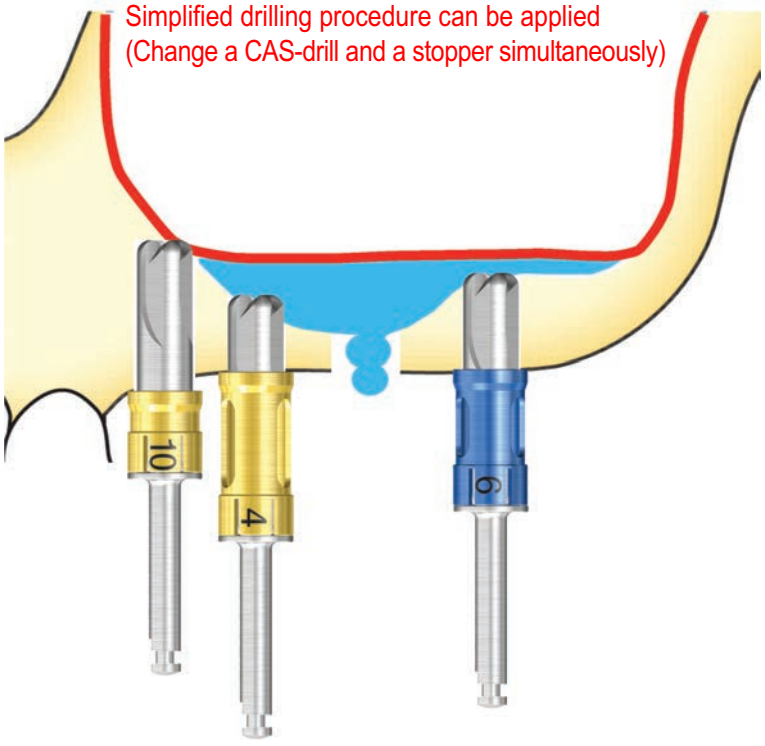


Hydraulic lifting:inject sufficient volume of normal saline (about 3.0cc) to separate membrane of the sinus floor



Following drilling sequencen can be safer and faster

Simplified drilling procedure can be applied
(Change a CAS-drill and a stopper simultaneously)



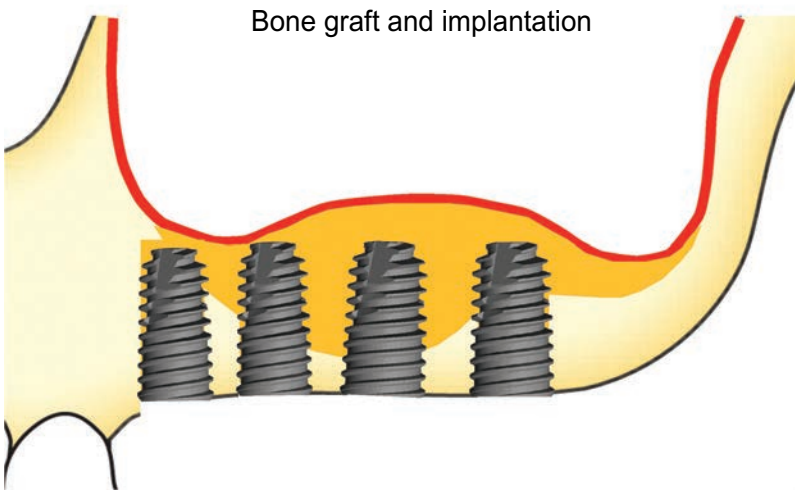


Fig. 3-64. Sequences of the CAS-KIT handling in multiple case.

5) Indication of the CAS-KIT

(1) The CAS-KIT, as a type of crestal approach sinus bone graft, should be used for remaining bone heights of 4.0mm or over. Articles suggest decrease in success rates for crestal approach sinus bone graft with remaining bone heights less than 4.0mm. The CAS-KIT is expected to yield better results in crestal approach sinus bone graft than osteotome technique, but a conservative disposition is nevertheless suggested until further research confirms so.

(2) Crestal approach sinus bone graft using the CAS-KIT is possible in common cases.
Especially, hard sinus floors or inclined planes that make fracturing with osteotome difficult are good indications for the CAS-KIT.

(3) Using the osteotome technique is difficult when the remaining bone height to the sinus floor is uncertain because it is difficult to decie the depth of drilling. Such cases lead to drill only shortly to avoid membrane perforations, and thus the sinus floor becomes difficult to fracture. The CAS-KIT, in such situations, allows trial and error method to advance in increments until the sinus floor is penetrated. Therefore, the CAS-KIT provides safety.

(4) The grooves in the sides of the CAS-drill collect autogenic bone when drilling. If collected well, it can also be utilized as autogenic bone graft material.

(5) Althought the CAS-KIT was developed for safe and rapid crestal approach sinus bone grafting, it can also be used in the mandible. When insufficient residual alveolar bone heights can potentially lead to nerve damage when placing implants in the mandible, the CAS-KIT can come in very handy. The Stopper allows perfect depth control, and the CAS-drill's structure is unlikely to grind and damage the nerves, hence avoiding permanent nerve damage.**(Fig. 3-65)**

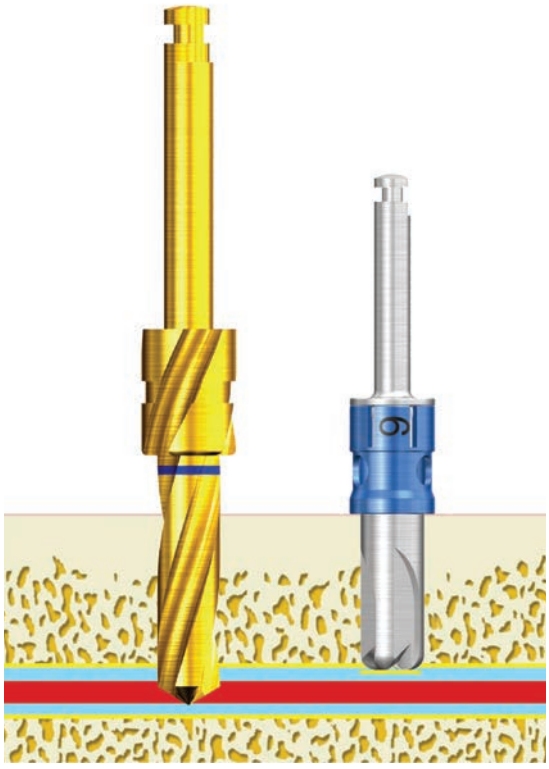
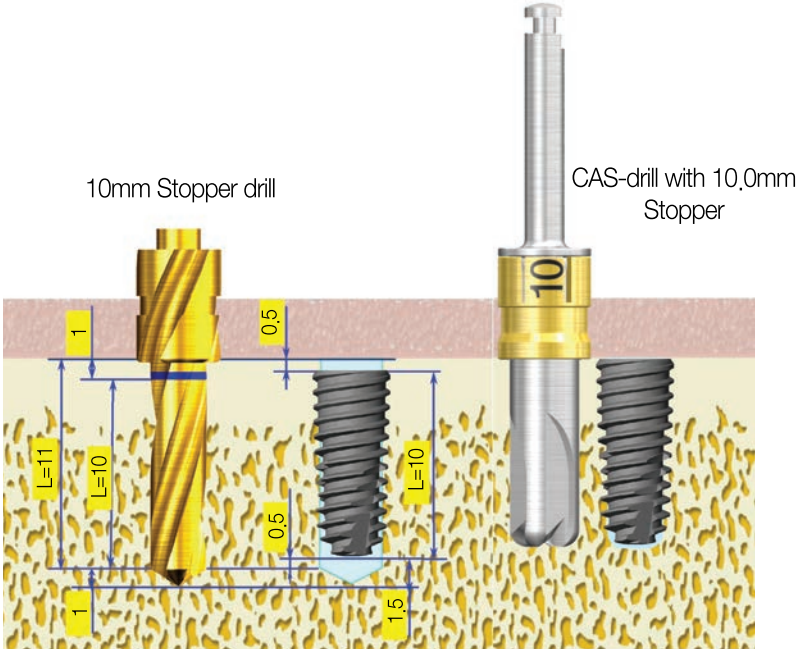


Fig. 3-65. The CAS-KIT can be applied in case of insufficient alveolar bone height in mandible to avoid nerve damage.

In mandible with hard bone density, the drill speed is set to high speed of 1,500rpm and is used under copious saline irrigation. Placing an implant at least 1.0mm shorter than the last stopper is advantageous for depth control when using the CAS-drill to place implants in the mandible. **(Fig. 3-66)**



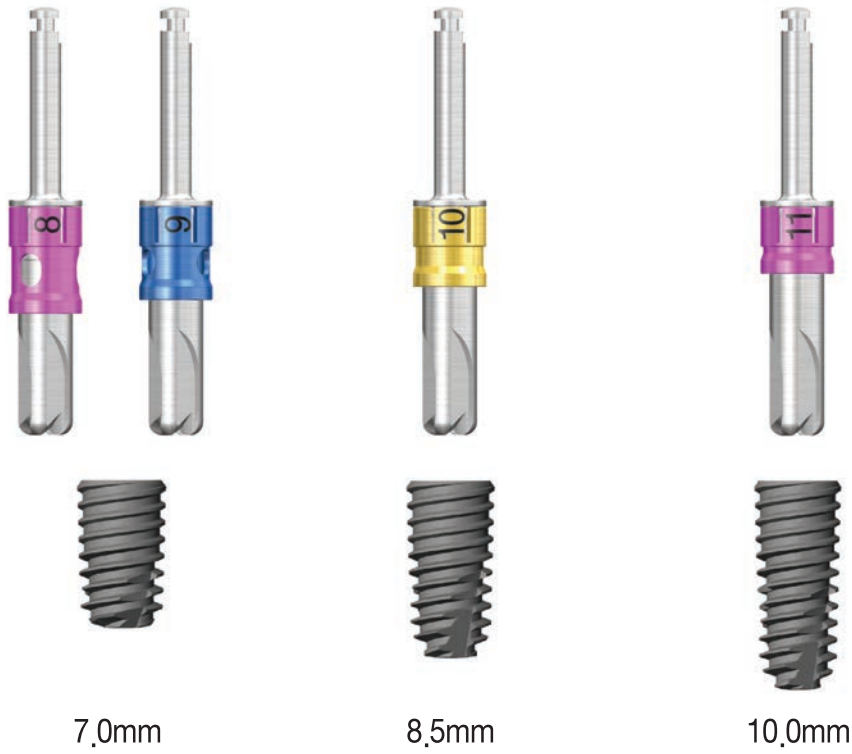


Fig. 3-66. Place an implant at least 1.0mm shorter than the last stopper when using the CAS-drill in the mandible.

6) Advantages of the CAS-KIT

(1) The CAS-KIT rapidly and safely penetrates the sinus floor. It provides better cutting ability than other similar sinus surgery kits, allowing simple penetration of the sinus floor. Its grinding ability is superb even in low speeds, and its unique structure decreases risks of membrane perforation even in high speeds.

(2) The stopper system provides impeccable depth and force control. Compared to kits of the competitors, the composition and identification of the stoppers is outstanding.

(3) The hydraulic lift system of the CAS-KIT is also excellent. Wide separation of the sinus membrane for crestal approach sinus bone graft is necessary for safe and successful bone regeneration.
This system allows simple yet efficacious means for such purpose.

(4) If desired, the CAS-drill can collect autogenic bone.

(5) The CAS-drill's durability and outstanding cutting power is good enough to be used in the mandible.
The ability to avoid nerve damage is an even greater benefit than making easy maxillary sinus bone grafting.

2. The LAS(Lateral Approach Sinus)-KIT

Despite the relative simplicity, easiness, and increase in development of fine tools for crestal approach sinus bone graft technique, clinicians nevertheless face cases that require them to perform lateral window approach sinus bone graft technique, in which they must approach laterally, open a bone window, approach the sinus membrane, elevate the sinus membrane and then bone graft. The lateral window approach sinus bone graft technique is a more predicatable surgical method when the remaining bone height is less than 4.0mm, potential pathology may exist inside the sinus maxillary, or the structure of the sinus floor or the remaining bone is complex. **(Fig. 3-67)**

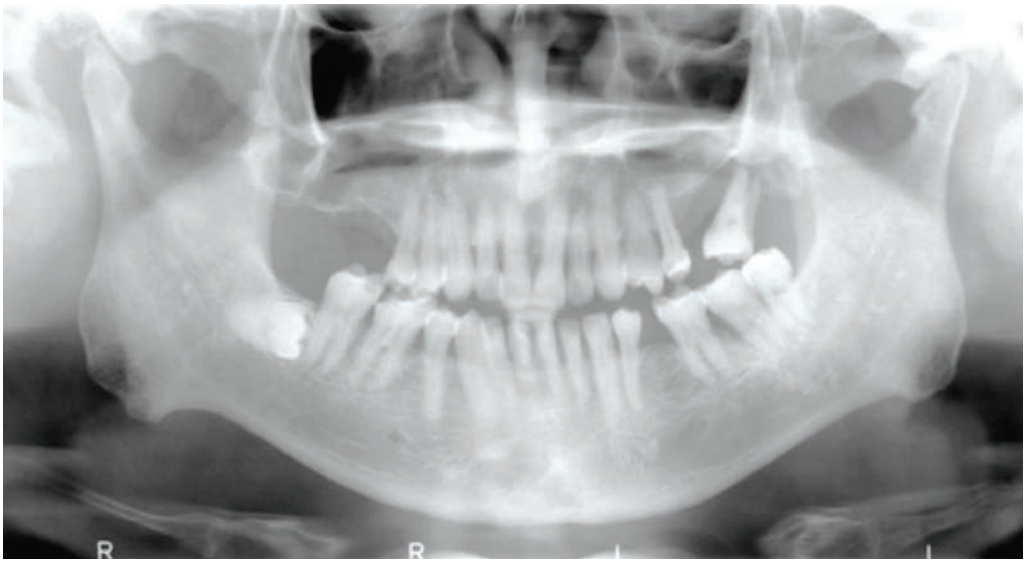


Fig. 3-67. Generally, lateral approach sinus bone graft technique is recommended for residual alveolar bone height less than 4.0mm.

It is not an easy surgery, as it requires more knowledge and surgical technqiues compared to the crestal approach sinus bone graft technique, not to mention the greater number of variables that may complicate situations. To be able to perform lateral window approach sinus bone grafting with ease, knowing related information about maxillary sinus bone grafting and attaining basic surgical skills is necessary. Freely use good tools, material and observe and learn from experts. Know your own skill level, and accumulate experience beginning from patients with simple cases. The lateral window approach sinus bone graft technique requires multiple steps of operation. Beginning with incision, the operator needs to elevate the flap, open a bone window, separate the sinus membrane, drill for implant placement, bone grafti in the maxillary sinus, place the implant, and finally suture the membrane. Each step requires related knowledge, proper tools, and specific surgical skills. Opening the sinus bone window safely is an important step.
Depending on the operator's preference, high speed handpiece with round diamond bur, straight low speed handpiece with carbide bur, straight low speed handpiece with diamond bur, piezoelectric surgery, or other tools may be used. Grinding the sinus wall effectively while leaving the sinus membrane intact is important. Beginners of lateral approach sinus bone graft face the first challenge in this step. The CAS-KIT has been developed for crestal approach sinus bone graft in cases with remaining bone heights of 5.0mm or over, and

tools have also been developed to perform lateral window approach sinus bone graft in cases with remaining bone heights of 4.0mm or less. There are not many compared to kits developed for crestal approach sinus bone graft, but some companies still develop such tools. Ideal requirements for such tools are as follows:

(1) A tool fit for sinus bone grafting via lateral window approach needs special drills structured so that the sinus wall can be rapidly and easily penetrated without tearing the sinus membrane.

(2) A stopper system is needed for depth and force control during drilling.

(3) There needs to be a tool that can easily modify the bone window.

(4) The kit needs to be simple in composition, its surgical procedure simple, durable, and be affordable.

1) LAS instrument

Osstem's LAS-KIT is an excellent tool for lateral window approach sinus bone graft that meets the above criteria. **(Fig. 3-68)**

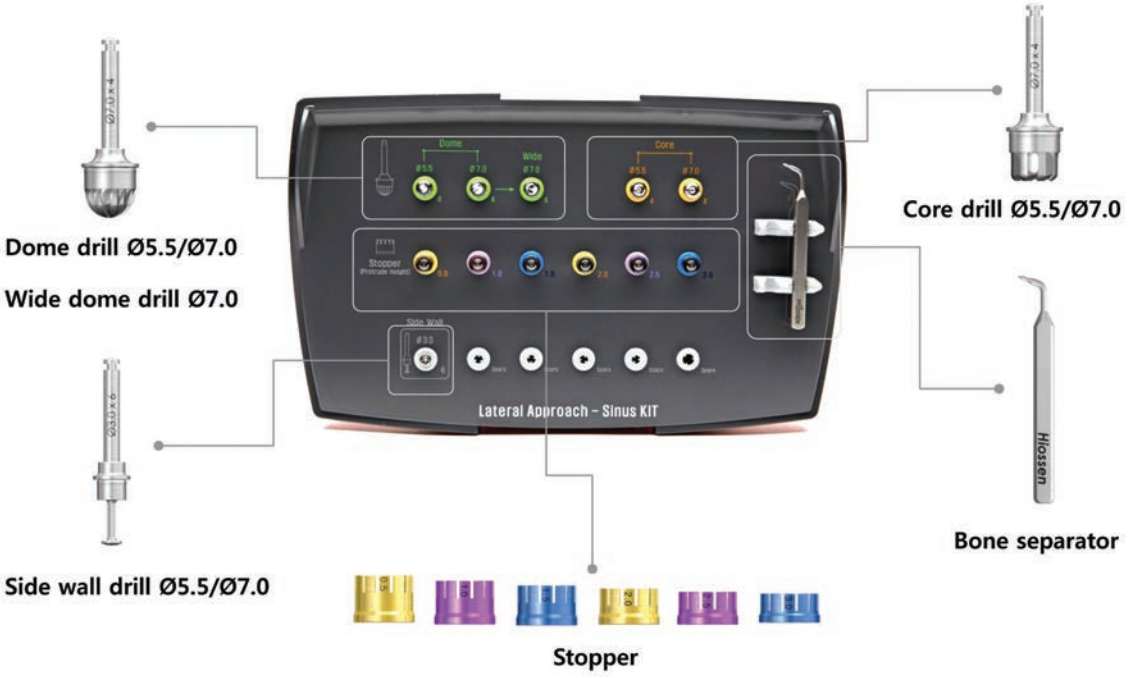


Fig. 3-68. The LAS-KIT.

LAS-KIT possesses two tools to open a bone wall. The Dome drill reveals the sinus membrane by grinding the bone wall, and the Core dril creates a round bone window in the sinus wall. **(Fig. 3-69)**

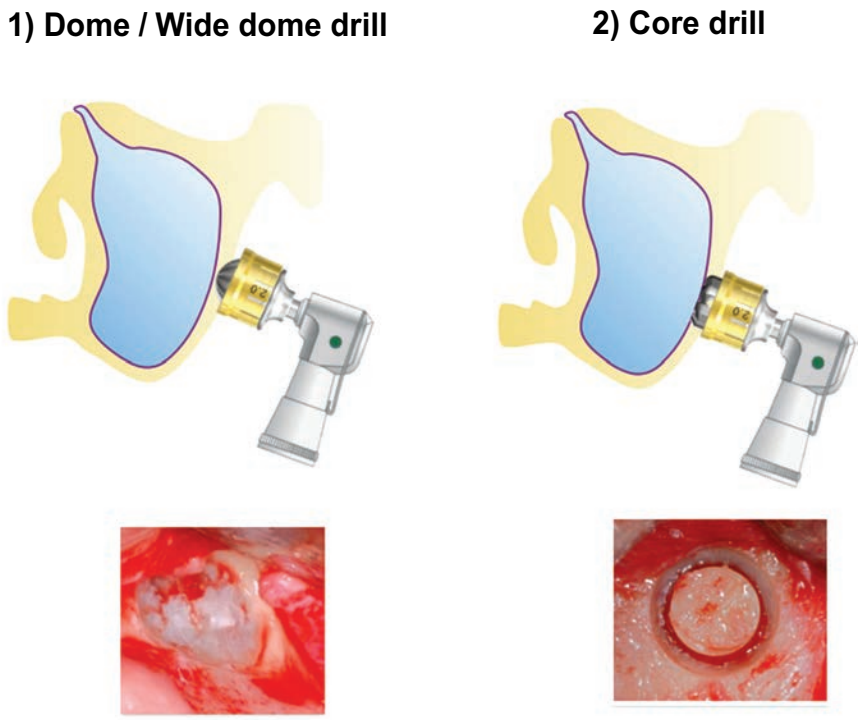
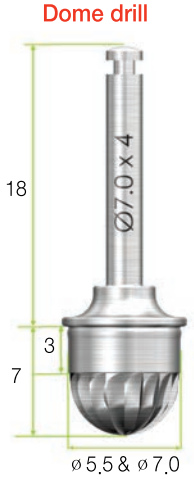


Fig. 3-69. The Dome drill reveals the sinus membrane by grinding the bone wall, and the Core drill creates a round bone window in the sinus wall.

There two types of the Dome drill, ø5.5 and ø7.0. An adequate length of Stopper is connected, and the sinus membrane is approached by grinding the sinus lateral wall at a high speed of 1,200~1,500rpm. Compared to similar tools of other companies, Osstem's Dome drill provides excellent grinding ability and only little vibration and slipperiness when contacting the bone wall. The Dome drill leaves a thin layer of bone without fully drilling the sinus wall, and this thin layer prevents direct contact with the sinus membrane and thus protects it from being ground as well. **(Fig. 3-70)**



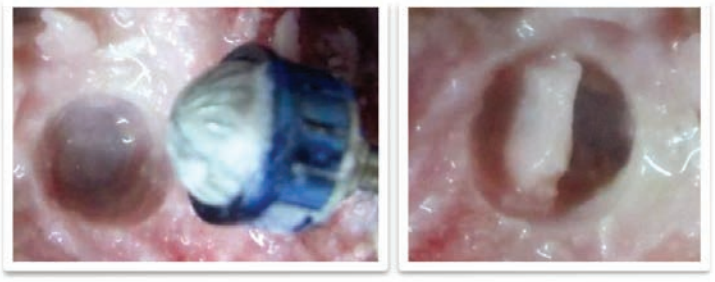


Fig. 3-70. The Dome drill provides excellent grinding ability and little vibration and slipperiness when contacting the bone wall.

The Wide dome drill is used to enlarge the bone window opened by the Dome drill. Connecting the stopper, the drill is pressed against the opened bone window and pushed to the direction enlargement is desired **(Fig. 3-71)**

Fig. 3-71. The Wide dome drill is used to enlarge the bone window

There are two types of the Core drill as well, ø 5.5 and ø 7.0. An adequate length of Stopper is connected, and the sinus memebrane is approached by creating a round Core on the sinus wall at a high speed of 1,200~1,500rpm. Osstem's Core drill's tip is round yet short, and provides superb cutting ability **(Fig. 3-72)**

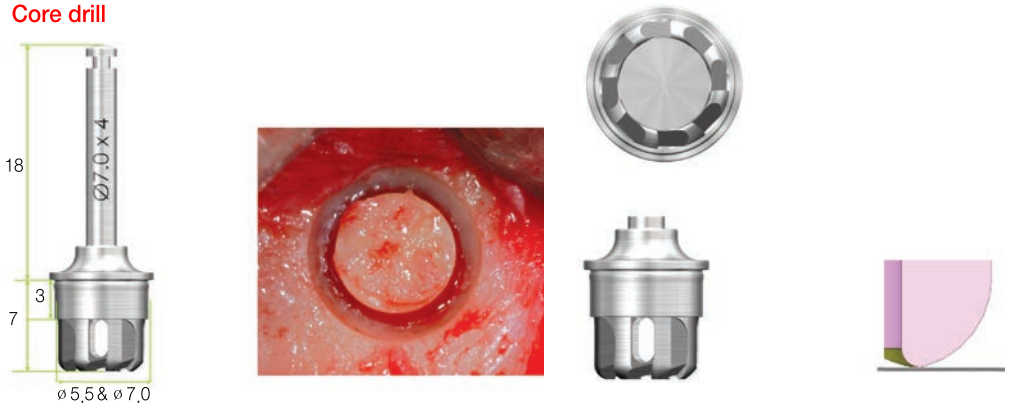


Fig. 3-72. The Core drill approach to sinus membrane by creating a round core on the sinus wall.

In addition compared to tools of competitors, it shows less vibration when contacting the sinus wall and connected stopper provides safety when penetrating the sinus wall. The Dome drill attaches a Stopper 0.5mm~1.0mm shorter than the expected thinkness of the sinus wall and advances incrementally by 0.5mm. When the membrane is visible, an adequate tool is used to fracture outwards and reveal the membrane.
The shortest Stopper connected to the Dome drill or the Core drill protrudes 0.5mm, and others increase incrementally by 0.5mm until 3.0mm. It is color coded in repeating yellow, purple, and blue for easy distinction.**(Fig. 3-73)**

Fig. 3-73. The LAS-KIT stoppers.

The Side wall drill is used to soften the bone window magin or enlarge the bone window after use of Dome drill. The CAS-KIT Stopper is also compatible **(Fig. 3-74)**

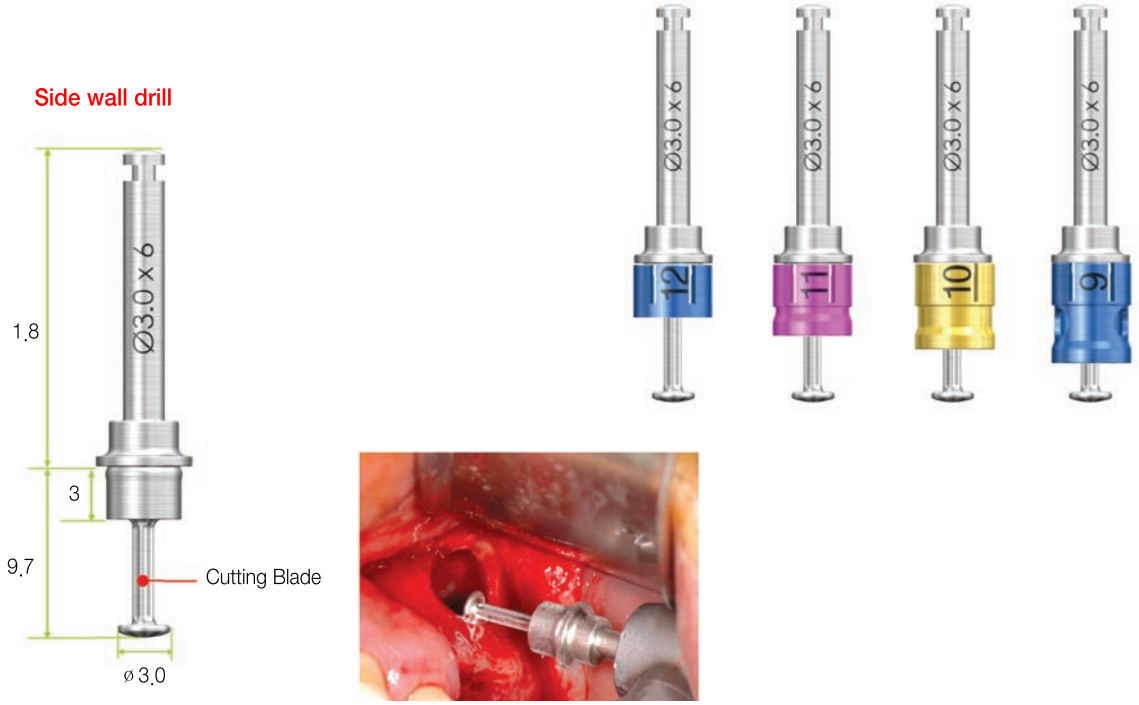


Fig. 3-74. Side wall drill.

If the bone window is stuck to the Core drill after opening, the Bone separator can separate it **(Fig. 3-75)**

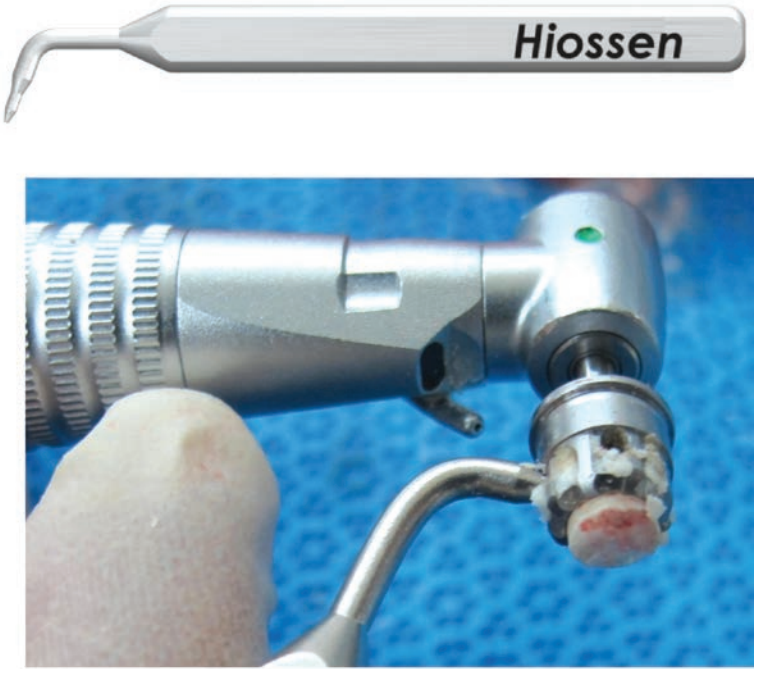


Fig. 3-75. Bone separator.

2) Summary of utilizing the LAS-KIT :

(1) Diagnosis is crucial in maxillary sinus bone grafting. If possible, take a CT to evaluate the thickness of the latera wall, position of the artery, and the conditions of the sinus membrane to plan the surgery.

(2) The LAS-KIT allows easier and safer creation of the bone winow. The Dome drill is superb in protecting the membrane, and can be helpful to beginniners. Downfalls exist, however. It is time consuming to grind away the sinus wall, and the missing bone window needs to be repaired with substitutes.

(3) The Core drill preserves the bone window, and allows repositioning. To prevent membrane damage, only advancing until the membrane is visible and fracturing the bone window is recommended, not penetrating the sinus wall completely.

(4) While experts may be able to operate with only one bone window opened with Core drill or Dome drill, beginners may feel uncomfortable working with only one bone window. In such cases, open an additional bone window, or enlarge the bone window with the Wide dome drill.

3. Guided Bone Regeneration Using the Smartbuilder – By Dr. Lee, Dae-Hee

Titanium is characterized with strong mechanical stability which enables space making, provides resistance to external force as well as the ability to supply blood and nutrient through its multiple pores, allowing penetration of nonosteoid tissue and dense connective tissue formation which can protect regenerated bone when titanium mesh is exposed. Many senior scholars such as von Arx, Lozada, Schopper, Prossafaes, and Roccuzo etc. have reported these advantages with numerous articles. However, titanium mesh is not commonly used despite such advantages because it has many disadvantages: its multiple pored structure enables soft tissue infiltration which decreases the function of GBR membrane, is difficult to bend because of its stiffness, frequently exhibits dehiscence phenomenon of soft tissue after surgery, and requires wide flap elevation to remove it. On the contrary, some clinicians continuously have been using titanium mesh considering its strong space making advantage which ensures bone cell growth not from periosteum but from bone marrow of the defect area which can suppress its disadvantage of delayed bone formation due to infiltration of nonosseous tissue below the titanium mesh.

Company Osstem introduced Smartbuilder, a customized titanium mesh fit to individual bone defect type, which has about 0.08~0.1mm thickness. It is invented for clinicians who desire to easily use the titanium mesh for its space making advantage, while overcoming its several disadvantages. Usually, bending is not necessary because it is already 3-dimensionally bent, and shows better adaptation because of wrinkle free margin by controlling margin shape and pore size, and it is easy to remove after simple crestal incision.

1) Components and types of the SMARTbuilder

Its components are shown in the figure 3-76.. Connect the Height, a special attachment, to the fixture and hang over the Smart membrane over it. Smart membrane can be fixed with healing abutment or cover cap depending on non-submerged or submerged surgery. For example, you can perform non-submerged surgery using connecting healing screw. However, connect cover cap and perform submerged surgery in following cases: in 1 wall defect or vertical augmentation case which has wide or poor shape defect, in case with excessive bone graft, when initial stability of fixture is weak, and when patient' wearing temporary denture.**(Fig. 3-77)**

Fig. 3-76. Components of the SMARTbuilder

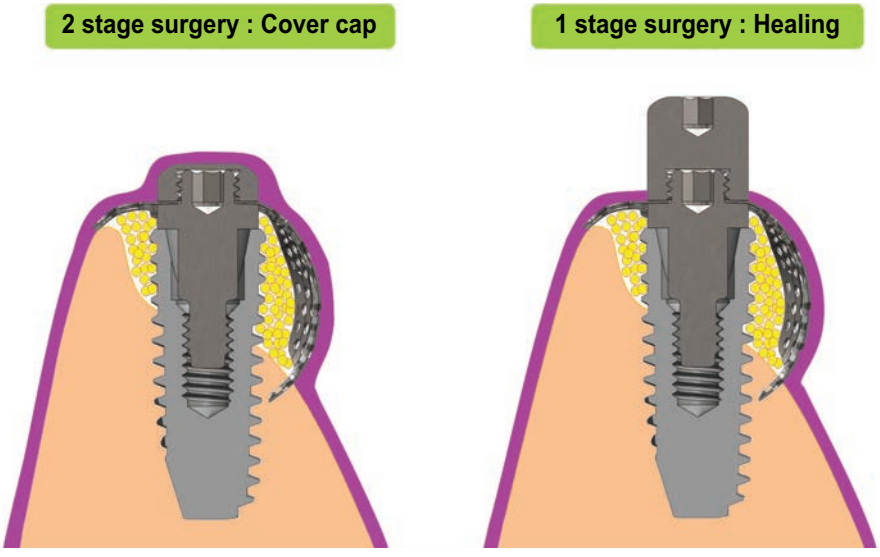


Fig. 3-77. Depending on clinical situations or type of bone defect, non-submerged or submerged surgery can be done.

Depending on bone defect type to be repaired, Smart Builders are categorized into three types: type 1 for 1 wall augmentation, type 2 for 2 wall augmentations, and type 3 for 3 wall augmentations. After determining basic type, select subtype by measuring proximal width, buccal width, and buccal length of the defect **(Fig. 3-78~84)**

< 1 wall augmentation >

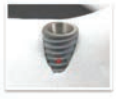
Fig. 3-78. Type 1 SMARTbuilder for 1-wall augmentation.

< 2 wall augmentation >

Fig. 3-79. Type 2 SMARTbuilder for 2-wall augmentation.

< 3 wall augmentation >

Fig. 3-80. Type 3 SMARTbuilder for 3-wall augmentation.



1 wall augmentation : 3 type

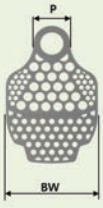
SMARTbuilder		P	BW	BL	BD
3D	Image				
		4	8	7	5.5
		4	10	7	5.5
		4	10	9	5.5

Fig. 3-81. 3 subtypes for 1-wall augmentation.

2 wall augmentation : 6 type

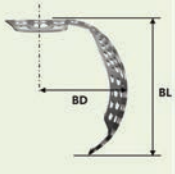
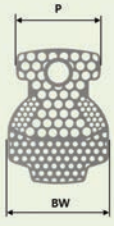
SMARTbuilder		P	BW	BL	BD
3D	Image				
		7	9	7	5.5
		7	9	9	5.5
		10	12	7	5.5
		10	12	9	5.5
		12	12	7	5.5
		12	12	9	5.5

Fig. 3-82. 6 subtypes for 2-wall augmentation.

3 wall augmentation : 6 type

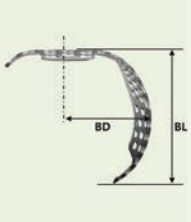
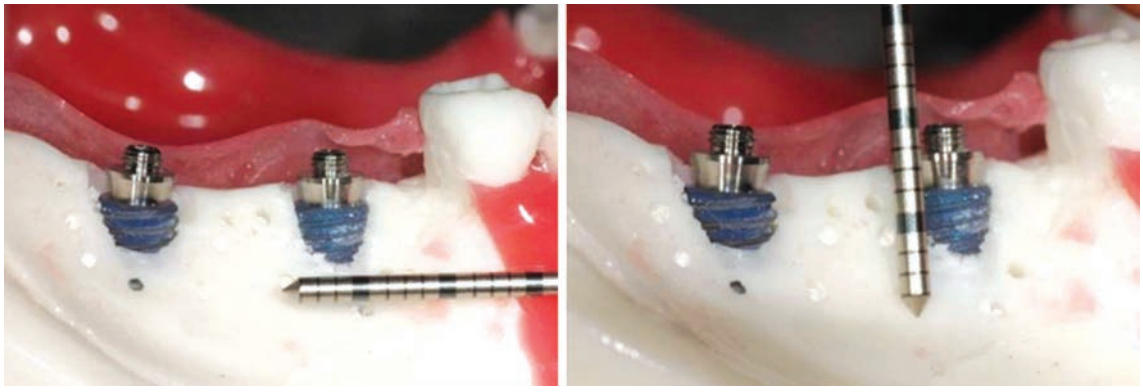
SMARTbuilder		P	BW	BL	BD
3D	Image				
		7	9	7	5.5
		7	9	9	5.5
		10	12	7	5.5
		10	12	9	5.5
		12	12	7	5.5
		12	12	9	5.5

Fig. 3-83. 6 subtypes for 3-wall augmentation



46 Type 2
Proximal 7mm buccal width 9mm buccal length 9mm
SM2W7999SB

Fig. 3-84. Dimension of defect is measured using a defect gauge in dentiform model.

2) Handling of the SMARTbuilder and clinical case

Acceptable kinds of bone graft material such as autogenic bone, allogenic bone, xenogenic bone or, alloplastic bone can be selected according to operator's preference. In hard bone defect, especially in mandible, it is better to perform cortical perforation to facilitate osteogenesis and angiogenesis before bone grafting. The margin of Smart Builder should be positioned at least 1~1.5mm away from vertical incision line and some distance from adjacent teeth. In type 2 and type 3 defect, which require much bone graft and cover proximal and lingual surface, titanium mesh may be exposed early. To prevent such an early exposure, do not use too much graft material and use additional fixation for the Smart Builder using horizontal sling suture. Removal timing of the Smart Builder is same as that of nonresorbable membrane in conventional GBR. To remove the Smart Builder, first, unscrew cover cap or healing abutment followed by insertion of an explorer into the pore of Smart Builder under flap, mobilizing the Smart Builder, and then remove the Height using a 1.2 hex screw driver. Then the Smart Builder will come out with the Height. However, type 3 Smart Build or in cases with wide buccal width and buccal length, give some stab incisions at crest and remove it after dissection.

A clinical case of the Smartbuilder.

This is a 50 years old male patient who is generally healthy. Abutment teeth of mandibular left 2nd premolar to 2nd molar bridge were extracted because of dental caries and periapical lesion 2 months ago and replaced with two TSIII implants. At this moment, dehiscence defect occurred at buccal side of anterior implant and it was managed with GBR using allogenic bone graft material and Smartbuilder system. 4 months later, I removed the Smartbuilder and reflected flap to identify regenerated bone at dehiscence deft, and I could see the regenerated bone covering the fixture at buccal defect. **(Fig. 3-85~89)**

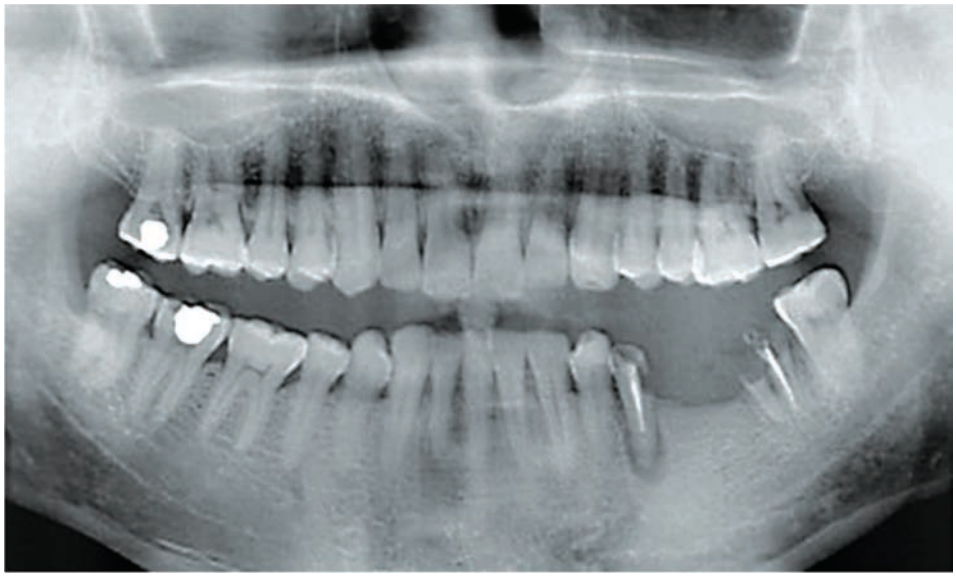


Fig. 3-85. Initial Panoramic radiograph shows hopeless left mandibular 2nd premolar and 2nd molar.

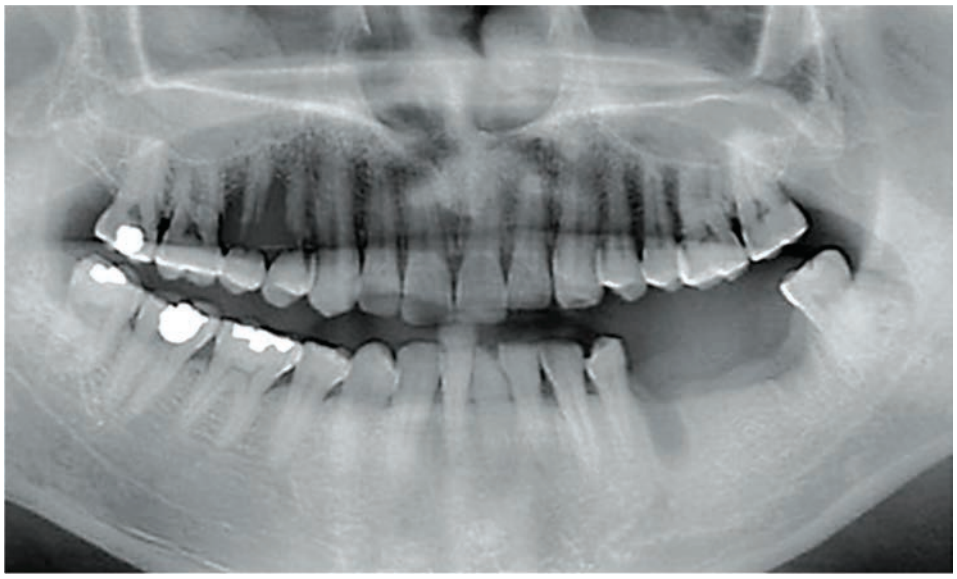


Fig. 3-86. Panoramic radiograph 2 months after extraction of the left mandibular 2nd premolar and 2nd molar.

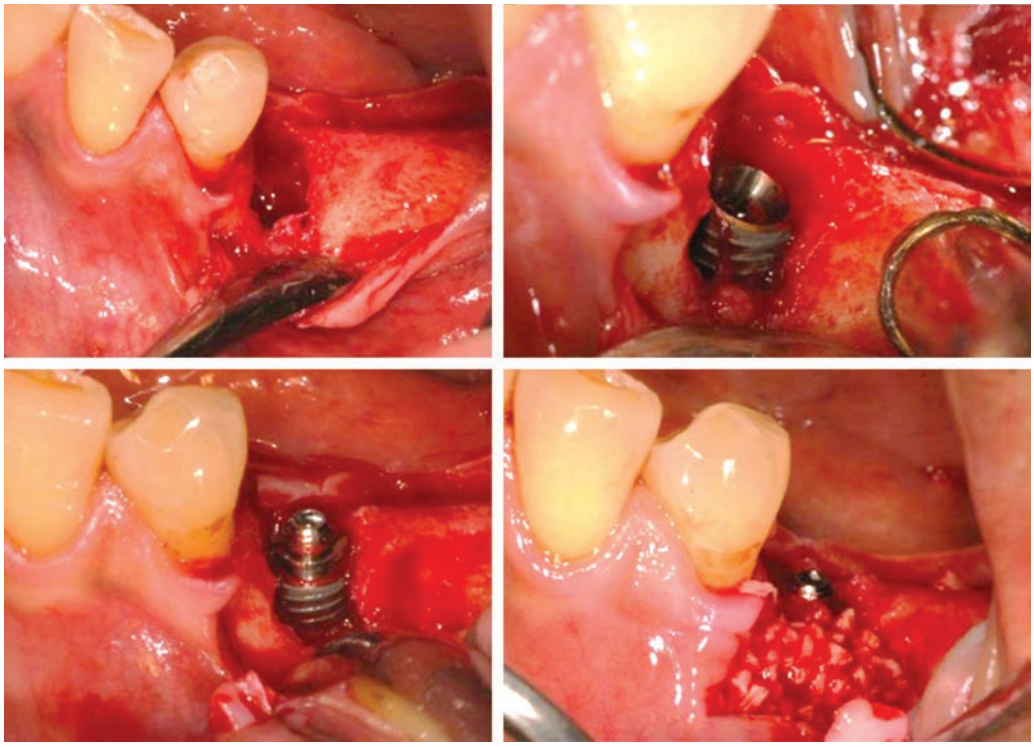


Fig. 3-87. After implant placement bone graft wad performed at buccal dehiscence defect.

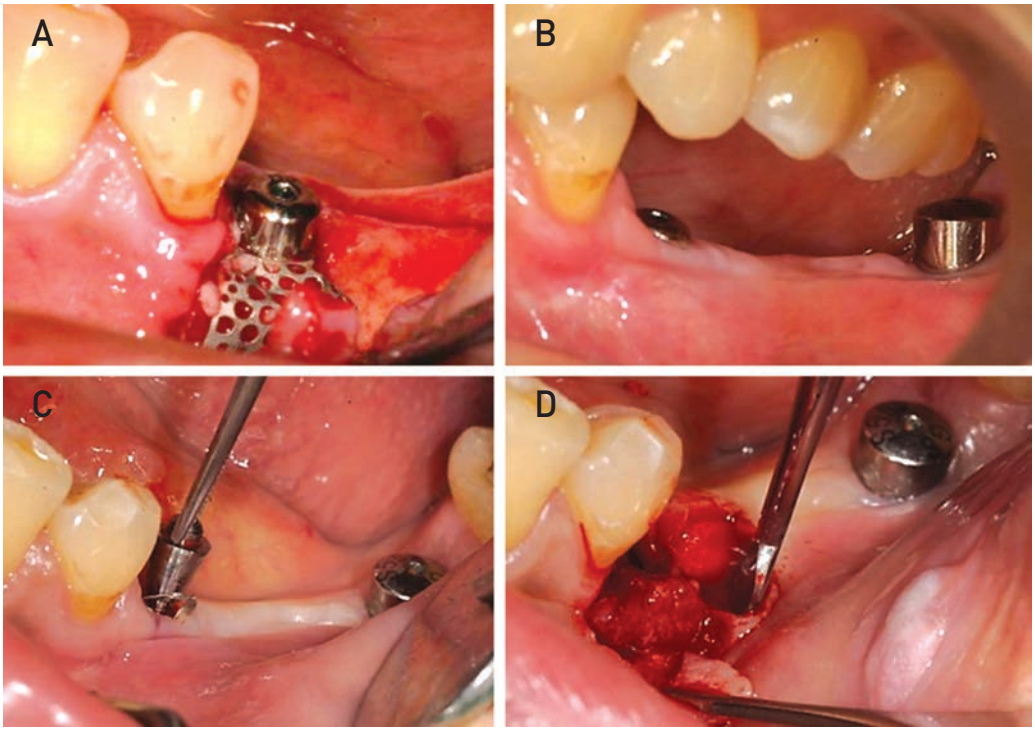


Fig. 3-88. **A.** Connect the SMATbuilder and the healing cap.
B. POP 4 months.
C. Removed the healing screw.
D. Can see the good bone regeneration at buccal dehiscence defect.

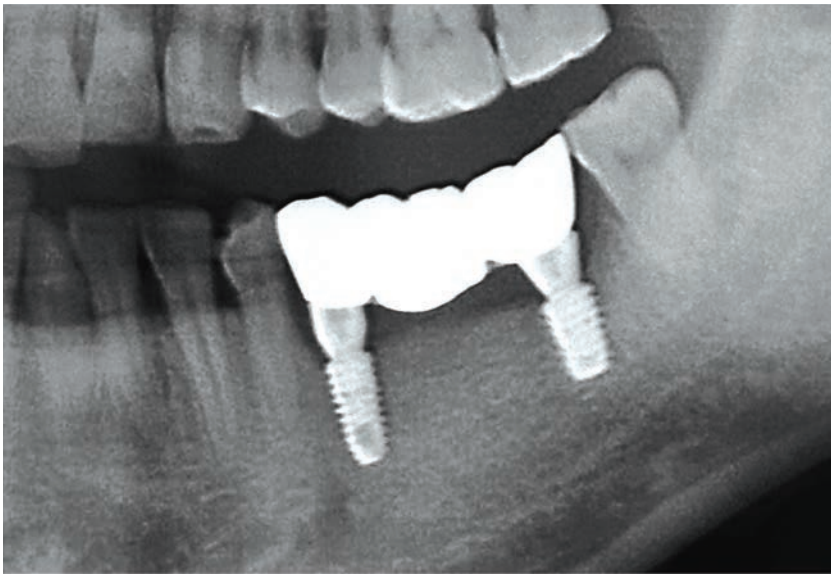


Fig. 3-89. Panoramic radiograph just after delivery of final bridge.

4. AutoBone Collector (A.B.C) – By Dr. Lee, Dae-Hee

Although autogenic bone is considered as a gold standard of bone graft material because it is osteogenic, osteoinductive, and osteoconductive, it has disadvantage of requiring additional surgery at other site to take sufficient amount. Additionally, it is inconvenient to use bone mill or bone crusher to particulate collected bone using instruments such as trephine drill, chisel, bur, or saw, and this procedure causes loss of some amount of the bone. Recently, company Osstem developed an innovative product named Auto Bone Collector (ABC) which can collect autogenic bone simply and particulate simultaneously. It is composed of bone collection drill and titanium cage which function as stopper and container of collected bone. Its advantages: it can collect autogenic bone just near the operation site through extension of the flap slightly, does not require bone mill or bone crusher, and can minimize loss of collected bone.

Use the Auto Bone Collector lightly under slow drill speed of about 300~600 rpm, touching the bone without excessive force. Otherwise, it can cause problem in handpiece cartridge and malfunction of stopper. Lightly lock stopper at lower portion and start drilling, and then gradually the stopper will move towards upper portion, saving collected bone in the stopper during bone grinding. There are three kinds of ABC drills: 5, 6, 7mm, as well as different sized corresponding titanium cages (Stoppers). Usually we can collect 0.25~0.5cc autogenic bone by single use and can simply and conveniently collect more bone using the drill continuously at adjacent site. After autogenic bone collection, separate the titanium cage from the drill and collect autogenic bone on the drill and inside the cage using the bone ejector. Save the bone in the bone well before use. **(Fig. 3-90)**

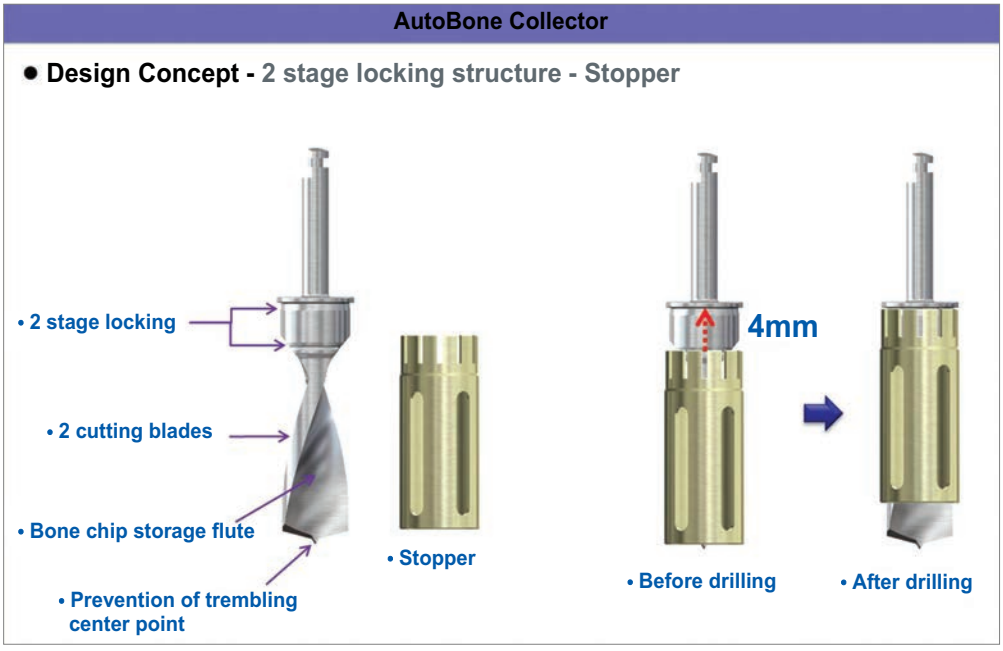


Fig. 3-90. Structure of AutoBone Collector

SEM image of autogenic bone collected with AutoBone Collector. ABC drill rotates and cuts bone, generating bone curl pattern like fruit peels rather than bone chip. Hence, it will be resorbed faster than chip bone and requires membrane coverage in open defect, which is not self-contained defect. **(Fig. 3-91)**

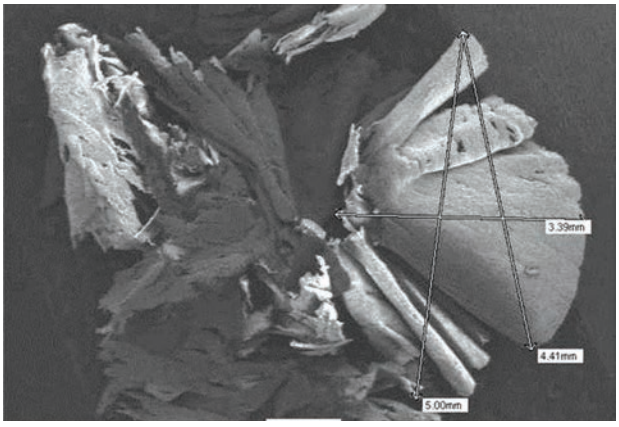


Fig. 3-91. SEM image of collected autogenic bone using the AutoBone Collector

Drill of Auto Bone Collector has excellent cutting ability and durability so it can be reused about 50~100 times. After use, clean the drill and stopper mechanically using a brush and an ultrasonic cleaner followed by dry, storage. Sterilize just before use. **(Fig. 3-92)**

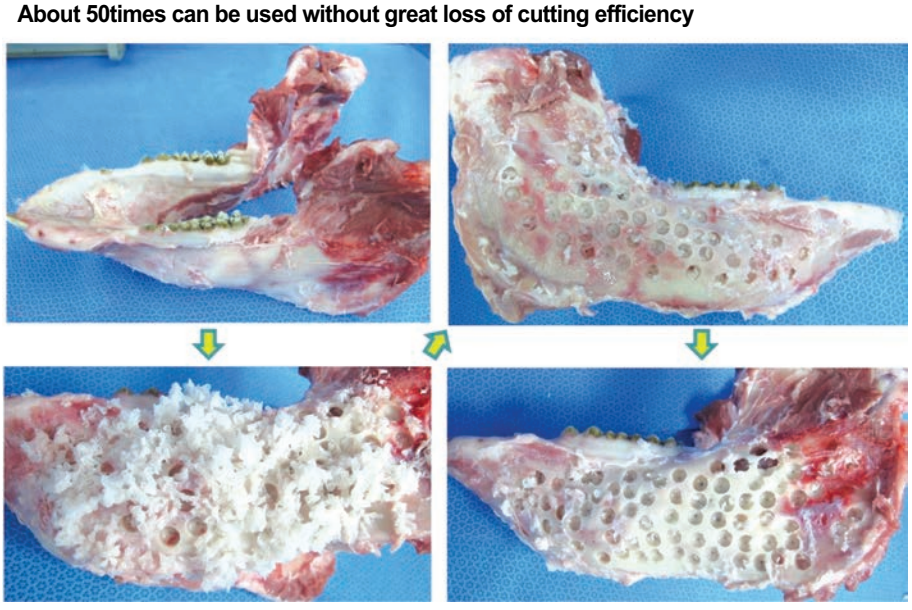


Fig. 3-92. AutoBone Collector can be reused about 50 times.

A clinical case of AutoBone Collector

668 years old female patient received 2 implants at right maxillary central & lateral incisor and was delivered temporary bridge. However one implant was retrieved and the other was in ailing condition because of continuous bone resorption. After retrieval of ailing implant, ridge augmentation was performed using titanium mesh and allogenic bone mixed with autogenic bone collected by ABC. 6 months late, removed the mesh and placed two TSIII SA implant. Now temporary restoration is delivered after second stage surgery .**(Fig. 3-93~97)**

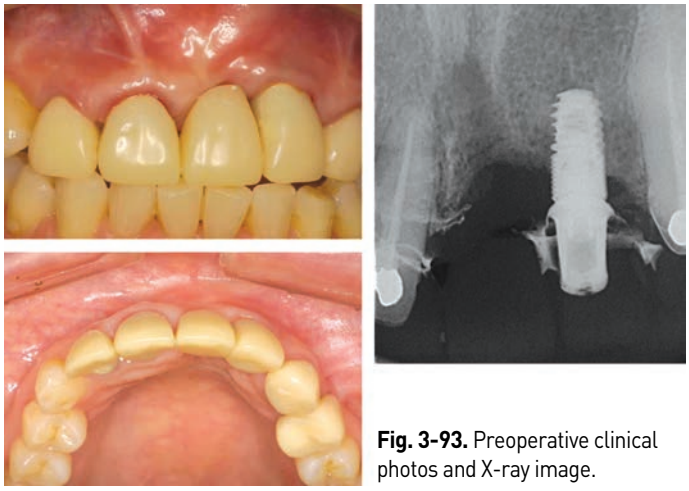


Fig. 3-93. Preoperative clinical photos and X-ray image.

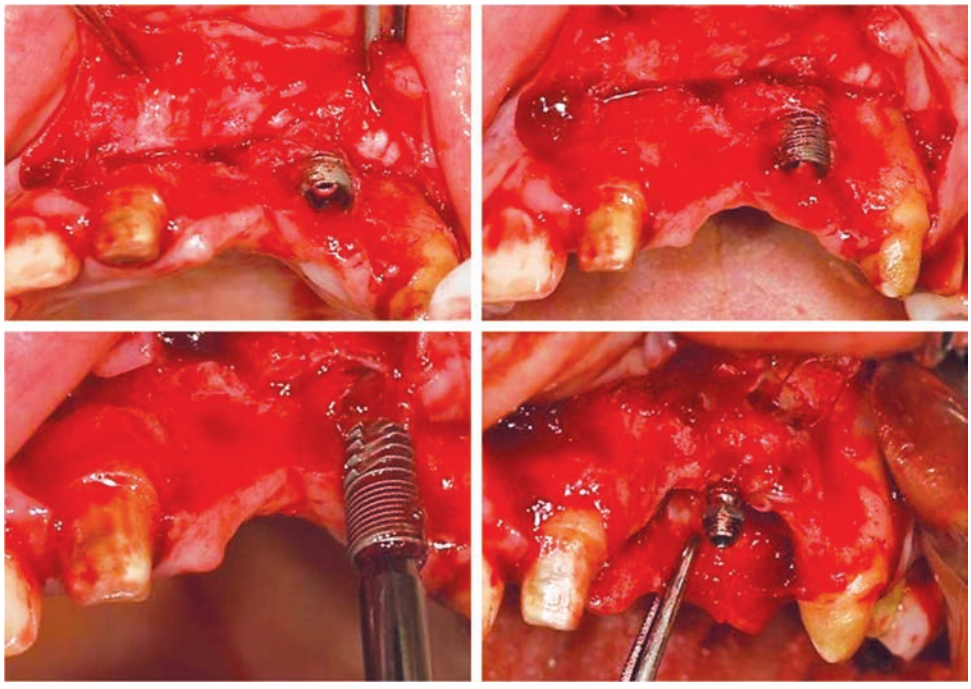


Fig. 3-94. Retrieved existing implant after flap elevation and bone exposure.

Fig. 3-95. Autogenic bone curls are collected using the AutoBone Collector.

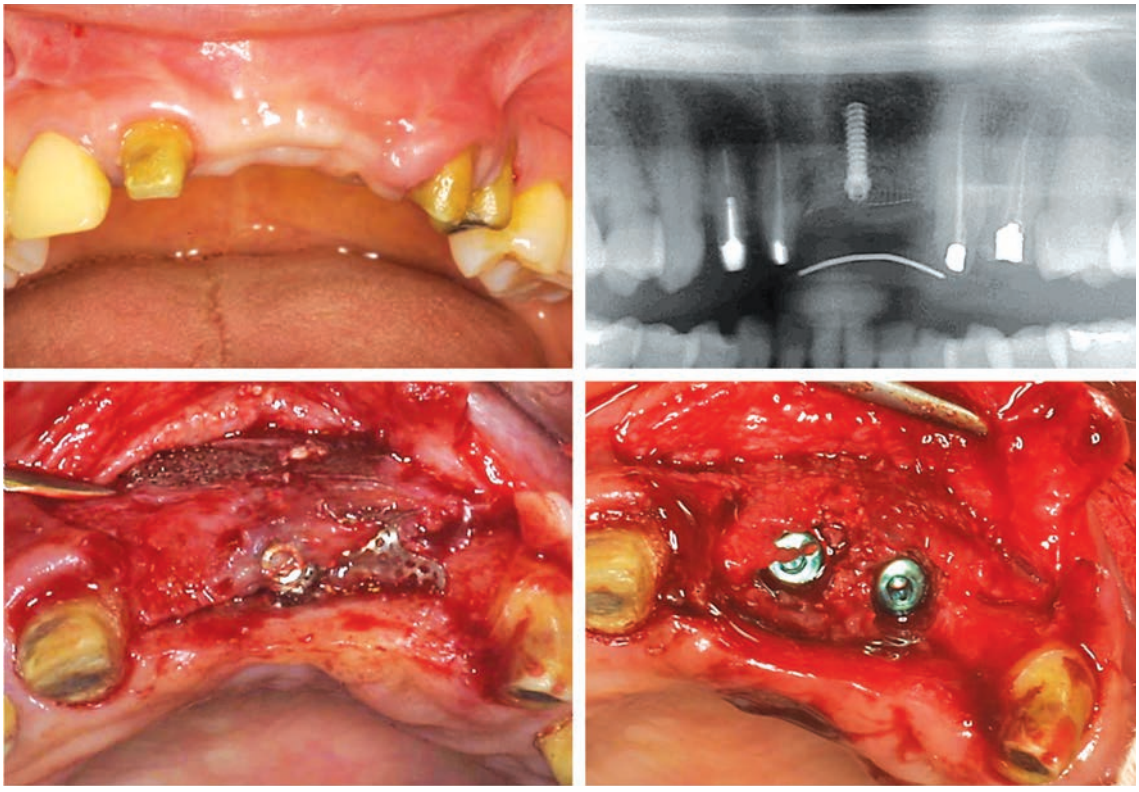
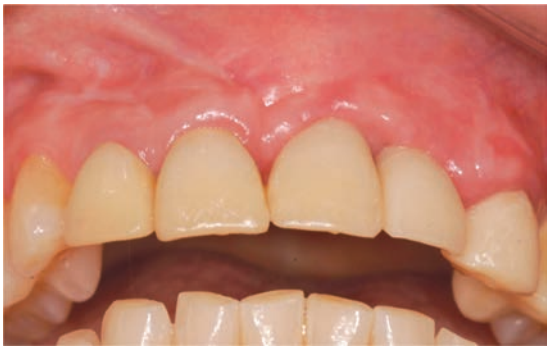


Fig. 3-96. After 6 months, removed the titanium mesh and placed implants.



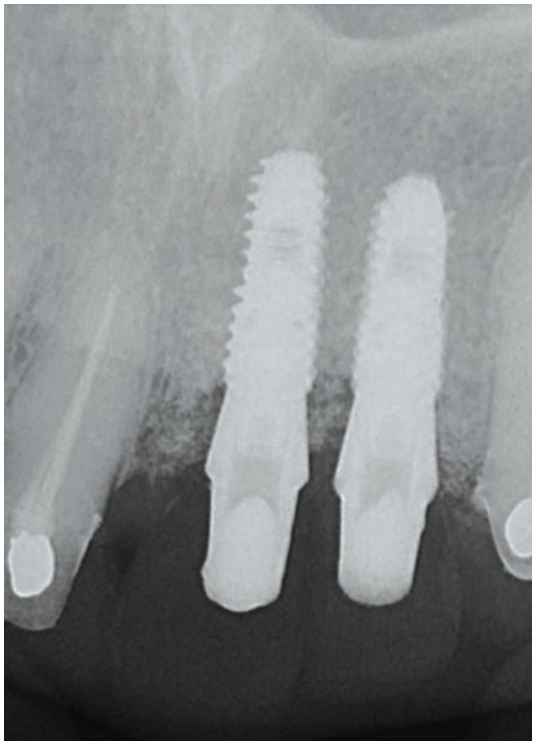


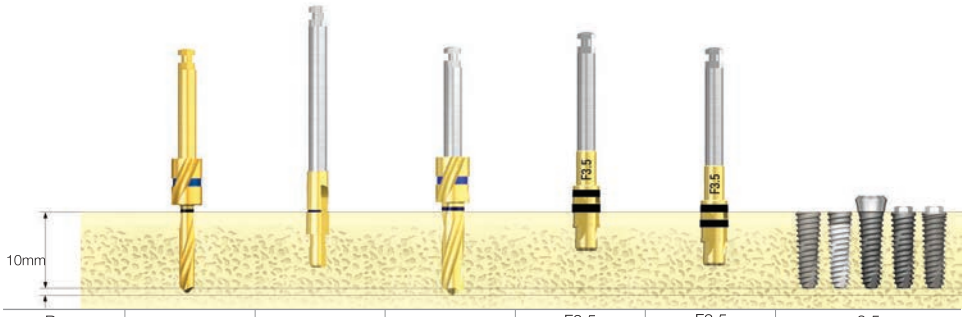
Fig. 3-97. Temporary restoration was delivered.

Drilling Sequence for

TSIII / TSIII Ca-SA / TSIII HA / SSIII SA / SSIII RBM / SSIII HA / USIII SA / USIII RBM

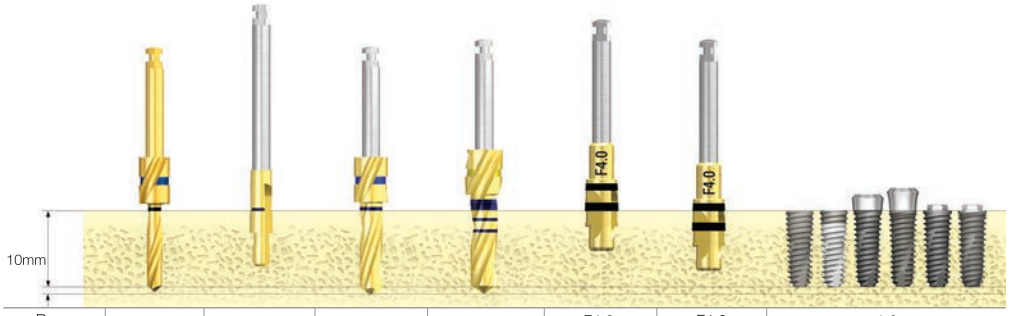
TSIII / TSIII Ca-SA / TSIII HA / SSIII SA / SSIII RBM / SSIII HA / USIII SA / USIII RBM Fixture (Straight Drill)

ø 3.5mm Fixture
(Length :10mm)



Bone Quality	ø 2.0 Drill	Pilot Drill (2.0/3.0)	ø 3.0 Drill	F3.5 Cortical Drill 3	F3.5 Cortical Drill 3	3.5 Fixture
Soft	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶		
Hard	▶	▶	▶		▶	

ø 4.0mm Fixture
(Length :10mm)



Bone Quality	ø 2.0 Drill	Pilot Drill (2.0/3.0)	ø 3.0 Drill	ø 3.3 Drill	F4.0 Cortical Drill 3	F4.0 Cortical Drill 3	4.0 Fixture
Soft	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶		
Hard	▶	▶	▶	▶		▶	

※ Recommended insertion torque: 40Ncm or less

※ TSIII HA Fixture, SSIII HA Fixture (Recommended insertion torque: 35Ncm or less)

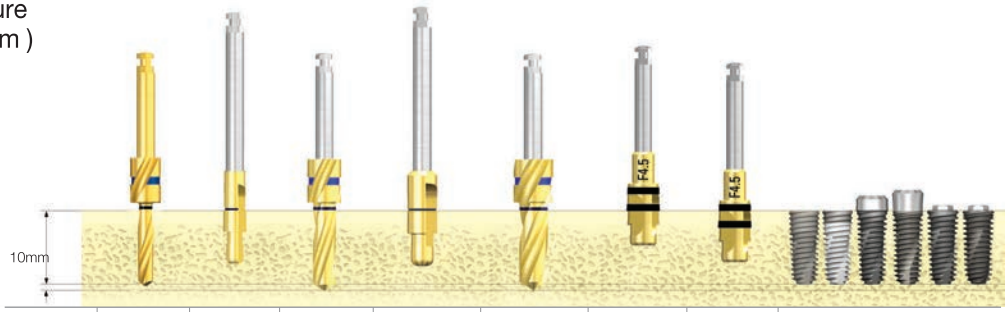
- HA fixtures do not recommended in hard bone for possible risk of separating HA coating layer.

※ Depth control of TS/GS Fixture

- It depends on clinical situation, however, generally 0.5~1.0mm subcrestal position recommended.

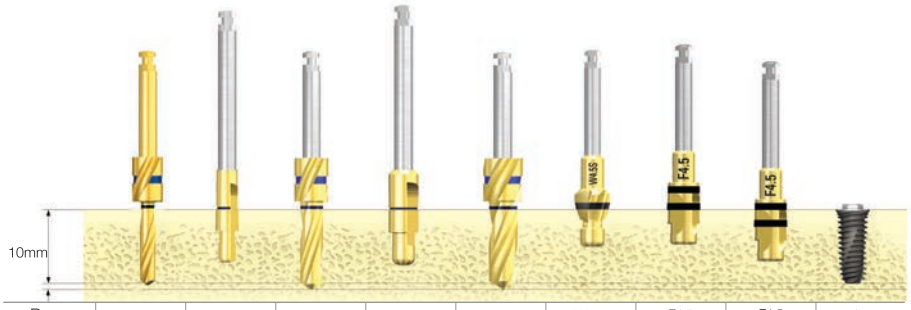
TSIII / TSIII Ca-SA / TSIII HA / SSIII SA / SSIII RBM / SSIII HA / USIII SA / USIII RBM Fixture (Straight Drill)

ø 4.5mm Fixture (Length :10mm)



Bone Quality	ø 2.0 Drill	Pilot Drill (2.0/3.0)	ø 3.0 Drill	Pilot Drill (3.0/3.8)	ø 3.8 Drill	F4.5 Cortical Drill 3	F4.5 Cortical Drill 3	4.5 Fixture
Soft	▶	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶	▶		
Hard	▶	▶	▶	▶	▶		▶	

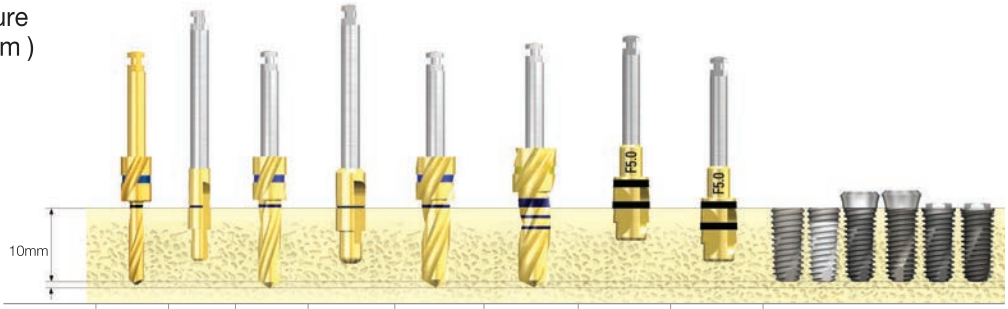
USIII Wide PS Fixture ø 4.5mm Fixture (Length :10mm)



Bone Quality	ø 2.0 Drill	Pilot Drill (2.0/3.0)	ø 3.0 Drill	Pilot Drill (3.0/3.8)	ø 3.8 Drill	W4.5 CounterSink	F4.5 Cortical Drill 3	F4.5 Cortical Drill 3	4.5 Fixture
Soft	▶	▶	▶	▶	▶				Implant placement
Normal	▶	▶	▶	▶	▶	▶	▶		
Hard	▶	▶	▶	▶	▶	▶		▶	

※ For Wide PS 4.5 of US III Fixture, Counter Sink is available separately. (Product Code : USSCS45W, recommended drilling speed : 300rpm)

ø 5.0mm Fixture (Length :10mm)



Bone Quality	ø 2.0 Drill	Pilot Drill (2.0/3.0)	ø 3.0 Drill	Pilot Drill (3.0/3.8)	ø 3.8 Drill	ø 4.3 Drill	F5.0 Cortical Drill 3	F5.0 Cortical Drill 3	5.0 Fixture
Soft	▶	▶	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶	▶	▶		
Hard	▶	▶	▶	▶	▶	▶		▶	

※ Depth control of TS/GS Fixture

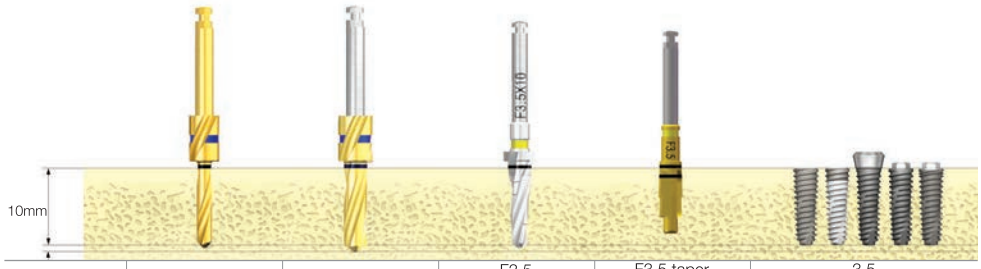
- It depends on clinical situation, however, generally 0.5~1.0mm subcrestal position recommended

Drilling Sequence for

TSIII / TSIII Ca-SA / TSIII HA / SSIII SA / SSIII RBM / SSIII HA / USIII SA / USIII RBM

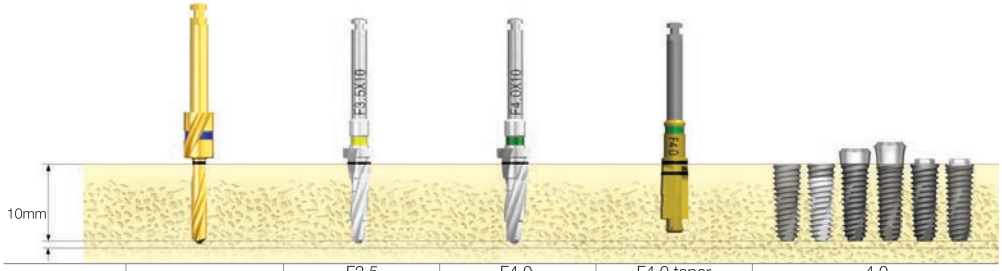
TSIII / TSIII Ca-SA / TSIII HA / SSIII SA / SSIII RBM / SSIII HA / USIII SA / USIII RBM (Taper Drill)

ø 3.5mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	ø 3.0 drill	F3.5 taper drill	F3.5 taper cortical drill	3.5 Fixture
Soft	▶	▶			Implant placement
Normal	▶		▶		
Hard	▶		▶	▶	

ø 4.0mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	F3.5 taper drill	F4.0 taper drill	F4.0 taper Cortical drill	4.0 Fixture
Soft	▶	▶			Implant placement
Normal	▶	▶	▶		
Hard	▶	▶	▶	▶	

※ Taper cortical Drill
- Lower marking line is for fixture length 8.5mm or shorter - Upper marking line is for fixture length 10.0mm or longer

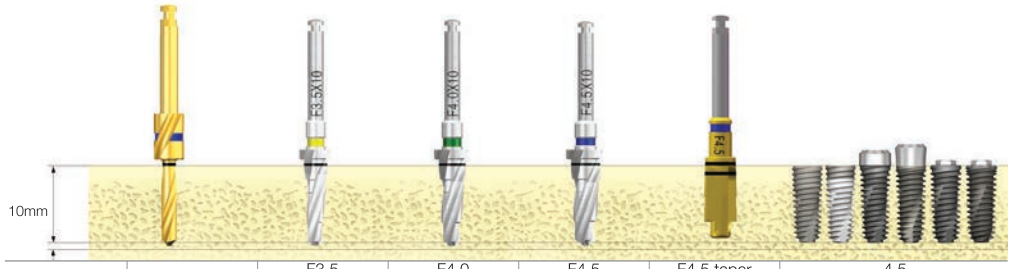
※ Recommended insertion torque: 40Ncm or less

※ TSIII HA Fixture, SSIII HA Fixture (Recommended insertion torque: 35Ncm or less)
- HA fixtures are not recommended in hard bone for possible risk of separating HA coating layer.

※ Depth control of TS/GS Fixture
- It depends on clinical situation, however, generally 0.5~1.0mm subcrestal position recommended.

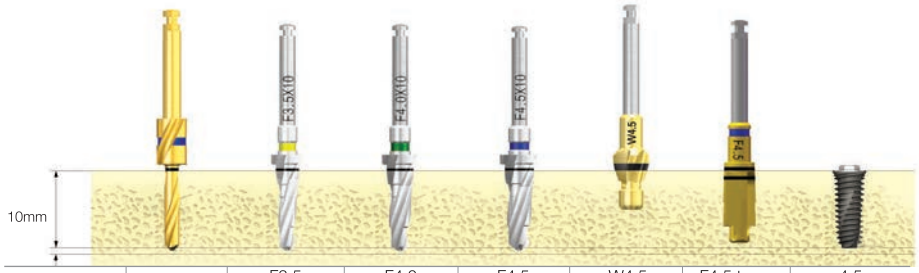
TSIII / TSIII Ca-SA / TSIII HA / SSIII SA / SSIII RBM / SSIII HA / USIII SA / USIII RBM (Taper Drill)

ø 4.5mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	F3.5 taper drill	F4.0 taper drill	F4.5 taper drill	F4.5 taper Cortical drill	4.5 Fixture
Soft	▶	▶	▶			Implant placement
Normal	▶	▶		▶		
Hard	▶	▶		▶	▶	

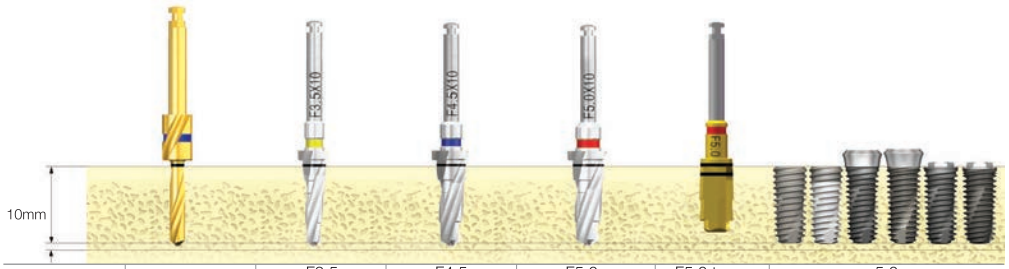
US III Wide PS Fixture ø 4.5mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	F3.5 taper drill	F4.0 taper drill	F4.5 taper drill	W4.5 CounterSink	F4.5 taper Cortical drill	4.5 Fixture
Soft	▶	▶	▶				Implant placement
Normal	▶	▶		▶	▶		
Hard	▶	▶		▶	▶	▶	

※ For Wide PS 4.5 of US III Fixture, CounterSink is available separately. (Product Code: USSCS45W, recommended drilling speed: 300rpm)

ø 5.0mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	F3.5 taper drill	F4.5 taper drill	F5.0 taper drill	F5.0 taper Cortical drill	5.0 Fixture
Soft	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶		
Hard	▶	▶	▶	▶	▶	

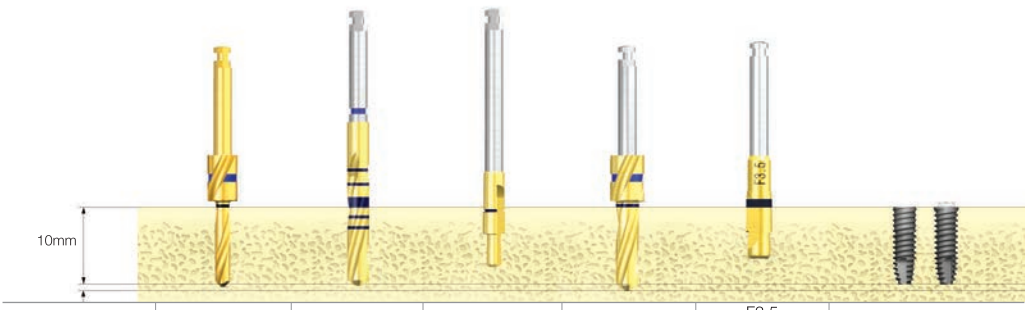
※ Depth control of TS/GS Fixture

- It depends on clinical situation, however, generally 0.5~1.0mm subcrestal position recommended.

Drilling Sequence for
TSII / SSII SA / USII SA

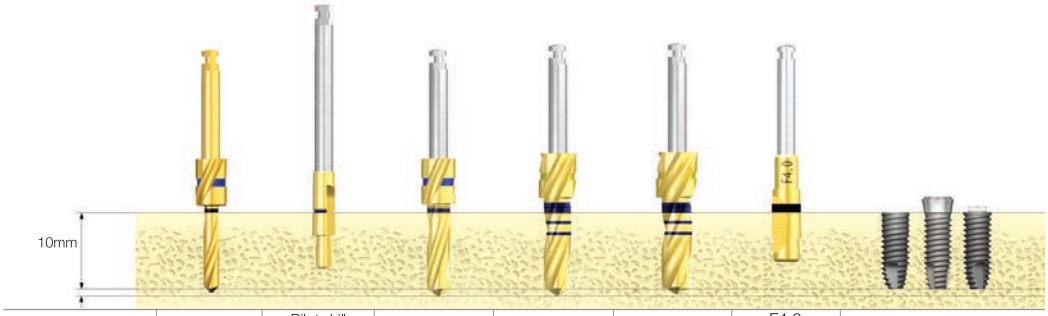
TSII / SSII SA / USII SA Fixture

ø 3.5mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	ø 2.7 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	F3.5 cortical drill	ø 3.5 Fixture
Soft	▶	▶				Implant placement
Normal	▶		▶	▶		
Hard	▶		▶	▶	▶	

ø 4.0mm Fixture (Length :10mm)

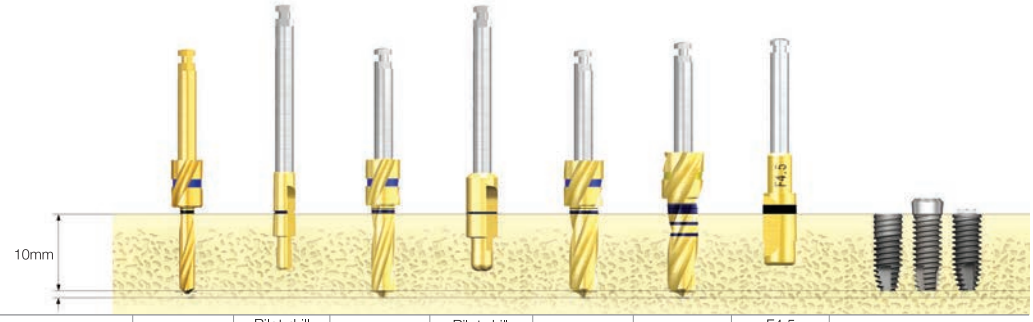


Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	ø 3.3 drill	ø 3.6 drill	F4.0 cortical drill	4.0 Fixture
Soft	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶		▶		
Hard	▶	▶	▶		▶	▶	

※ Recommended insertion torque: 40Ncm or less
※ Depth control of TS/GS Fixture
- It depends on clinical situation, however, generally 0.5~1.0mm subcrestal position recommended.

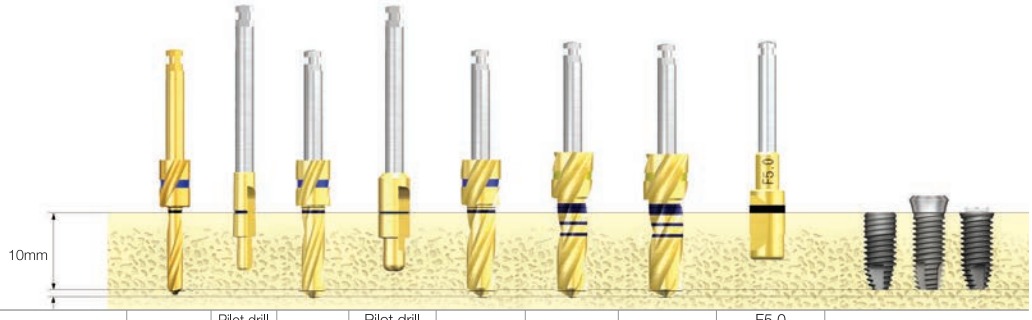
TSII / SSII SA / USII SA Fixture

ø 4.5mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.1 drill	F4.5 cortical drill	4.5 Fixture
Soft	▶	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶	▶		
Hard	▶	▶	▶	▶	▶	▶	▶	

ø 5.0mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.3 drill	ø 4.6 drill	F5.0 cortical drill	5.0 Fixture
Soft	▶	▶	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶		▶		
Hard	▶	▶	▶	▶	▶		▶	▶	

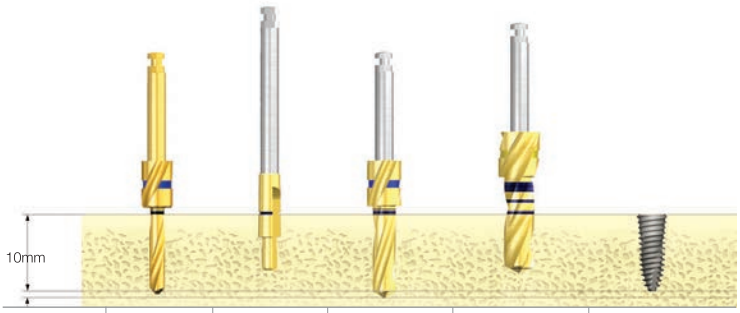
※ Depth control of TS/GS Fixture

- It depends on clinical situation, however, generally 0.5~1.0mm subcrestal position recommended.

Drilling Sequence for TSIV

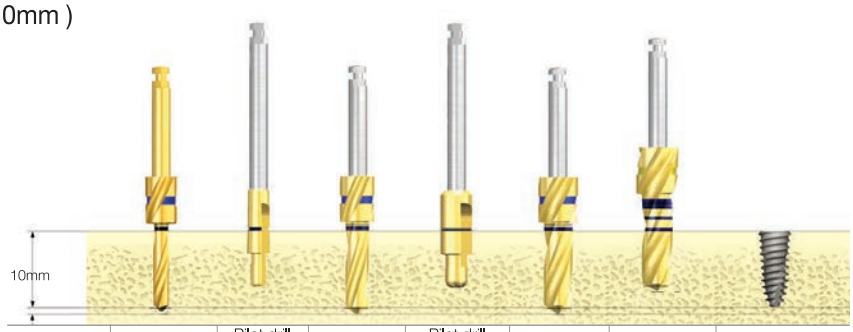
TSIV Fixture (Straight Drill)

ø 4.0mm Fixture (Length :10mm)



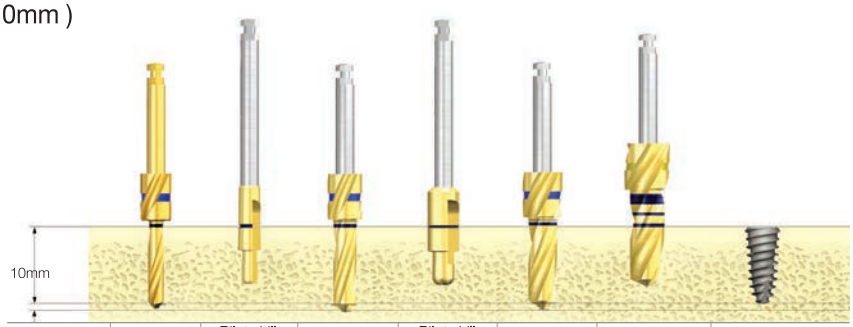
Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	ø 3.6 drill (Half)	4.0 Fixture
D4	▶				Implant placement
Soft	▶	▶	▶	▶	

ø 4.5mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.1 drill (Half)	4.5 Fixture
D4			▶				Implant placement
Soft	▶	▶	▶	▶	▶	▶	

ø 5.0mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.6 drill (Half)	5.0 Fixture
D4			▶				Implant placement
Soft	▶	▶	▶	▶	▶	▶	

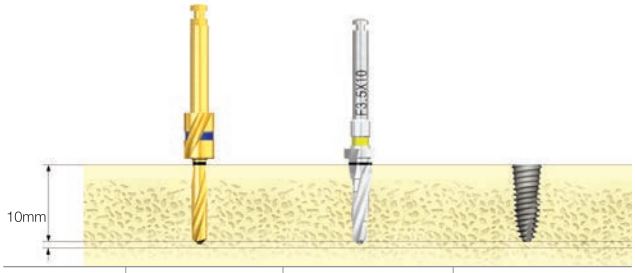
※ Recommended insertion torque: 40Ncm or less

※ TSIV fixture is for soft bone and sinus bone graft case exclusively. It is not recommended in normal or hard bone case.

※ In TSIV fixture, recommended insertion speed is 25rpm or less because it has big thread pitch which fasten insertion speed.

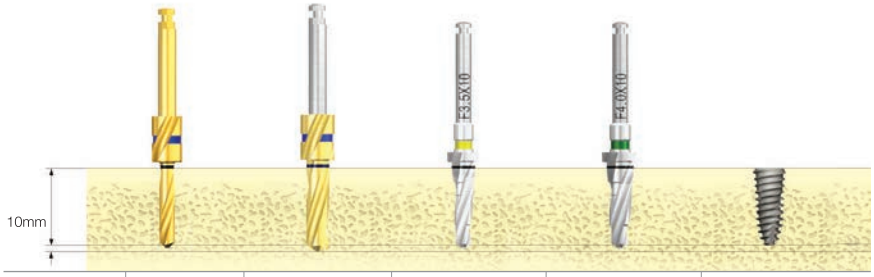
TSIV Fixture (Taper Drill)

ø 4.0mm Fixture (Length :10mm)



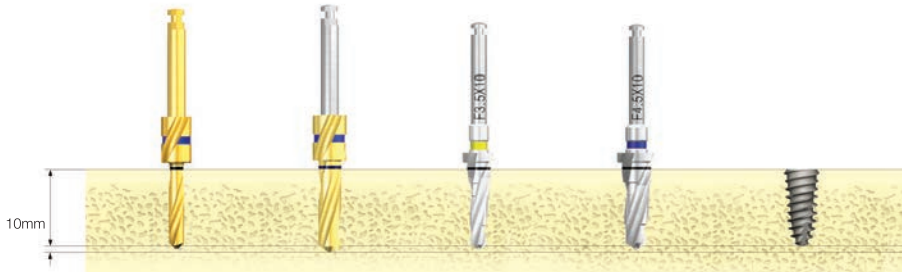
Bone quality	ø 2.0 drill	F3.5 taper drill	4.0 Fixture
D4	▶		Implant placement
Soft	▶	▶	

ø 4.5mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	ø 3.0 drill	F3.5 taper drill	F4.0 taper drill	4.5 Fixture
D4		▶			Implant placement
Soft	▶		▶	▶	

ø 5.0mm Fixture (Length :10mm)



Bone quality	ø 2.0 drill	ø 3.0 drill	F3.5 taper drill	F4.5 taper drill	5.0 Fixture
D4		▶			Implant placement
Soft	▶		▶	▶	

※ Recommended insertion torque: 40Ncm or less

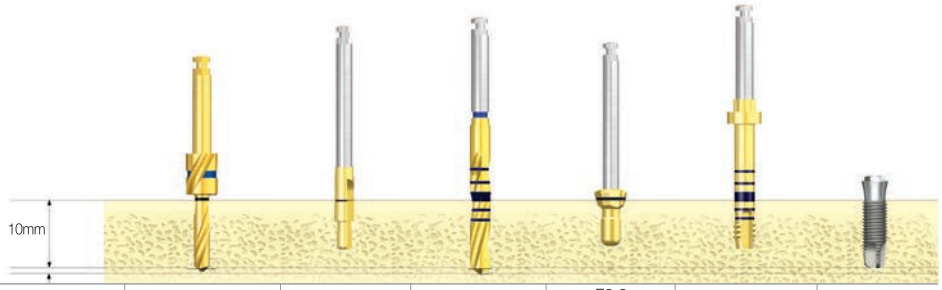
※ TSIV fixture is for soft bone and sinus bone graft case exclusively. It is not recommended in normal or hard bone case.

※ In TSIV fixture, recommended insertion speed is 25rpm or less because it has big thread pitch which fasten insertion speed.

Drilling Sequence for SSII RBM

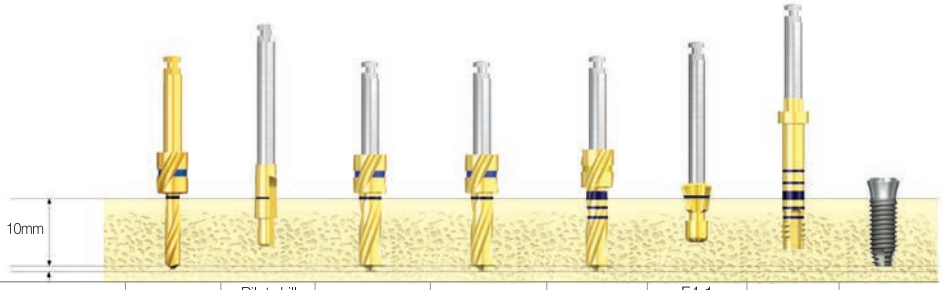
SSII RBM Fixture

ø 3.3mm Fixture (Length : 10mm)



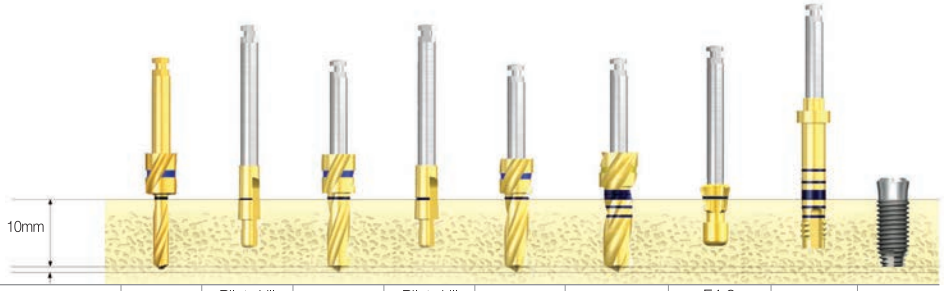
Bone quality	ø 2.0 drill	Pilot drill (2.0/2.7)	ø 2.7 drill	F3.3 Countersink	F3.3 Tap	3.3 Fixture
Soft	▶	▶				Implant placement
Normal	▶	▶	▶	optional		
Hard	▶	▶	▶	optional	▶	

ø 4.1mm Fixture (Length : 10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	ø 3.3 drill	ø 3.6 drill	F4.1 Countersink	F4.1 Tap	4.1 Fixture
Soft	▶	▶	▶	▶				Implant placement
Normal	▶	▶	▶	▶	▶	optional		
Hard	▶	▶	▶	▶	▶	optional	▶	

ø 4.8mm Fixture (Length : 10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.3 drill	F4.8 Countersink	F4.8 Tap	4.8 Fixture
Soft	▶	▶	▶	▶	▶				Implant placement
Normal	▶	▶	▶	▶	▶	▶	optional		
Hard	▶	▶	▶	▶	▶	▶	optional	▶	

※ Recommended insertion torque: 40Ncm or less

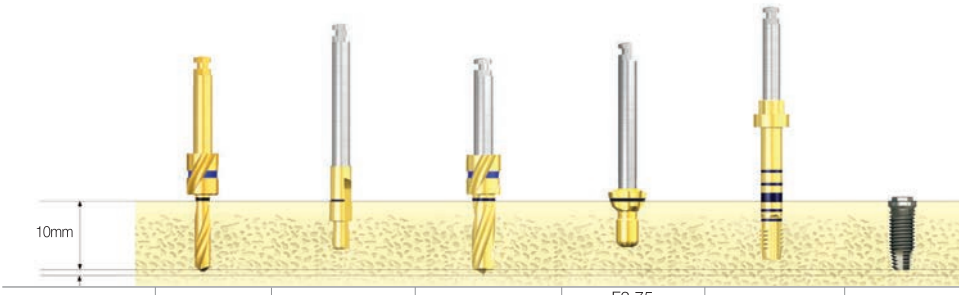
Drilling Sequence for USII RBM

USII RBM Fixture

ø 3.3mm Fixture (Length :10mm)

Bone quality	ø 2.0 drill	Pilot drill (2.0/2.7)	ø 2.7 drill	F3.3 Countersink	F3.3 Tap	3.3 Fixture
Soft	▶	▶				Implant placement
Normal	▶	▶	▶	optional		
Hard	▶	▶	▶	optional	▶	

ø 3.75mm Fixture (Length : 10mm)



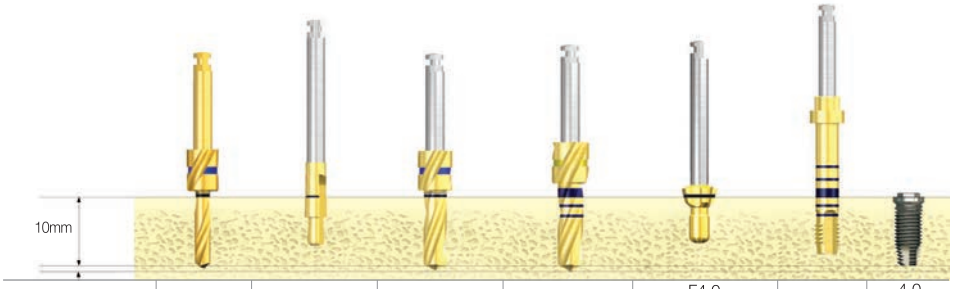
Bone quality	ø 2.0 drill	Pilot drill (2.0/3.7)	ø 2.7 drill	F3.75 Countersink	F3.75 Tap	3.75 Fixture
Soft	▶	▶				Implant placement
Normal	▶	▶	▶	optional		
Hard	▶	▶	▶	optional	▶	

※ Recommended insertion torque: 40Ncm or less

Drilling Sequence for USII RBM

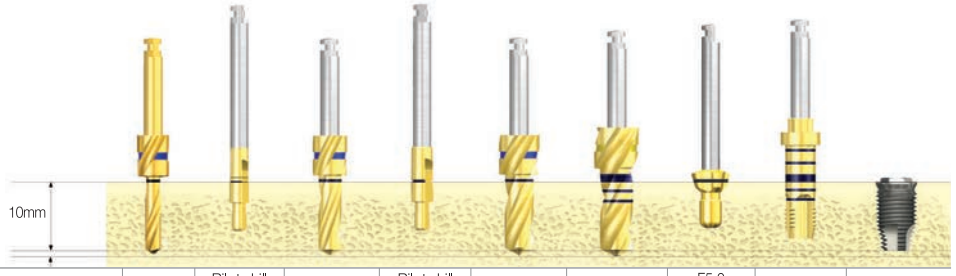
USII RBM Fixture

ø 4.0mm Fixture (Length : 10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	ø 3.3 drill	F4.0 Countersink	F4.0 Tap	4.0 Fixture
Soft	▶	▶	▶				Implant placement
Normal	▶	▶	▶	▶	optional		
Hard	▶	▶	▶	▶	optional	▶	

ø 5.0mm Fixture (Length : 10mm)



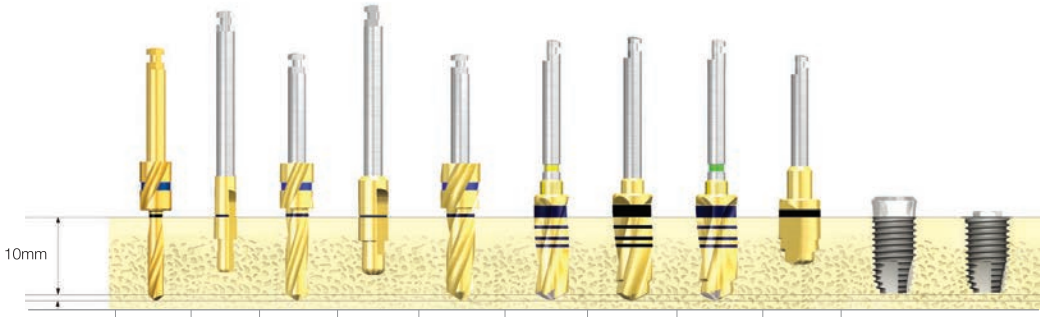
Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.3 drill	F5.0 Countersink	F5.0 Tap	5.0Fixture
Soft	▶	▶	▶	▶	▶				Implant placement
Normal	▶	▶	▶	▶	▶	▶	optional		
Hard	▶	▶	▶	▶	▶	▶	optional	▶	

※ Recommended insertion torque: 40Ncm or less

Drilling Sequence for Ultra-Wide®

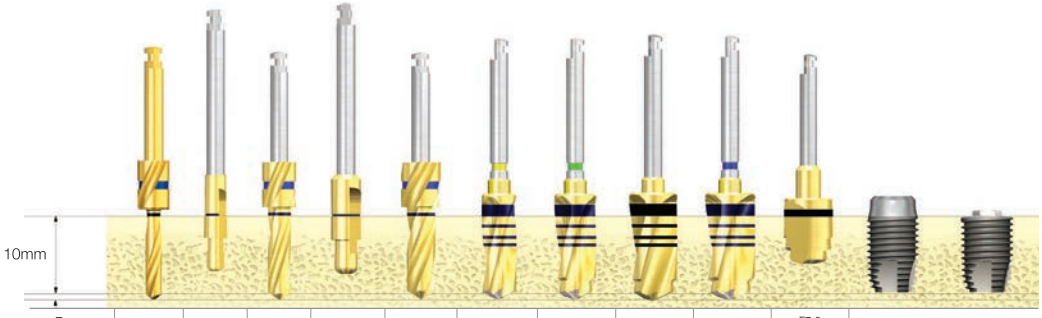
SSII / USII RBM Ultra-Wide® Fixture

ø 6.0 mm Fixture (Length : 10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.6 drill	ø 5.2 direct drill	ø 5.5 direct drill	F6.0 Cortical Drill	ø 6.0 Fixture
Soft	▶	▶	▶	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶	▶		▶		
Hard	▶	▶	▶	▶	▶	▶		▶	▶	

ø 7.0 mm Fixture (Length : 10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.6 drill	ø 5.5 direct drill	ø 6.2 direct drill	ø 6.5 direct drill	F7.0 Cortical Drill	ø 7.0 Fixture
Soft	▶	▶	▶	▶	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶	▶	▶		▶		
Hard	▶	▶	▶	▶	▶	▶	▶		▶	▶	

※ Recommended insertion torque: 40Ncm or less

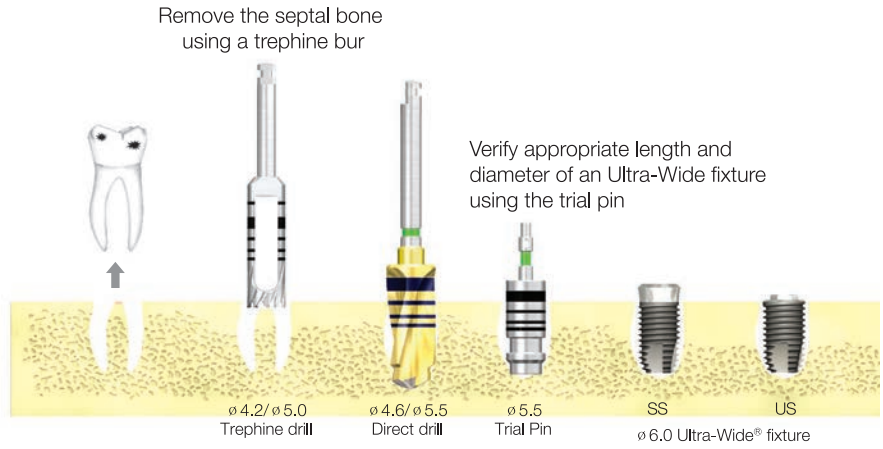
Drilling Sequence for Ultra-Wide®

SSII / USII RBM Ultra-Wide® Fixture

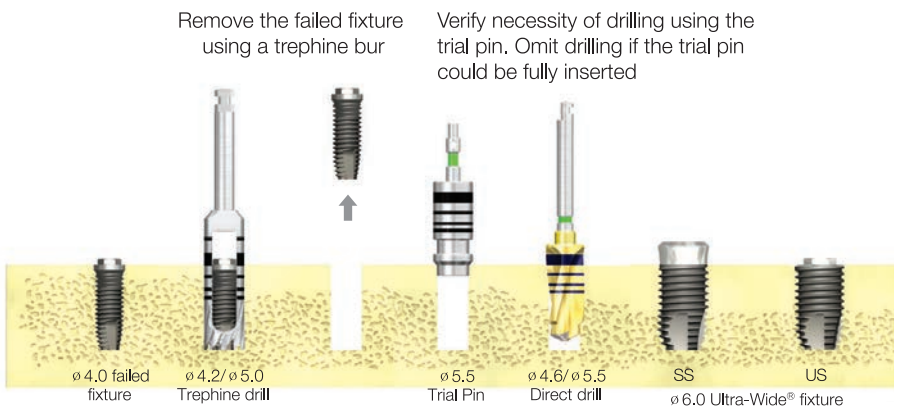
Drilling Sequence with Trephine in the healed mature bone (ø 6.0 Ultra-Wide® fixture, Length : 10mm)

Bone quality	ø 4.2/5.0 Trephine drill	ø 4.6/5.2 Direct drill	ø 4.6/5.5 Direct drill	F6.0 Cortical drill	6.0 Fixture
Soft	▶	▶			Implant placement
Normal	▶		▶		
Hard	▶		▶	▶	

Immediate placement at the extraction socket (ø 6.0 Ultra-Wide® fixture, Length : 10mm)

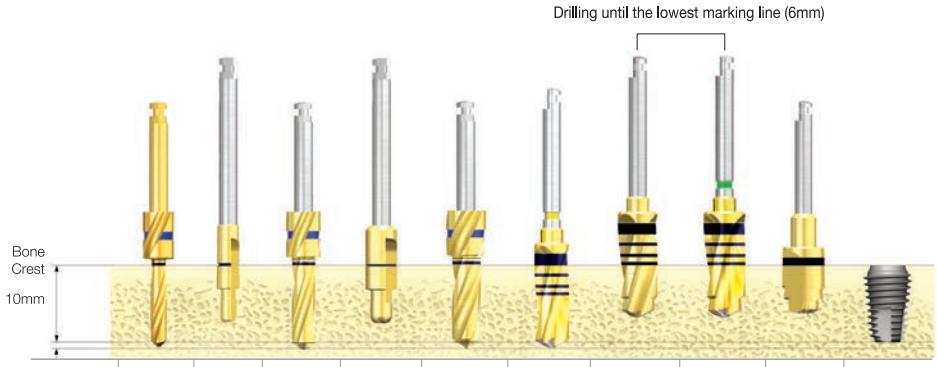


Immediate replacement of the failed implant (ø 6.0 Ultra-Wide® fixture, Length : 10mm)



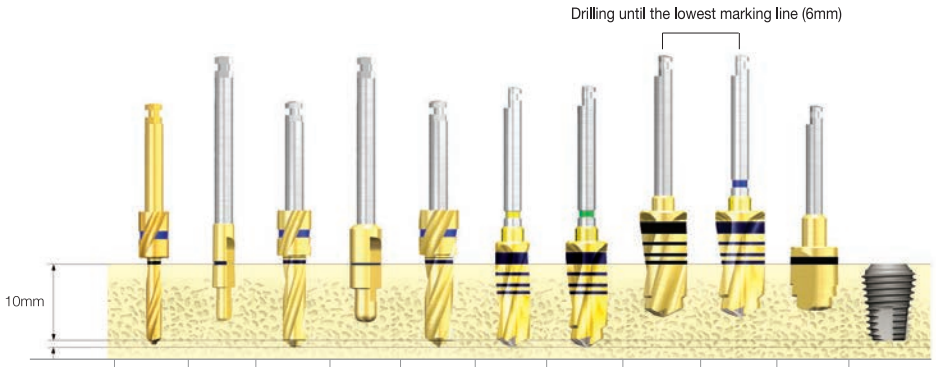
TSIII Ultra-Wide Fixture

ø 6.0 mm Fixture (Length : 10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.6 drill	ø 5.2 direct drill	ø 5.5 direct drill	F6.0 Cortical Drill	ø 6.0 Fixture
Soft	▶	▶	▶	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶	▶		▶		
Hard	▶	▶	▶	▶	▶	▶		▶	▶	

ø 7.0 mm Fixture (Length : 10mm)



Bone quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	ø 4.6 drill	ø 5.5 direct drill	ø 6.2 direct drill	ø 6.5 direct drill	F7.0 Cortical Drill	ø 7.0 Fixture
Soft	▶	▶	▶	▶	▶	▶	▶	▶			Implant placement
Normal	▶	▶	▶	▶	▶	▶	▶		▶		
Hard	▶	▶	▶	▶	▶	▶	▶		▶	▶	

※ Recommended insertion torque: 40Ncm or less

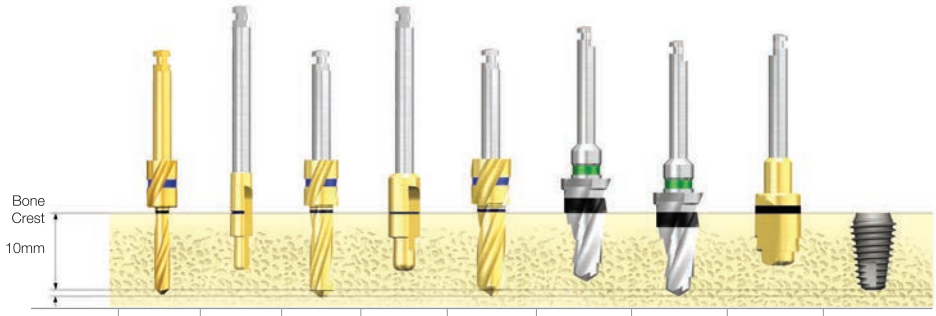
※ Depth control of TS/GS Fixture

- It depends on clinical situation, however, generally 0.5~1.0mm subcrestal position recommended.

Drilling Sequence for Ultra-Wide®

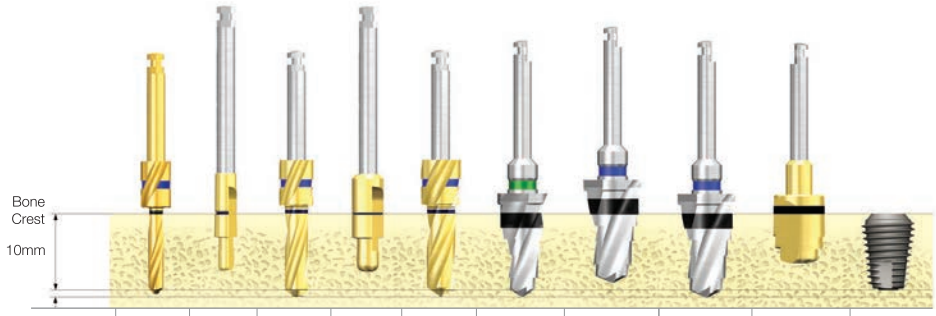
TSIII Ultra-Wide Fixture (Taper Drill)

ø 6.0 mm Fixture (Length : 10mm)



Bone Quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	F6.0 Taper Drill	F6.0 Taper Drill	F6.0 Cortical Drill	ø 6.0 Fixture
Soft	▶	▶	▶	▶		▶			Implant placement
Normal	▶	▶	▶	▶	▶		▶		
Hard	▶	▶	▶	▶	▶		▶	▶	

ø 7.0 mm Fixture (Length : 10mm)



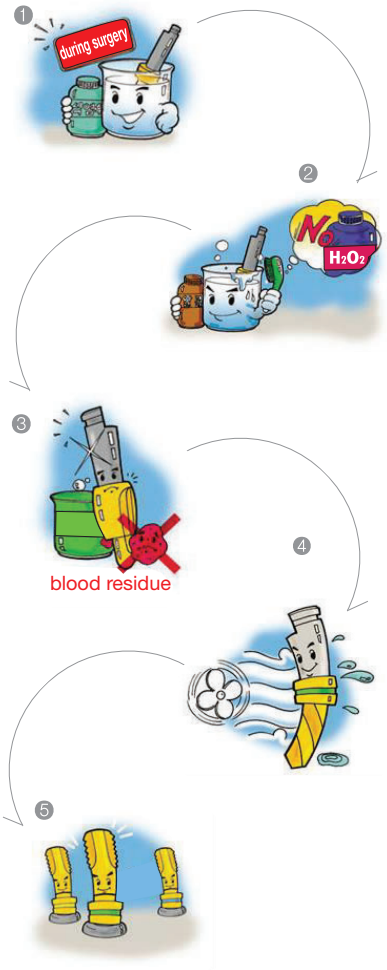
Bone Quality	ø 2.0 drill	Pilot drill (2.0/3.0)	ø 3.0 drill	Pilot drill (3.0/3.8)	ø 3.8 drill	F6.0 Taper Drill	F7.0 Taper Drill	F7.0 Taper Drill	F7.0 Cortical Drill	ø 7.0 Fixture
Soft	▶	▶	▶	▶	▶		▶			Implant placement
Normal	▶	▶	▶	▶	▶	▶		▶		
Hard	▶	▶	▶	▶	▶	▶		▶	▶	

※ Recommended insertion torque: 40Ncm or less

※ Depth control of TS/GS Fixture

- It depends on clinical situation, however, generally 0.5~1.0mm subcrestal position recommended.

Kit Maintenance



① Keep used tools in the saline solution or distilled water during the surgery.

② After surgery, all tools are separated and soaked in the alcohol solution for cleansing.

Caution

Tools kept in the kit for long times can be stained by humid.

Clean all tools periodically at least 1 time per quarter.

Do not use Hydrogen peroxide solution (H2O2), which can erase or corrode Laser Marking & Anodizing colors.

③ Completely clean and remove blood or foreign body remnants using distilled water or under running water.

④ Dry the tools using dry cloths or a dryer

⑤ Put the drills and tools at original position in the surgical kit

⑥ Dry the kit using an Autoclave (132℃, 15min) and Keep in the room temperature

Caution : Clean and keep all the tools immediate after surgery.

Sterilize the surgical kit just before the surgery (132℃, 15min).

Warranty of the surgical kit is 1 year after exposure.

Warranty of numbers of the drill reuse is 50 times.

2013
Osstem Implant System

Implant prosthodontics : Table of contents

Ⅳ Implant Prosthodontics

- By Dr. Kim, Ki-Seong
- By Dr. Kim, Se-Woung
- By Dr. Park, Hwee-Woong

OSSTEM IMPLANT

1. Introduction – By Dr. Kim, Ki-Seong

1) Introduction of implants in prosthodontics and its significance

As the goal of dental prosthesis or prosthodontics is the improvement of a patient's oral function and aesthetics, the introduction of implants in dentistry could be said to be the biggest revolution since the introduction of casting technique in the early 1900s. While the only alternative was to extract unhealthy teeth and deliver a removable denture, the casting technique provided a fixed prosthesis to continue maintaining one's teeth after treatment. Moreover, from the dentist's perspective, it became a critical tunning point that expanded interests previously limited to removable prosthesis that were close to mechanical devices such as full dentures, to physiology and anatomy of natural teeth and maxillofacial region. Since then, Dentistry and prosthodontics, accompanying other scientific fields, settled in as the specialized study and technique which research and improve function and aesthetics of natural teeth and oral and maxillofacial region. Introduction of modern implants proposed by P.I. Branemark in the late 1960s, was undoubtedly a milestone in not only dental prosthodontics or dentistry, but also in the entire medical field. Dentists and dentistry alike now show more attention to and research more in bone physiology and biology, and clinicians who only paid attention to intraoral or teeth treatment, now need to obtain physiological understanding of the maxillofacial region including the maxillary sinus, maxillofacial hard tissue (bone, teeth), and soft tissue, to perform minor operations and implant surgeries.
Especially, implant in prosthetic dentistry is no short of a milestone, its significance summarized as follows:

First, it is now possible to make fixed prosthesis for most cases. In mankind's era of prolonged life, it particularly implies that prosthodontics or dentists have strong means to increase the importance of teeth and to satisfy patient's convenience demands. With fixed prosthesis using implants, dentists, are now able to dramatically improve patient function, aesthetics, comfort, and phonetics with more predictability. Also, implant-supported prosthesis prevents disuse atrophy of the jaw bones by loading masticatory force into the bone. Moreover, improvements have been made in facial appearance, normal secretion of saliva, prevention of inflammatory changes in periodontal tissue caused by soft tissue-supported prosthesis, and maintaining overall body health.

Second, even removable prosthesis using implants can gain increased stability. In cases of fully edentulous patients, especially in the severely resorbed mandible, all clinicians are aware that the difference of patient convenience between conventional full denture and implant overdenture using 2~4 implants is significant. For such reasons, 15 international clinicians and dentists at the 2002 McGill Consensus, decided that implant overdenture in the mandible be the first choice standard of care for edentulous patients.

Third, in perio-prosthodontics perspective, early extraction and replacement with implant appeared as an reasonable method of treatment for hopeless teeth which continued bone loss despite treatment. When the only alternative after extraction was to prepare the adjacent teeth or use removable prosthesis, it is no

exaggeration to say that the object of periodontology was solely focused on keeping natural teeth in the mouth as long as possible. However, the introduction of implant that prevents bone resorption around teeth that contracted progressive periodontitis confirms the long-term benefits in oral health from extraction and early installation of implant. Nevins et al. have conveyed such idea with words as 'paradigm shift', which has powerful sociological meaning.

For clinicians, implant prosthodontics is a new opportunity as well as a source of stress. Prosthetic procedure related to implants is similar to prosthetic procedure for natural teeth, but nevertheless has completely new ideas.

Similar parts include:
First, procedures of impression, lab-work, and delivery are similar
Second, fitness of prosthesis is an important issue caused by contraction-expansion in impression/lab-work process.
Third, classic concepts such as occlusion and vertical dimension in prosthodontics are still important.

New ideas introduced in implant prosthodontics include:
First, the need to learn new concepts regarding implant superstructure(characteristics and types of abutment, prosthesis).
Second, the need to learn new concepts of taking impressions of implant or abutment.
Third, the decision to either attach implant superstructure with cement or screw.
Fourth, increased need to consider the biomechanical reaction between forces applied to implant prosthesis and implant and bone interface and its variables.
Fifth, more meticulous occlusal adjustment to control biomechanical load on implant than on natural teeth.

With such intents, this article demonstrates approaches to clinical guidelines that help clinicians to select their own implant system. In addition, occlusion of the implant prosthesis will be discussed.

2) Selection of implant system.

Since Prof. P.I. Branemark's first adoption of osseointegrated implant in 1965, varieties of implant systems have been developed and used. Various implants produced by Osstem implant corporations include: US(Universal Solution), SS(Success Solution), TS(Transcendent Solution), MS(Micro Solution) system, etc.**(Fig. 4-1)**

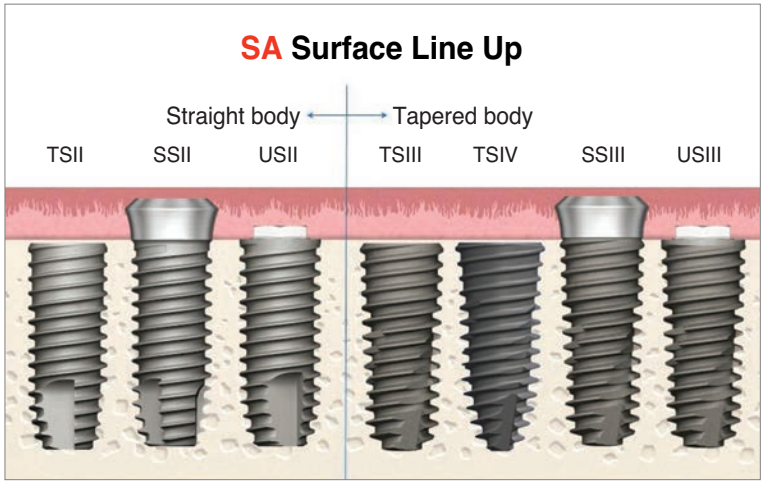


Fig. 4-1. Osstem implant SA surface line-up

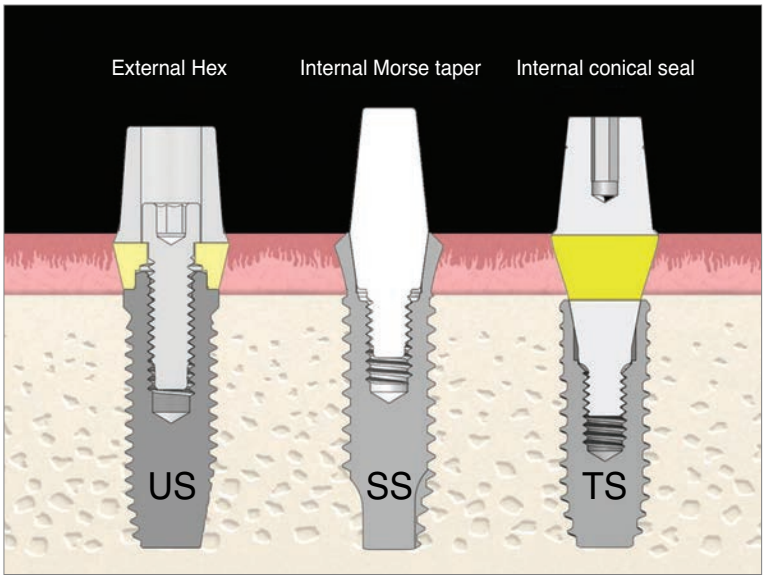


Fig. 4-2. Types of Osstem implant connection

Connection between implant and abutment is the critical factor in influencing the stability of implant, abutment, and prosthesis. These connection systems are divided into two main, External connection and Internal connection. **(Fig. 4-2)**

Osstem's US system, early traditional external type implant is designed so that hex top in the height 0.7mm is placed above implant platform, and an abutment is placed above that hex platform. US implant and abutment are connected with an abutment screw that is tightened with a setting torque (20Ncm~30Ncm). In fact, External connection is the prototype for modern implant. Most of the observed long-term data so far is External connection, because it has been used widely since long ago for fully edentulous jaw. This system demonstrates fairly good results in long-term observations in fully edentulous jaw. However, as clinical application of implant expanded to recovery of a single tooth or partially edentulous jaw, implant and abutment had to be loaded more. Because implant unit is more exposed to lateral bending moment, tipping or elongation when compared to implants for fully edentulous jaw, more joint opening and screw loosening has been reported relatively. We can also point out the shortcomings of difficulties in precisely locating Exernal hex clinically, especially in posterior teeth. While many solutions (increasing Hex height from 0.7mm to 1.0mm, increasing the Hex width, etc) have been proposed by several companies to solve the basic problems of External connection, no definite solution has been discovered nor is it being used extensively in clinics. On the other hand, Osstem introduced SS system and TS system, in which the lower part of abutment is located inside the implant platform. They are internal connection systems in which friction is created between the tapered interfaces of implant and abutment, at the same time clamping force is gained from the lower spiral helix. To supplement the shortcomings of External connection, the internal interface distributes lateral load to inside of implant, protects abutment screw by supporting with inner wall of implant, prevents disconnection by having more contact with long walls, completely buffers micro-vibrations, and acts as a barrier against microorganisms from entering into the implant.
When selecting the clinically optimal implant from such variety of implant structures and connections, many factors need to be considered.**(Table 4-1)**

Table 4-1. Considerations for optimal implant selection

Prosthetic considerations	Surgical considerations
• Retrievability • Limited interocclusal space • Compatibility with other implant system • Emergence profile • Screw & Cement Retained Prostheses • Screw loosening	• One-stage / Two-stage surgery • Second surgery • Guided Bone Regeneration(GBR) • Marginal(crestal) bone maintenance • Proximity to mandibular canal • Initial stability • Speed & quality of osseointegration

In general, US system of External connection type is advantageous for prosthetic convenience and retrievability, and SS system and TS system of Internal connection type is advantageous for stability of Joint and prevention of both bone loss and screw loosening. Utilizing the advantages and supplementing the disadvantages, any system can make clinically successful implant prosthesis. No specific implant system can be definitely superior to others.

3) Kinds of implant prosthesis and its selection

Implant prosthesis can be largely divided into two depending on the connection type of abutment to fixture. Cement-retained type and screw-retained type both clinically have advantages and disadvantages. **(Table 4-2)**

Table 4-2.
Advantages and disadvantages of cement-retained and screw-retained restoration

Screw-retained	Cement-retained
• Easy Retrievable • Easy to solve prosthetic complications • Difficult to obtain passive fit • Compromised esthetics • Compromised occlusal function	• Easier passive fit • More esthetic • Advantages in occlusal function & axial load • Time efficient & lower costs • Difficult to retrieve • Problems due to residual cement

Focusing on the biomechanical aspects, cement-retained type is relatively superior. Assuming perfect passive fit of prosthesis is basically difficult, screw-retained prostheses, especially for long-span prostheses, cannot avoid the misfit between fixtures and prostheses caused by errors in clinical and lab procedures. Thus, it always has possibilities that can overload the bone surrounding the implant. In contrast, by filling the gap between prosthesis and abutment with cement after fixture and abutment is passively connected, cement-retained prosthesis reduces or removes preloading by misfit, and more uniformly distributes load on implant than screw-retained type.

Recently, however, as the need for repair led by prosthetic complications such as mesial proximal contact loosening or fracturing of porcelain rises, securing retrevability became vital necessity. Hence, SCRP(Screw & Cement Retained Prostheses), which combines the advantages and reduces the disadvantages of both cement-retained type and screw-retained type are being widely used **(Fig. 4-3)**

SCRP is most compatible with external connection, and requires caution when applying to internal connection such as TS system, the most commonly used type in clinics today. Characteristically, internal connection has wide, long, interface contact between fixture and abutment, which limits 'Path of insertion' and thereby causes problems in attaching/removing the prosthesis. Moreover, it should also be considered that Settling or Sinking-down phenomenon of internal abutment can act as a cause of the misfit

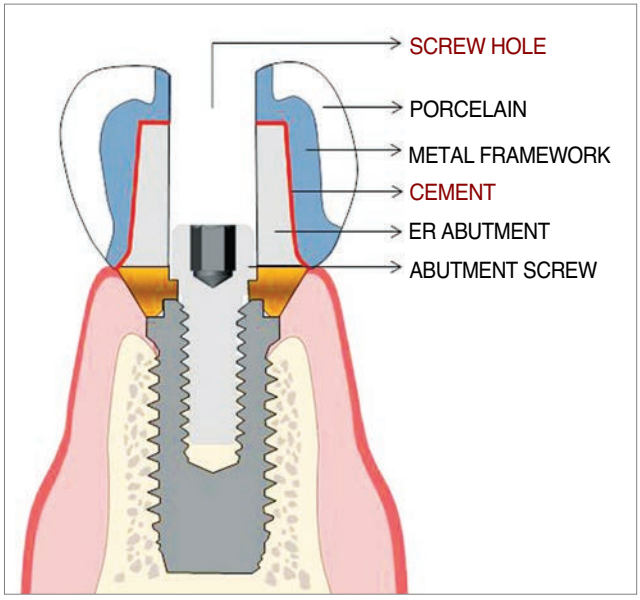


Fig. 4-3. SCRP(Screw & Cement Retained Prosthesis)

References

1. Misch CE. Dental Implant Prosthetics. Missouri: Mosby; 2005.
2. Feine JS, Carlsson GE, Awad MA et al. The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24-25, 2002. Int J Oral Maxillofac Implants 2002 17(4):601-2.
3. Nevins M., Mellonig JT. Implant Therapy. Carol Stream: Quintessence Publishing Co; 1998.
4. Adell R, Eriksson B, Lekholm U, Brånemark PI, Jemt T. Long-term follow-up study of osseointegrated implants in the treatment of totally edentulous jaws. Int J Oral Maxillofac Implants 1990;5(4):347-59.
5. Duncan JP, Nazarova E, Vogiatzi T, Taylor TD. Prosthodontic complications in a prospective clinical trial of single-stage implants at 36 months. Int J Oral Maxillofac Implants 2003 18(4):561-5.
6. Cho SC, Small PN, Elian N, Tarnow D. Screw loosening for standard and wide diameter implants in partially edentulous cases: 3- to 7-year longitudinal data. Implant Dent 2004 13(3):245-50.
7. Binon PP. Implants and components: entering the new millennium. Int J Oral Maxillofac Implants 2000 15(1):76-94.
8. Heckmann SM, Karl M, Wichmann MG, Winter W, Graef F, Taylor TD. Cement fixation and screw retention: parameters of passive fit. An in vitro study of three-unit implant-supported fixed partial dentures. Clin Oral Implants Res 2004 15(4):466-73.
9. Michalakis KX, Hirayama H, Garefis PD. Cement-retained versus screw-retained implant restorations: a critical review. Int J Oral Maxillofac Implants 2003 18(5):719-28.
10. Guichet DL, Caputo AA, Choi H, Sorensen JA. Passivity of fit and marginal opening in screw- or cement-retained implant fixed partial denture designs. Int J Oral Maxillofac Implants 2000 15(2):239-46.
11. Kim KS, Lim YJ, Kim MJ, Kwon HB, Yang JH, Lee JB, Yim SH. Variation in the total lengths of abutment/implant assemblies generated with a function of applied tightening torque in external and internal implant-abutment connection. Clin Oral Implants Res 2011;22:834-839.

4) Types of abutment of Osstem implant

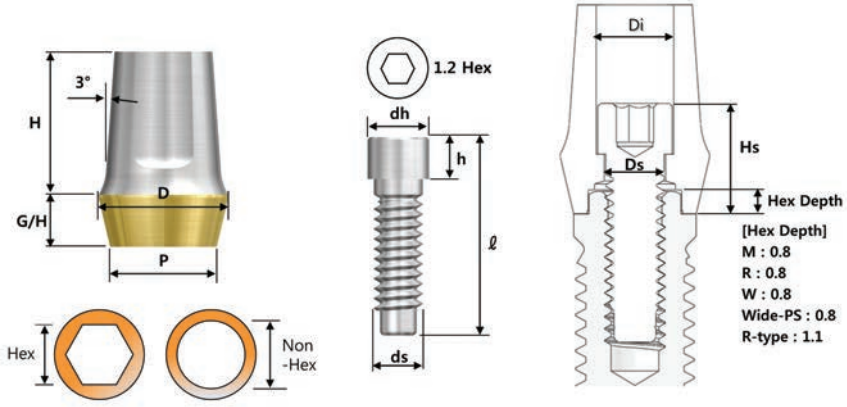
(1) Abutment of External implant: US system

① Cement abutment

Cemented abutment is used for cement-retained prosthesis, which is retained with dental cement. For aesthetics, the TiN coating is applied in the gingival area for gold coloring. The abutment is made of Ti-Grade 3 material. It features taper body design for easy prosthetic compatibility, anti-rotation surface to prevent rotation of single prosthesis, and chamfer margin for easy prosthesis fabrication. Dentists can prepare the abutment in the mouth, and dental technician can adjust the abutment in the model by milling. However, when repairing the prosthesis for reasons as abutment screw loosening or fracture and crown fracture, removal of prosthesis is difficult and thus decreases retrievability. And there is the inconvenience of removing excess cement around the abutment collar when delivering prosthesis. Recently, SCRP (which is an prosthetic design that connects abutment and final crown with cement and connects again to implant body with screw) is commonly used. There are two types in cemented abutment depending on how it is connected with fixture hex: the hex type, in which fixture hex and hex counterpart of abutment are connected, and the non-hex type, in which fixture hex and non-hex of abutment are connected. Specification of abutment is shown in **Table. 4-3**

Depending on the material of abutment screw, there are Ti-screw and EbonyGold screw, and head hex size is 1.2mm. 1.2 Hex hand driver is used for initial screw seating, but 1.2 hex torque driver must be used for final torque tightening. The tightening torque is 30Ncm for Ti-screw, and 20Ncm(mini), 30Ncm(regular and wide) for EbonyGold screw. To prevent screw loosening and screw fracture, retightening with intervals (2~3 times) is recommended.

Table 4-3. Specification of Cemented abutment



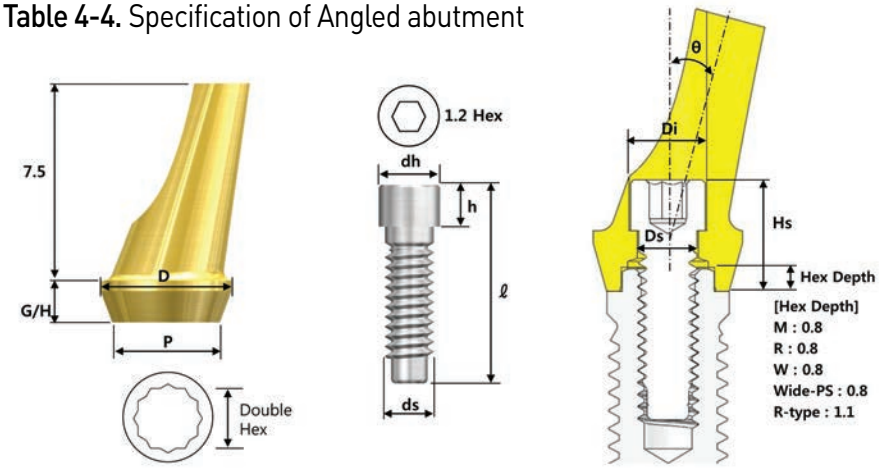
	Mini	Regular	Wide	Wide-PS	R-type		Mini	Regular	Wide	Wide-PS	R-type
Plat.(P)	ø3.5	ø4.1	ø5.1	ø5.0	ø5.0	Hs	3.7	3.7	3.7	3.7	4.2
Dia.(D)	ø4	ø5/ø6	ø6/ø7	ø6	ø6	dh	ø2.3	ø2.5	ø2.9	ø2.5	ø3.2
Height(H)	7	4, 5.5, 7	4, 5.5, 7	7	4, 5.5, 7	ds	ø1.6	ø2.0	ø2.5	ø2.0	ø2.5
G/H	2, 4	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4	-	h	1.7	1.7	1.7	1.7	2
Hex/ Non-Hex	2.4 / ø2.75	2.7 / ø3.1	3.4 / ø4.0	2.7 / ø3.1	ø3.3	ℓ	8.0	8.0	8.0	8.0	8.2
Di	ø2.4	ø2.6	ø3.0	ø2.6	ø3.3	Tightening Torque	30Ncm	30Ncm	30Ncm	30Ncm	30Ncm
Ds	ø1.7	ø2.1	ø2.6	ø2.1	ø2.6	Remarks			ø7, 5.5 only		only Hex

P : Platform diameter **D :** Abutment diameter **H :** Abutment height **G/H :** Gingival height **Hex :** Hex size
Non-hex : Non-hex hole diameter **Di :** Abutment screw hole diameter **Ds :** Abutment screw hole neck diameter
Hs : Distance from Platform to abutment screw head top **dh :** Abutment screw head diameter
ds : Abutment screw thread diameter **h :** Abutment head length **l :** Abutment screw length

② Angled abutment

Angled abutment is for cement-retained prosthesis, and is used to correct the path of fixture.
For aesthetics, the surface of Angled abutment is yellow colored by TiN coating, and is made of Ti-Grade 3.
Angled abutment has double hexagon in connection part, which provides 12 angles and 12 possible directions of connection with different 30 degrees when angled abutment is connected to fixture. Hence 12 repositioning positions of abutment are possible for convenience in compensating misaligned implant path .
Other characteristics are similar to those of cemented abutment. Depending on how tilted the abutment is, there are 15° angled abutment and 25° angled abutment. Their specifications are shown in **Table. 4-4**
The abutment screw is same as that for cement abutment, as well as the tightening torque which is 30Ncm for Ti-screw.

Table 4-4. Specification of Angled abutment

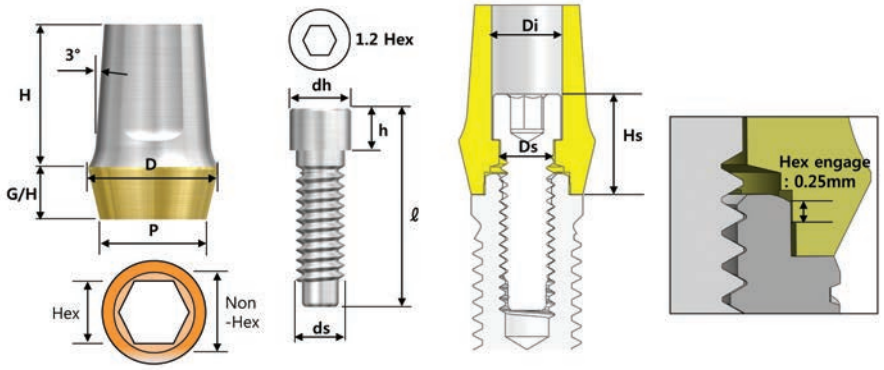


	Mini	Regular	Wide	Wide-PS	R-type		Mini	Regular	Wide	Wide-PS	R-type
Plat.(P)	ø3.5	ø4.1	ø5.1	ø5.0	ø5.0	Hs	3.7	3.7	3.7	3.7	4.2
Dia.(D)	ø4	ø5	ø6	ø6	ø6	dh	ø2.3	ø2.5	ø2.9	ø2.5	ø3.2
G/H	2, 4	2, 4	2, 4	2, 4	2, 4	ds	ø1.6	ø2.0	ø2.5	ø2.0	ø2.5
Angle(θ)	15° / 25°	15° / 25°	15° / 25°	15° / 25°	15° / 25°	h	1.7	1.7	1.7	1.7	2
Double Hex	2.4	2.7	3.4	2.7	3.3	ℓ	8.0	8.0	8.0	8.0	8.2
Di	ø2.4	ø2.6	ø3.0	ø2.6	ø3.3	Tightening Torque	30Ncm	30Ncm	30Ncm	30Ncm	30Ncm
Ds	ø1.7	ø2.1	ø2.6	ø2.1	ø2.6	Connection	All double hex				

③ ER abutment

ER abutment is used for cement-retained prosthesis, has its unique connection structure which has advantages of both Hex and Non-hex type. This is a specific abutment for combination type prosthesis(SCRP) which uses cement and also has screw access hole. Passive fit between implant and prosthesis can easily be made by using cement, thus minimizing complications of screw loosening and screw fracture by misfit in screw-retained prosthesis. Also, the screw access hole allows application of the screw-retained concept, which provides retrievability for easy removal of prosthesis. Structures except the connection part are equal to those of cemented abutment. Their specifications are shown in **Table. 4-5** Abutment screws, depending on the material are divided into Ti-screw and EbonyGold screw. The head hex size is 1.2mm. 1.2 hex hand driver is used for initial screw tightening, but 1.2 hex torque driver must be used for final torque tightening. Tightening torque is 30Ncm for Ti-screw, and 20Ncm(mini), 30Ncm(regular & wide) for EbonyGold screw. To prevent screw loosening and screw fracture, retightening with intervals (2~3 times) is recommended.

Table 4-5. Specification of ER abutment



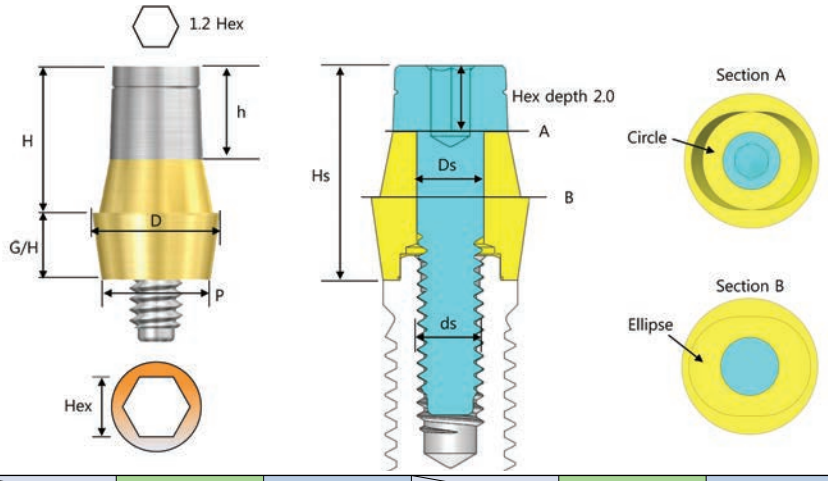
	Mini	Regular	Wide	Wide-PS		Mini	Regular	Wide	Wide-PS
Plat.(P)	ø3.5	ø4.1	ø5.1	ø5.0	Hs	3.7	3.7	3.7	3.7
Dia.(D)	ø4	ø5 / ø6	ø6/ ø7	ø6	dh	ø2.3	ø2.5	ø2.9	ø2.5
Height(H)	7	4, 5.5, 7	4, 5.5, 7	7	ds	ø1.6	ø2.0	ø2.5	ø2.0
G/H	2, 4	1, 2, 3, 4	1, 2, 3, 4	2, 4	h	1.7	1.7	1.7	1.7
Hex & Non-Hex	2.4 / ø2.8	2.7 / ø3.2	3.4 / ø4.0	2.7 / ø3.2	ℓ	8.0	8.0	8.0	8.0
Di	ø2.4	ø2.6	ø3.0	ø2.6	Tightening Torque.	30Ncm	30Ncm	30Ncm	30Ncm
Ds	ø1.7	ø2.1	ø2.6	ø2.1	Connection	Hex(upper) & Non-Hex(lower)			

④ Safe abutment

Safe abutment is used for cement-retained prosthesis, and is often used in molar prosthetic cases where screw loosening needs to be prevented. It consists of cylindrical abutment body with hex type connection, Ti-screw with large, protruding head part, Carrier cap, and Protect cap. It is gold colored in the gingival area for aesthetics, and is made of Ti-Grade 3. Safe abutment has only hex type connection in which two hexes are connected. Their specifications are shown in **Table. 4-6**

Because final implant prosthesis holds abutment body and abutment screw simultaneously with cement, unless the cement washes out, screw does not loosen, and therefore Safe abutment is useful for single implant prosthesis in molar region. Permanent cement with strong adhesiveness is recommended, and lack of retrievability after cementation of prosthesis is a disadvantage

Table 4-6. Specification of Safe abutment



	Regular	Wide		Regular	Wide
Plat.Dia.(P)	ø 4.1	ø 5.1	Hs	G/H + H, minimum 5mm	
Dia.(D)	ø 4.8	ø 6.0	Ds	ø 2.1	ø 2.6
Height (H)	4, 5.5, 7	4, 5.5	ds	ø 2.0	ø 2.5
G/H	1, 2.5, 4	1, 2.5, 4	h	If Height(H) is 4.0, 2mm, if Height(H) is 5.5 or 7, 3.5mm	
Hex	2.7	3.4	Tightening Torque	30Ncm	30Ncm

⑤ UCLA abutment

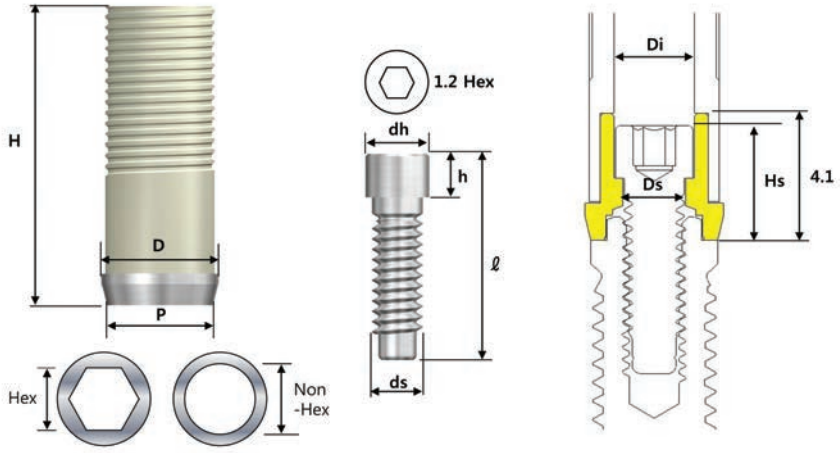
UCLA abutment is used for screw-retained type prosthesis. It is used when limitations in space and path make cement-retained type prosthesis difficult to fabricate and when aesthetics and precise customization are required. UCLA abutment allows flexible and easy customizing, and with gold casting, all three methods (Screw / Cement / SCRP type) are possible to make the prosthesis. Because screw-retained prosthesis is possible with UCLA abutment, it can permits prosthesis up to 4mm crown height space. It also has good retrievability because unscrewing allows removal of prosthesis. Making casting abutment allows convenient fabrication of prosthesis that requires severe angle corrections. However, it has some disadvantages, for example, high cost and time consuming, as well as complexity in laboratory procedure. It is often used in the anterior region for aesthetic prosthesis, and in the molar region for controlling angles of multiple implants.

There are two types in UCLA abutment depending on how it is connected with fixture: the hex type, in which Hex and Hex are connected, and the non-hex type, in which Hex and cylinder are connected. Their specifications are shown in **Table. 4-7**

Because abutment is made with fixture-level impression, prosthesis' passive fit may decrease because of errors in impression procedure. Hence, meticulous prosthetic procedure is necessary, and non-hex types should be used in multiple implant prosthesis to reduce errors. Abutment is made of either gold (melting point 1450~1500) with plastic, or only plastic. All plastic products reduce cost, but precision of connection part with fixture after casting also decreases. For easy distinction, hex type's plastic is ivory and non-hex type's plastic is white.

UCLA abutment that has been customized with pattern resin or wax needs to be casted by casting method of dental precious gold alloy. Use of gold alloy which has under 1200C melting range is recommended as the casting metal. Non-precious alloys as porcelain metal of Ni-Cr may lead to transformation of cylinder and discoloration after casting, and should not be used. The screw tightening torque (Ti-screw 30Ncm) used is same as that of cement abutment. **Table 4-7**. Specification of UCLA abutment

Table 4-7. Specification of UCLA abutment



	Mini	Regular	Wide	Wide-PS	R-type		Mini	Regular	Wide	Wide-PS	R-type
Plat.(P)	ø3.5	ø4.1	ø5.1	ø5.0	ø5.0	Hs	3.7	3.7	3.7	3.7	4.2
Dia.(D)	ø4.0	ø4.5	ø5.5	ø5.5	ø6.0	dh	ø2.3	ø2.5	ø2.9	ø2.5	ø3.2
Height (H)	12	12	12	12	12	ds	ø1.6	ø2.0	ø2.5	ø2.0	ø2.5
G/H	-	-	-	-	-	h	1.7	1.7	1.7	1.7	2
Hex/ Non-Hex	2.4 / ø2.75	2.7 / ø3.1	3.4 / ø4.0	2.7 / ø3.1	ø3.3	ℓ	8.0	8.0	8.0	8.0	8.2
Di	ø2.4	ø2.6	ø3.0	ø2.6	ø3.3	Tightening Torque.	30Ncm	30Ncm	30Ncm	30Ncm	30Ncm
Ds	ø1.7	ø2.1	ø2.6	ø2.1	ø2.6						

⑥ US ZioCera abutment

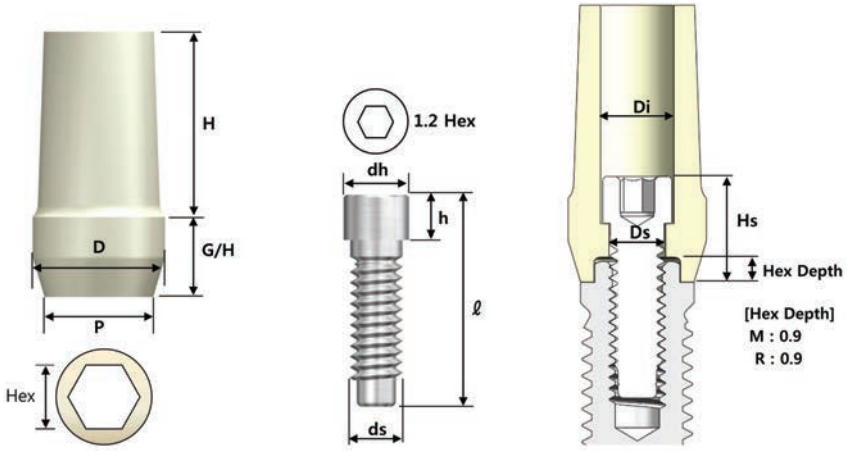
ZioCera abutment is a body-screw detachable, two piece prosthetic abutment, either cement- or screw-retained type prosthesis abutment, and is used for anterior aesthetic prosthesis.

ZioCera abutment demonstrates biocompatibility, is made of excellent strength Zirconia material, has ivory color similar to that of natural teeth, and is possible to make screw retained type prosthesis through direct porcelain Build-up. For increased operator convenience, straight and 17 angled types exist. All are hex type connection.

In maxillary anterior region where its anatomic morphology requires path control of abutment, utilizing angled type ZioCera abutment can decrease work for abutment customizing, and increase applicability of screw retained type prosthesis. If a satisfactory path is obtained, using straight type ZioCera abutment allows free customization in various forms. Generally, the ZioCera abutment is used as abutment for all ceramic prosthesis in cement retained type prosthesis.

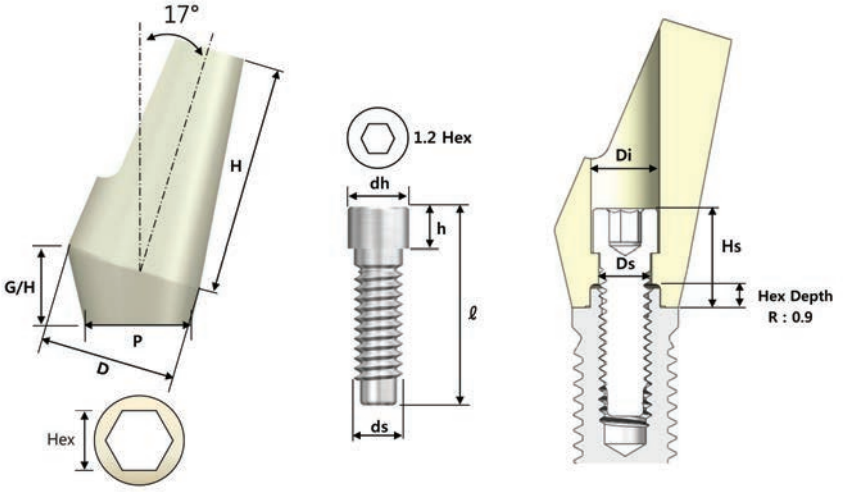
1.2 Hex hand driver is used for initial screw seating, but 1.2 hex torque driver must be used for final torque loading. The tightening torque is Ti-screw 30Ncm. To prevent loosen-fracturing of abutment screw, retightening with intervals (2~3 times) is recommended.**(Table. 4-8, 9)**

Table 4-8. Specification of ZioCera abutment



	Mini	Regular		Mini	Regular
Plat.Dia.(P)	ø3.5	ø4.1	Hs	3.8	3.8
Dia.(D)	ø5.0	ø5.0 / ø6.0	dh	ø2.5	ø2.5
Height(H)	7.0	7.0	ds	ø1.6	ø2.0
G/H	3.0, 5.0	3.0, 5.0	h	1.7	1.7
Hex	2.4	2.7	ℓ	8.0	8.0
Di	ø2.6	ø2.6	Tightening Torque	30Ncm	30Ncm
Ds	ø1.7	ø2.1	Connection	Only Hex type	

Table 4-9. Specification of ZioCera Angled abutment



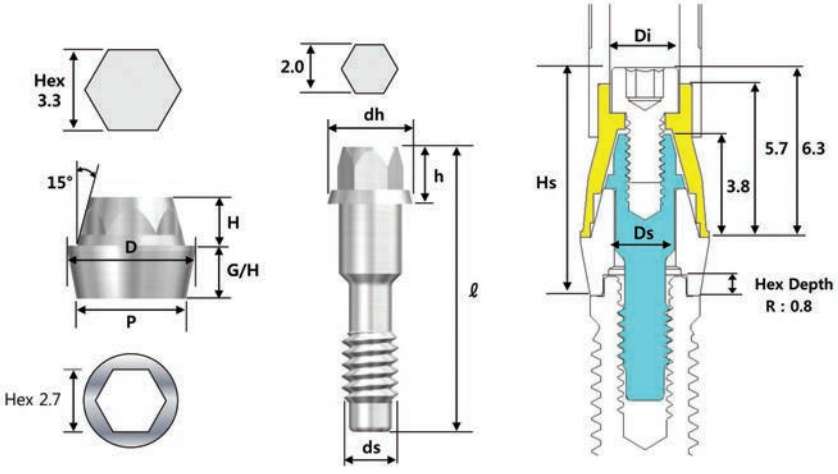
	Regular			Regular
Plat.Dia.(P)	ø4.1		Hs	3.8
Dia.(D)	ø5.5	ø6.5	dh	ø2.5
Height(H)	9.0	9.0	ds	ø2.0
G/H	3.0	4.0	h	1.7
Hex	2.7		ℓ	8.0
Di	ø2.6		Tightening Torque	30Ncm
Ds	ø2.1		Connection	Only Hex type

⑦ Esthetic abutment

Esthetic abutment uses cylinder screws to fasten screw-retained type prosthesis.

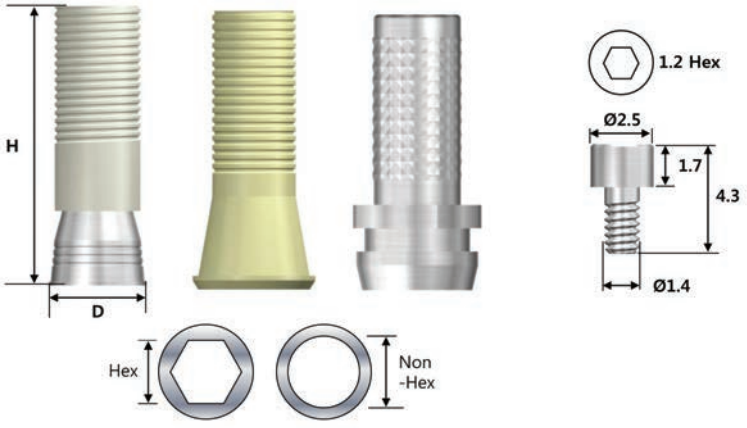
The conical area of abutment is slanted 15 degrees and allows adjustment of path up to 30 degrees, and its large contact area between abutment and cylinder provides durability against lateral pressure. There are 1, 2, 3, 4mm collar heights. Because the impression is taken in abutment level, accuracy of impression body is excellent in thick gingiva, and brings no inconvenience in attaching the prosthesis. The prosthesis is retained by screw so retrievability is also excellent. The abutment's conical part's height is 1.8mm despite it being screw retained type. Its gold cylinder height is 5.7mm, and cylinder screw exceeds slightly above. Hence, it can only be used when the occlusal clearance above fixture is minimum 7.3mm. Like UCLA abutment, an esthetically unpleasing screw hole on the crown occlusal surface exists. Depending on how abutment is connected with cylinder, there are hex types and non-hex types. Depending on the material, there are gold cylinder made of both gold and plastic, and plastic cylinder made of only plastic., There are titanium and EbonyGold cylinder screws. Tightening torque is 30Ncm for abutment screw, and 20Ncm for Ti cylinder screw. **(Table. 4-10, 11)**

Table 4-10. Specification of Esthetic abutment



	Regular		Regular
Plat.Dia.(P)	ø 4.1	Hs	G/H + 6.3
Dia.(D)	ø 4.8	dh	ø 3.0
Height(H)	1.8	ds	ø 2.0
G/H	1 / 2 / 3 / 4	h	2
Hex	2.7(only Hex type)	ℓ	G/H + 7.9
Di	ø 2.6	Tightening Torque	30Ncm
Ds	ø 2.3	Tightening driver	2.0 internal hex driver

Table 4-11. Specification of Esthetic cylinder



	Regular
Dia.(D)	ø 4.8
Height(H)	12
Hex / Non-Hex	3.3 / ø 4.1
Remarks	Cylinder Screw Tightening Torque 20Ncm

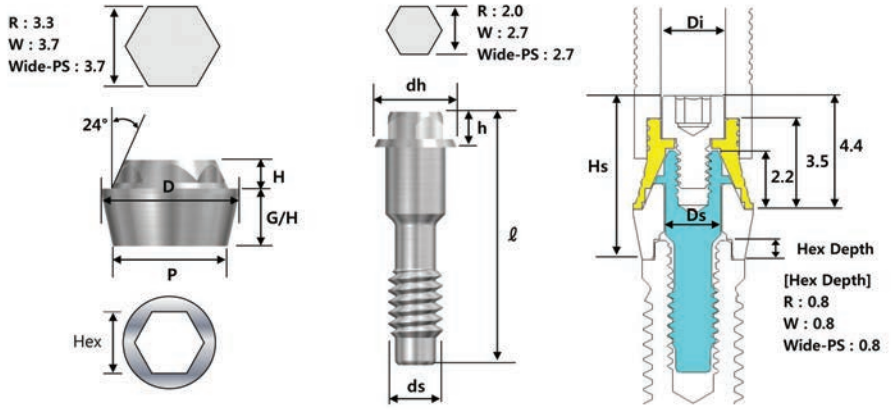
⑧ Esthetic-low abutment

Esthetic-low abutment uses cylinder screw to fasten screw-retained type prosthesis.

Height of conical part for esthetic low abutment is 1.0mm, and for gold cylinder is 3.5mm. Using G/H 1mm allows prosthesis in minimum occlusal clearance of 5.4mm. Because conical part is slanted up to 24 degrees, path can be adjusted up to 48 degrees. Other characteristic are same as those of esthetic abutment. Unlike esthetic abutment, esthetic low abutment has Wide PS type which is compatible with wide and 3i wide fixture.

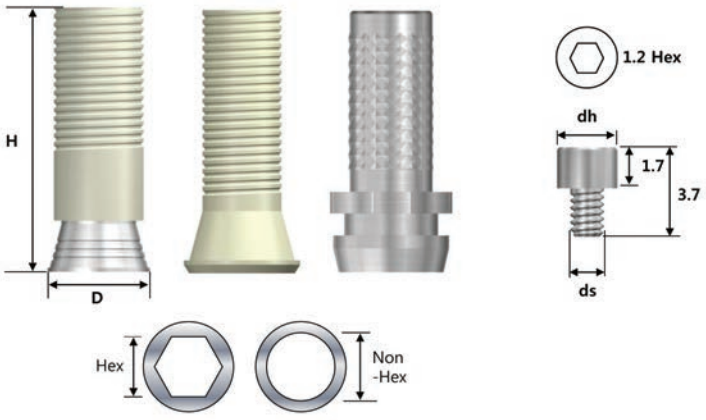
Cylinder screw uses the same screw as esthetic abutment. Tightening torque is 30Ncm for abutment screw, and 20Ncm for Ti cylinder screw. **(Table. 4-12, 13)**

Table 4-12. Specification of Esthetic-low abutment



	Regular	Wide	Wide-PS		Regular	Wide	Wide-PS
Plat.Dia.(P)	ø4.1	ø5.1	ø5.0	Hs	G/H+4.4	G/H+4.4	
Dia.(D)	ø4.8	ø5.5		dh	ø3.0	ø3.6	ø3.6
Height(H)	1.0	1.0		ds	ø2.0	ø2.5	ø2.0
G/H	1/2/3/4	1/2/3/4		h	2	1.3	1.3
Hex	2.7	3.4	2.7	ℓ	G/H+6.8	G/H+6.8	G/H+6.8
Di	ø2.6	ø3.0	ø3.0	Tightening Torque	30Ncm	30Ncm	30Ncm
Ds	ø2.3	ø2.9	ø2.9	Tightening driver	2.0(Regular), 2.7(Wide) internal hex driver		

Table 4-13. Specification of Esthetic-low cylinder



	Regular	Wide	Wide-PS
Dia.(D)	ø4.8	ø5.5	
Height(H)	12	12	
Hex/Non-Hex	3.3/ø4.1	3.7/ø4.6	
dh	ø2.5	ø2.9	
ds	ø1.4	ø2.0	
Remarks	Cylinder Screw Tightening Torque 20Ncm		

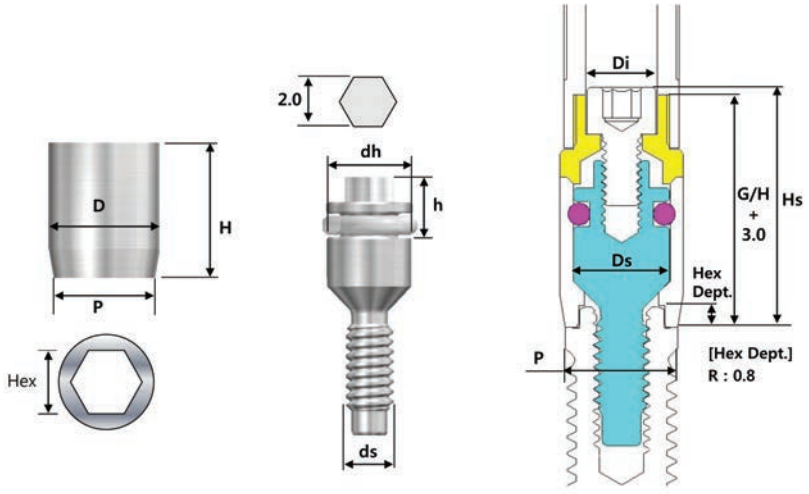
⑨ Standard abutment

Standard abutment uses cylinder screw to fix screw-retained type prosthesis, and is specific to multiple bridge often used in fully edentulous jaw. There is only regular fixture specification, so it must be considered when installing fixture. There is only non-hex type cylinder. Because fixture and abutment is connected with hexagon and abutment and cylinder is connected in 45 degrees tilting portion, it is convenient to correct unparallel path between fixtures. Also, the range of abutment heights (3, 4, 5.5, 7, 8.5mm) provides a wide scope of application. In addition, it has excellent retrievability because it is retained by screw. It is located 1~2mm higher than gingiva, so it is unaesthetic yet advantageous in manipulation and maintaining of oral hygiene.

Takking impression in abutment level, and send the impression & gold cylinder to dental laboratory room.

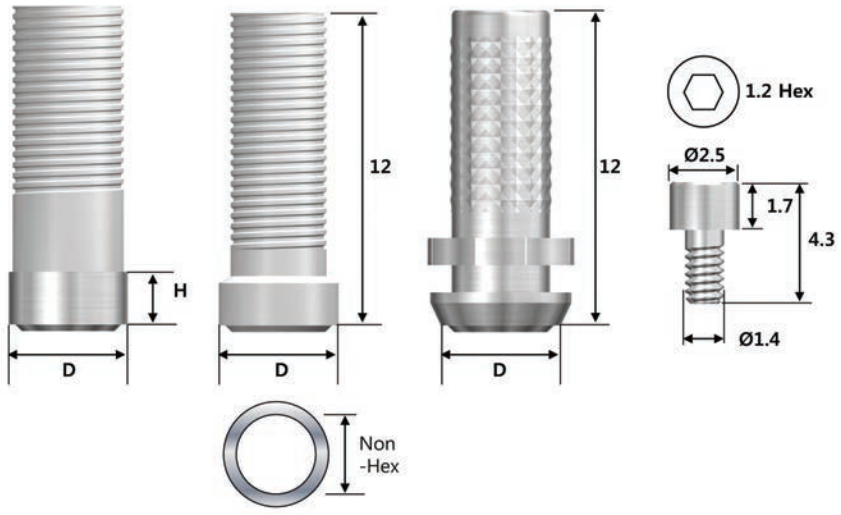
Depending on the material, there are gold cylinder made of both gold and plastic, and plastic cylinder made of only plastic. Torque for abutment tightening screw is 30Ncm, and 20Ncm for Ti cylinder. **(Table. 4-14, 15)**

Table 4-14. Specification of Standard abutment



	Regular		Regular
Plat.Dia.(P)	ø4.1	Hs	G/H + 3.25
Dia.(D)	ø4.5	dh	ø3.5
Height (H)	3, 4, 5.5, 7, 8.5	ds	ø2.0
Hex	2.7(only Hex type)	h	2
Di	ø2.6	Tightening Torque	30Ncm
Ds	ø3.6	Tightening driver	2.0 internal hex driver

Table 4-15. Specification of Standard cylinder



	Regular
Dia.(D)	ø 4.5
Height(H)	1.0, 2.0 (only Gold cylinder)
Non-Hex	ø 4.1(only Non-Hex type)
Remarks	Cylinder Screw Tightening Torque 20Ncm

⑩ O-ring abutment

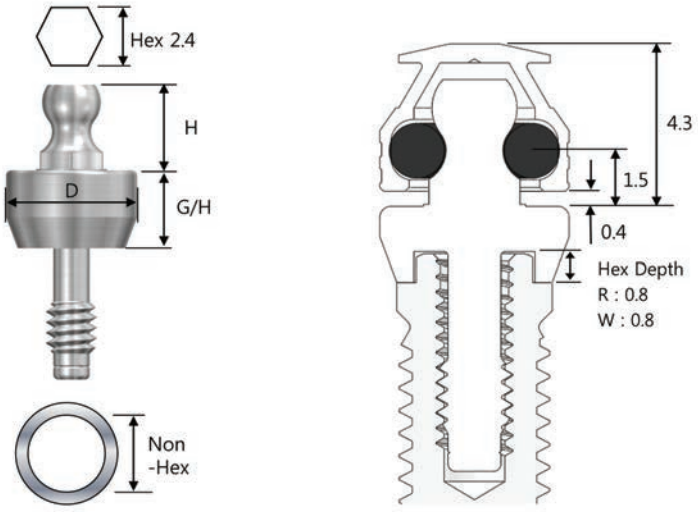
O-ring abutment is generally applied to prosthetic procedure for overdentures. Its O-ring attachment retained abutment, connected to fixture, and then acts as the male counterpart. It is used best when jaw bone resorption is severe, fixed type implant prosthesis is difficult, and full denture is deficient in retention and stability.

O-ring abutment is used along with retainer and O-ring. The retainer, in prosthetic procedure, is inserted inside denture during denture curing, and fastens the O-ring inside denture. The O-ring inserted in the retainer acts as the female counterpart. Black ring is used during lab procedure, and yellow ring(4N) and orange ring (6N) are used when delivering final prosthesis. If retention diminishes during usage, replace with a new one.

Fixture and abutment is connected with non-hex, and impression is taken in abutment level. O-ring abutment is only specific to regular and wide fixture. There are various collar heights depending on the gingival height. Specific data are in **Table 4-16.**

Tightening torque is 30Ncm using exclusive 2.4 hex O-ring abutment driver.

Table 4-16. Specification of O-ring abutment



	Regular	Wide
Plat.Dia.(P)	ø 4.1	ø 5.1
Dia.(D)	ø 5.0	ø 5.6
Height(H)	3.3	3.3
G / H	2, 3, 4, 5, 6	2, 3, 4, 5, 6
Non - Hex	ø 3.1	ø 4.0
Tightening Torque	30Ncm	30Ncm
Tightening driver	O-ring abutment driver	

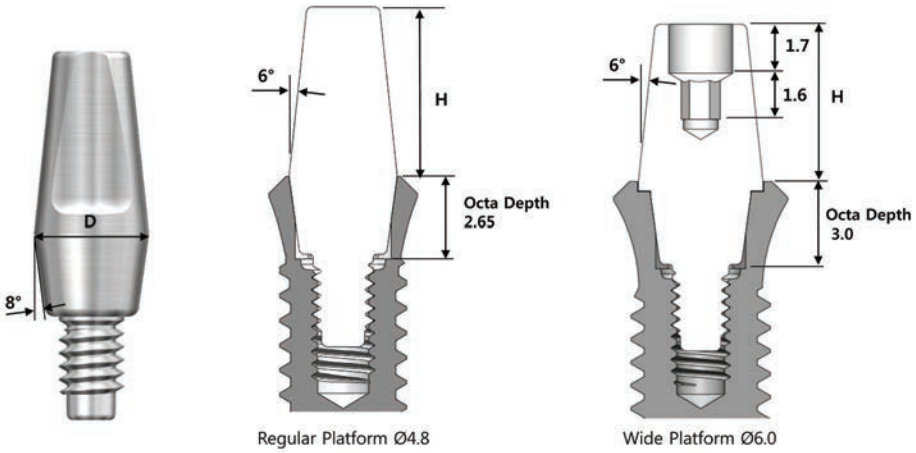
(2) Prosthetic abutment of internal implant: SS system

① Solid abutment

In solid abutment, structure of fixture body and screw is an integral 1-piece. It is cement-retained type abutment for internal connection type SS fixtures. Entire abutment is made of Ti-Grade 5 titanium alloy (To-6Al-4V), has an anti-rotation surface to prevent prosthesis rotation, has 8 degree Morse taper structure, and forms a stable connection with fixture. Because abutment and screw in solid abutment is a single piece, when attaching abutment, connection is made with rotation, not with hex. Hence, it is self-guiding and positioning is easy. Moreover, abutment is entirely made of titanium alloy and therefore has high fracture strength. Its connection mechanism which forms stable retention for abutment inside fixture, does not depend on screw's length, but on friction caused between two adjacent 8 degree Morse taper inclined plane, such as cold welding mechanism that prevents screw loosening. However, abutment cannot be replaced in the original circumferential direction after separation, because its single body rotates the anti-rotating surface after connection. Therefore, solid abutment needs to stay fixed inside the mouth, its impression needs to be taken after repeated tightening with final torque, and should not be further tightened after impression. If there are no modifications to abutment, take snap-on impressions using solid impression coping in abutment level. If abutment has been prepared, take direct impression by inserting retraction cord, or take direct impression after gingival sculpting by using solid retraction cap.

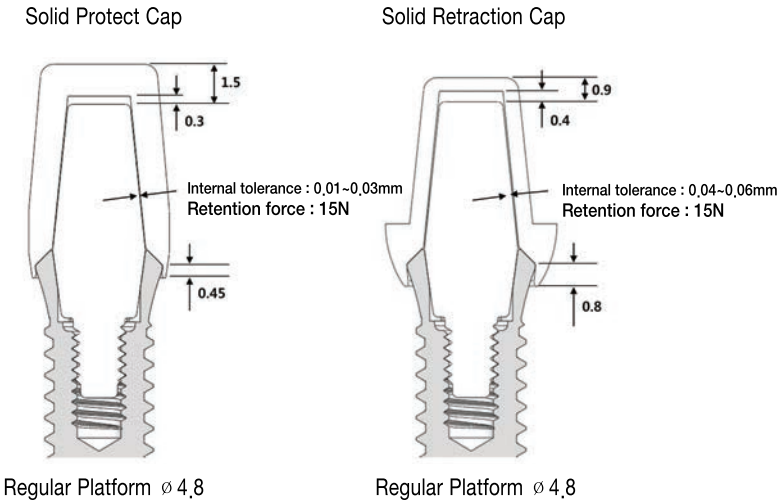
Solid abutment is a single bodied abutment for cement retained type prosthesis, and thus is easy and convenient. However, removal of prosthesis is difficult and thus decreases retreivability, not to mention the inconvenience of removing cement that drips when attaching prosthesis. Regular specific abutment has groove for exclusive driver connection, wide specific abutment has 1.2 hex on top for connection.
When connecting abutment, use conically processed abutment driver for platform 4.8 abutment, and 1.2 hex driver for platform 6.0. The tightening torque is 30Ncm.**(Table. 4-17, 18)**

Table 4-17. Specification of Solid abutment



	Regular	Wide
Plat.Dia.(P)	ø 4.8	ø 6.0
Dia.(D)	ø 3.5	ø 4.3
Height(H)	4, 5.5, 7	4, 5.5, 7
Tightening driver	Solid abutment driver	1.2 hex driver
Tightening Torque	30Ncm	30Ncm
Connection	8° Morse taper contact	

Table 4 -18. Specification of the Solid Protect Cap and Retraction Cap



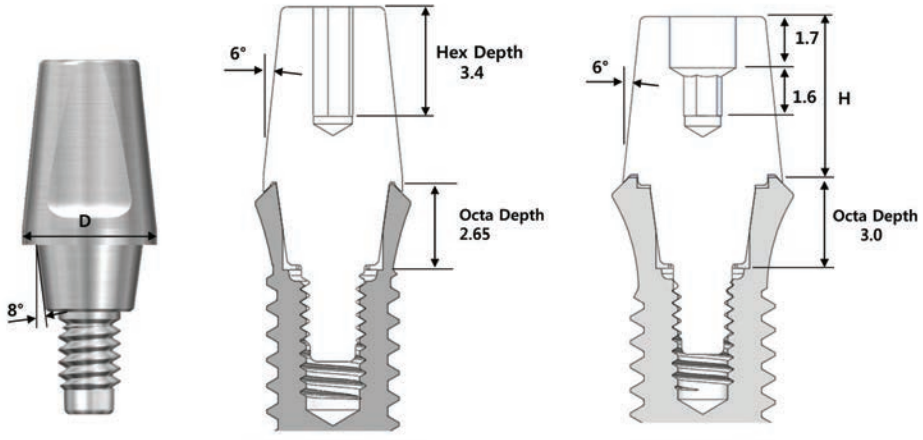
② Excellent Solid abutment

In Excellent Solid abutment, fixture body and screw is an integral 1-piece structure. It is cement-retained type abutment for internal connection type SS fixtures. The volume is 20~30% larger than that of solid abutment. Entire abutment is made of Ti-Grade 5 titanium alloy(To-6Al-4V), has an anti-rotation surface to prevent prosthesis rotation, has 8 degree Morse taper structure, and has stable connection with fixture.

Like Solid abutment, Excellent Solid abutment needs to be attached in the mouth and tightened with final torque before taking impression. Compared to Solid abutment, because of its large volume, relatively smaller volume is lost even after preparation for path correction and thus guarantees strength. In case of gold prosthesis, it is more economical because increased abutment volume can decrease amount of precious metal used, and has a larger cement surface area. In particular, this type of abutment prevents fracture of plaster model when abutment is milled and direct impression is taken.

Like Solid abutment, when connecting abutment, use conically processed excellent solid driver and 1.2 hex driver for platform 4.8 abutment, and 1.2 hex driver for platform 6.0. If necessary, upper part can be reduced up to 2mm because of sufficient hex depth. Excellent solid abutment has a wing in its margin area. To make constant contact with Morse taper when seated in fixture, it is designed with a gap of 0.01~0.1mm at 45 degree incline between wing and fixture. X-Rays will show a micro gap. Tightening torque is 30Ncm, retightening with intervals (2~3 times) is recommended to avoid abutment loosening.**(Table. 4-19)**

Table 4-19. Specification of Excellent Solid abutment



	Regular	Wide
Plat.Dia.(P)	ø 4.8	ø 6.0
Dia.(D)	ø 4.3	ø 5.3
Heigh(H)	4, 5.5, 7	4, 5.5, 7
Tightening driver	Excellent Solid abutment driver or 1.2 hex driver	1.2 hex driver
Tightening Torque	30Ncm	30Ncm
Connection	8° Morse taper contact	

■ **Excellent Solid Abutment Connection Design Concept**

To avoid screw loosening and fracture, Excellent solid abutment, is designed so that the connection structure provides constant contact with Morse taper. In case of Shoulder contact in which connection part's gap is contacted, Morse taper may not be contacted. This design concept is also applied to ComOcta abutment. **(Fig. 4-4)**

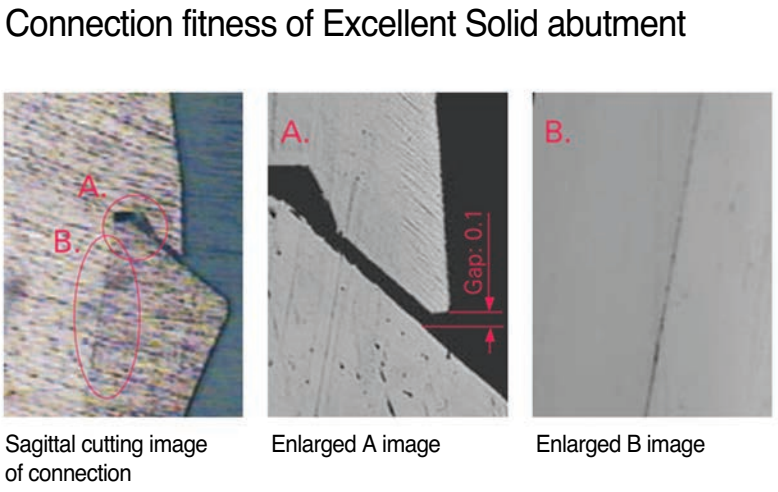


Fig. 4-4. Photos of connection fitness of Excellent Solid abutment

■ **Implant prosthesis' position of margin.**

Cement retained type implant prosthesis, depending on form of implant fixture, i.e. depending on the location of margin of superstructure, can be divided into "abutment margin system" and "implant (fixture) margin system". Abutment margin system is mainly applied to submerged implant systems as US, TS system, while implant margin system is mainly applied to non-submerged implant system as SS system. Abutment margin system refers to the superstructure's margin being set up on the abutment. Most external connection system and internal connection systems of TS system belong in this system.

Advantages include being able to adjust angle in subgingiva for making aesthetic superstructure and to flexibly respond to different gingival shapes. In other words, selecting the margin position of superstructure and expressing it on abutment by milling is its greatest advantage. While it is a disadvantage that processing superstructure is more difficult than that of implant margin system, it provides more flexibility and is often selected. In implant margin system, superstructure's margin is placed above implant fixture, and thus fabrication of superstructure becomes very simple. Also, superstructure's "ferrule effect" can be expected because margin is set on the implant fixture itself. Force applied on abutment screw is relatively less than on abutment margin system. Hence more predictable superstructure due to lack of screw loosening, fatigue, and fracture on single molar region under strong masticatory force can be made.

Typical examples are SS system's Solid and Excellent Solid abutment. However, if implant margin system is

chosen, the superstructure's margin location is already set. Therefore for aesthetic region, depth, location, and angle of insertion of implant fixture needs to be considered. If implant fixture is exposed in esthetic region, fixture's marginal area may need to be prepared, whereas if it is installed too deeply, risk of remaining cement in case of cementation may increase. Thus, for such implant system, it is recommended that ideal implant site development preceds implant fixture installation.**(Fig. 4-5)**

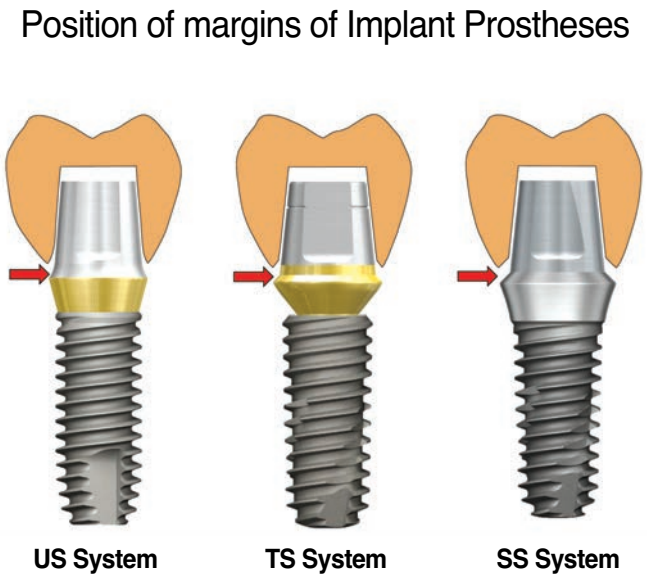


Fig. 4-5. Position of margins of implant prostheses in different implant systems

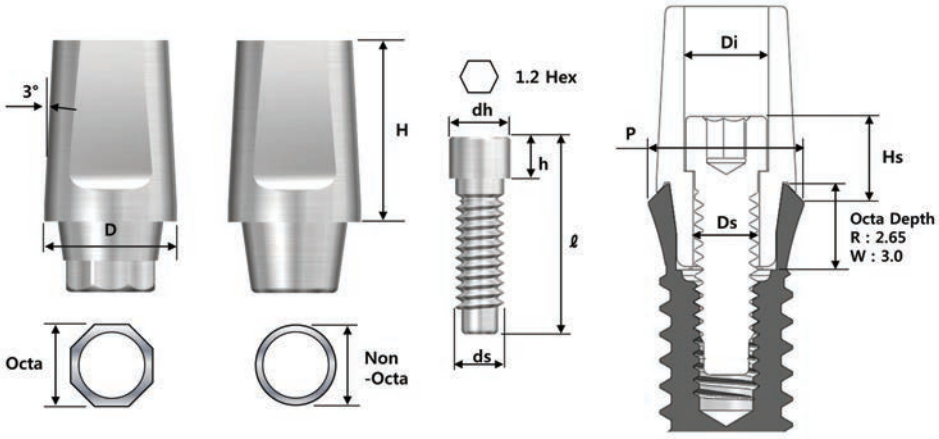
③ ComOcta abutment

In ComOcta abutment, fixture body and screw are separate 2-piece structure. It is cement-retained type abutment for internal connection type SS fixtures. It is made of Ti-Grade 5 titanium alloy (To-6Al-4V), has an anti-rotation surface to prevent prosthesis rotation, has 8 degree Morse taper structure, and has stable connection with fixture. Repositioning abutment is possible because abutment and screw are separate, and this allows convenient laboratory work as abutment can be transferred to and fro mouth and dental laboratory. Two repositionable octa and non-octa connection type are available on the bottom of abutment.

Because ComOcta is also cement type abutment, it has low retreivability, not to mention the inconvenience of removing cement that drips when attaching prosthesis. It can be used as SCRP for single tooth , in which abutment and crown is fixed with cement and finished prosthesis is connected to fixture with screw, but is not recommended because the prosthetic margin is on fixture, not on abutment.

ComOcta solid abutment has a wing in its margin area. To make constant contact with Morse taper when seated in fixture, it is designed with a gap of 0.01~0.1mm at 45 degree incline between wing and fixture. X-Rays will show a micro gap. 1.2 Hex hand driver is used for initial screw seating, but 1.2 hex torque driver must be used for final torque loading. Tightening torque is 30Ncm. Use same screws that are for UCLA screw. **(Table. 4-20)**

Table 4-20. Specification of ComOcta abutment



	Regular	Wide		Regular	Wide
Plat.Dia.(P)	ø 4.8	ø 6.0	Hs	2.65	2.3
Dia.(D)	ø 4.3	ø 5.3	dh	ø 2.5	ø 2.5
Height(H)	4, 5.5, 7	4, 5.5, 7	ds	ø 2.0	ø 2.0
G/H	-	-	h	1.7	1.7
Octa / Non-Octa	2.9 / ø 2.8	2.9 / ø 2.8	ℓ	8.0	8.0
Di	ø 2.6	ø 2.6	Tightening Torque	30Ncm	30Ncm
Ds	ø 2.1	ø 2.1	Remarks	Octa / Non-Octa type	
Connection	8° Morse taper contact				

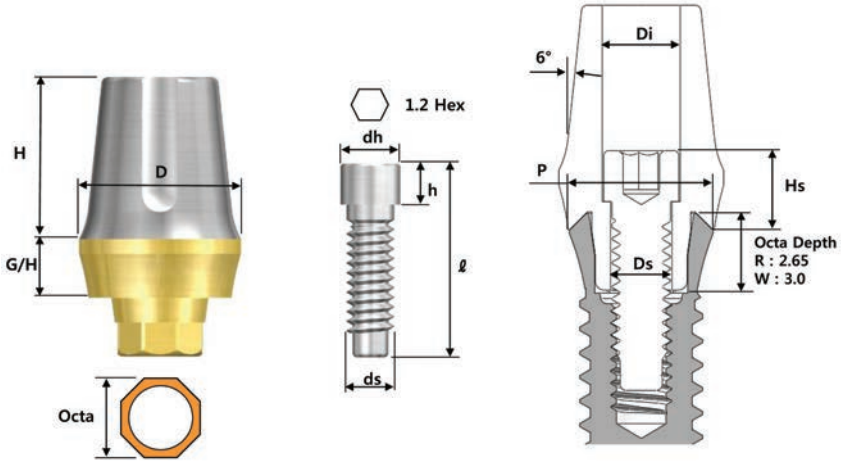
④ ComOcta Plus abutment

In ComOcta Plus abutment, fixture body and screw are separate 2-piece structure. It is a cement-retained type abutment for internal connection type SS fixtures. It is based on the ComOcta abutment, but is a cement-retained type whose prosthesis margin is on the abutment.

It is made of Ti-Grade 5 titanium alloy (To-6Al-4V), has an anti-rotation surface to prevent prosthesis rotation, and is TiN coated in Gold color for aesthetic purposes in the gingival area to minimize gray shade of gingival and crown. ComOcta Plus abutment supplements the inconvenient disadvantage of ComOcta abutment which were caused by prosthesis margin on the fixture. Hence, if the prosthesis margin is formed deep inside the gingival after deep fixture installation, using ComOcta Plus abutment with collar height of 2mm and 4mm makes high adjustment of prosthesis margin convenient. ComOcta Plus abutment has a wing, but unlike ComOcta abutment, it is designed so that Morse taper part is always apart and 45 degree incline between wing and fixture make constant contact. Hence, it makes Shoulder contact, not Morse taper contact. Gap between fixture and abutment caused by prosthesis margin being on abutment may facilitate growth of bacteria. To prevent this, the wing part is designed to make constant contact.

Only Octa speficification exists for implant connection, screws are same as ones used for ComOcta abutment, and tightening torque is 30Ncm as well. **(Table. 4-21)**

Table 4-21. Specification of ComOcta Plus abutment



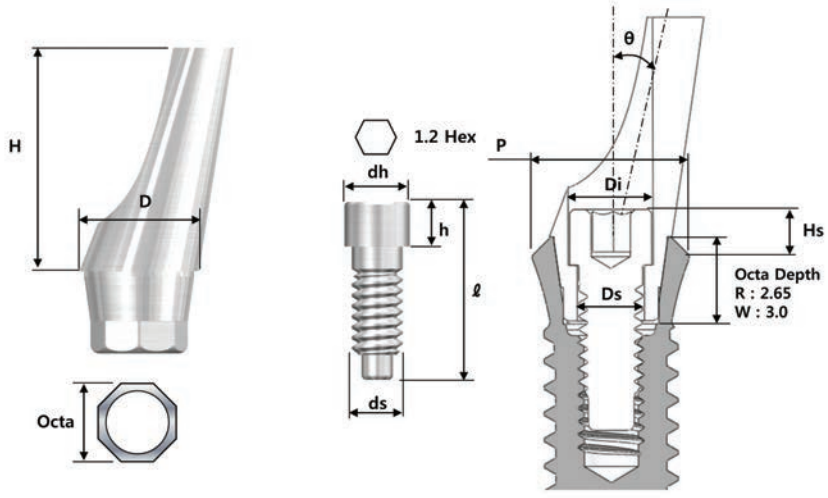
	Regular	Wide		Regular	Wide
Plat.Dia.(P)	ø 4.8	ø 6.0	Hs	2.65	2.3
Dia.(D)	ø 5.5	ø 6.5	dh	ø 2.5	ø 2.5
Height(H)	5.5	5.5	ds	ø 2.0	ø 2.0
G/H	2 / 4	2 / 4	h	1.7	1.7
Octa	2.9	2.9	ℓ	8.0	8.0
Di	ø 2.6	ø 2.6	Tightening Torque	30Ncm	30Ncm
Ds	ø 2.1	ø 2.1	Remarks	Only Octa type	
Connection	Shoulder contact				

⑤ ComOcta Angled abutment

In ComOcta Angled abutment, fixture body and screw are separate 2-piece structure. It is a cement-retained type abutment for internal connection type SS fixtures. It is an abutment used to adjust path of the fixture.

It is made of Ti-Grade 5 titanium alloy (To-6Al-4V), has 8 degree Morse taper structure, and has stable connection with fixture. Just like ComOcta abutment, repositioning abutment is possible because abutment and screw are separate, and this allows convenient laboratory work as abutment can be transferred to and fro mouth and dental laboratory There is an Octagon on the lower part so that repositioning is possible. Depending on the angle of incline, it can be divided into 15° Angled abutment and 20° Angled abutment. Other features are equal to those of ComOcta abutment. Screw specific to Angled abutment is used, and tightening torque is 30Ncm as well.**(Table. 4-22)**

Table 4-22. Specification of ComOcta Angled abutment



	Regular	Wide		Regular	Wide
Plat.Dia.(P)	ø4.8	ø6.0	Hs	1.4	1.05
Dia.(D)	ø3.75	ø4.3	dh	ø2.5	ø2.5
Height(H)	6.7	6.7	ds	ø2.0	ø2.0
θ	15°/ 20°	15°/ 20°	h	1.7	1.7
Octa	2.9	2.9	ℓ	6.75	6.75
Di	ø2.6	ø2.6	Tightening Torque	30Ncm	30Ncm
Ds	ø2.1	ø2.1	Remarks	Only Octa type, exclusive Ti screw	
Connection	8° Morse taper contact				

⑥ ComOcta Gold abutment

In ComOcta Gold abutment, fixture body and screw are separate 2-piece structure. It is a screw- or cement-retained type abutment for SS fixtures. It is designed so that it makes contact with fixture's 45 degree incline to make Shoulder contact rather than Morse taper contact.

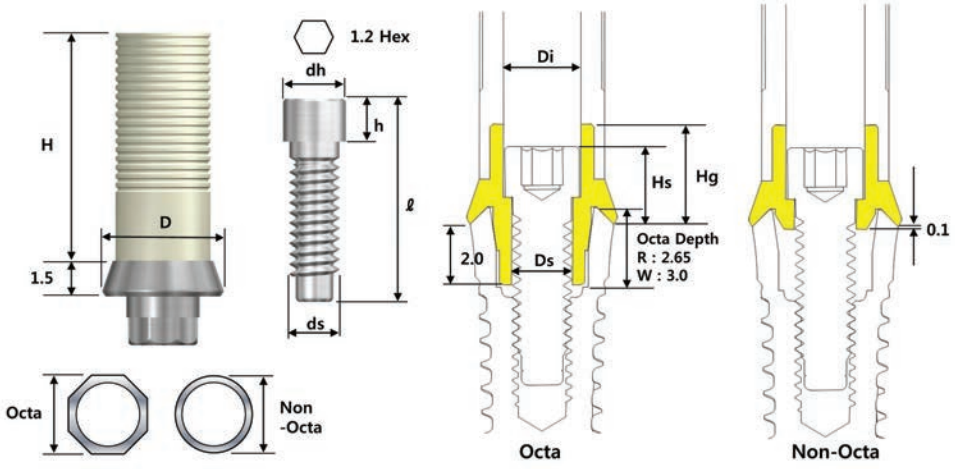
It is used when limitations in space and path make cement retained type prosthesis difficult to make and aesthetics and precise customization are required. ComOCta Gold abutment allows flexible and easy customizing, and with gold casting, all three methods (Screw/Cement/SCRP type) are possible to make the prosthesis. Abutment is made of gold (Au, Pt, Pd Alloy, melting point 1450~1500) and plastic (POM). For easy distinction, Octa type's plastic is ivory and Non-Octa type's plastic is white.

Prosthesis coping should be casted by dental technician after carving the abutment using pattern resin or wax on POM area. Dental technicians can personally manufacture custom abutment, and thus apply abutment to variety of cases. There are Octa and Non-Octa type connections for ComOCta Gold abutment. Non-Octa specification is suggested if path is severely misaligned on the bridge.

ComOcta Gold abutment that has been customized with pattern resin or wax needs to be casted with dental precious gold alloy. Use of gold alloy whose casting metal's melting range is under 1200C is recommended. Non-precious alloys as porcelain metal of Ni-Cr affiliation may cause transformation of cylinder and discoloration after casting, and thus should not be used.

Use same screw for ComOcta abutment. Tightening torque is 30Ncm as well. **(Table. 4-23)**

Table 4-23. Specification of ComOcta Gold abutment



	Regular	Wide		Regular	Wide
Plat.Dia.(P)	ø 4.8	ø 6.0	Hg	3.35	3.0
Dia.(D)	ø 5.05	ø 6.3	dh	ø 2.5	ø 2.5
Height(H)	10.0	10.0	ds	ø 2.0	ø 2.0
Octa / Non-Octa	2.9 / ø 2.74	2.9 / ø 2.74	h	1.7	1.7
Di	ø 2.6	ø 2.6	ℓ	8.0	8.0
Ds	ø 2.1	ø 2.1	Tightening Torque	30Ncm	30Ncm
Hs	2.6	2.1	Remarks	Octa / Non-Octa type	
Connection	Shoulder contact				

⑦ Hanaro abutment

Hanaro abutment is a cement-retained type prosthesis abutment designed based on ComOcta plus abutment. It is a multifunctional abutment capable of being used as fixture mount and impression coping.

Mount exclusive screw is used when used as fixture mount, and head is composed of 3.5 Octa so that use of simple mount driver is possible. Also, its body shape is designed to allow use for impression coping, and its flat surface indicates direction when taking impression.

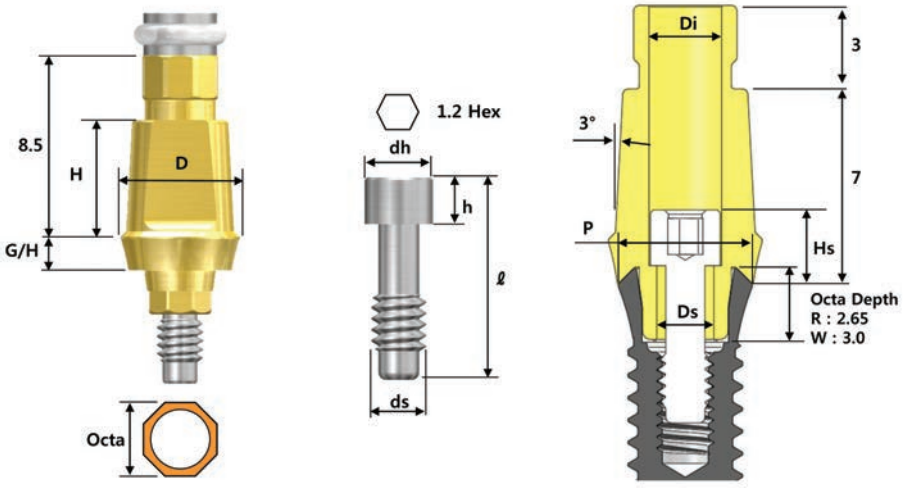
3mm of Octa part on the top can be reduced away, to be used as if it were ComOcta Plus abutment.

All features and directions of use are the same, except for its collar height which is 1.5mm.

Method of connection with fixture is also same as that of ComOcta plus. It makes constant shoulder contact in 45 degree incline, and Morse Taper part is always separate.

Use Hanaro abutment exclusive screw, and tightening torque is also 30Ncm. **(Table. 4-24)**

Table 4-24. Specification of Hanaro abutment



	Regular	Wide		Regular	Wide
Plat.Dia.(P)	ø 4.8	ø 6.0	Hs	2.65	2.3
Dia.(D)	ø 5.5	ø 6.5	dh	ø 2.5	ø 2.5
Height(H)	5.5	5.5	ds	ø 2.0	ø 2.0
G/H	1.5	1.5	h	2	2
Octa	2.9	2.9	ℓ	7.65	7.65
Di	ø 2.6	ø 2.6	Tightening Torque	30Ncm	30Ncm
Ds	ø 2.1	ø 2.1	Remarks	Only Octa type, exclusive Ti screw	
Connection	Shoulder contact				

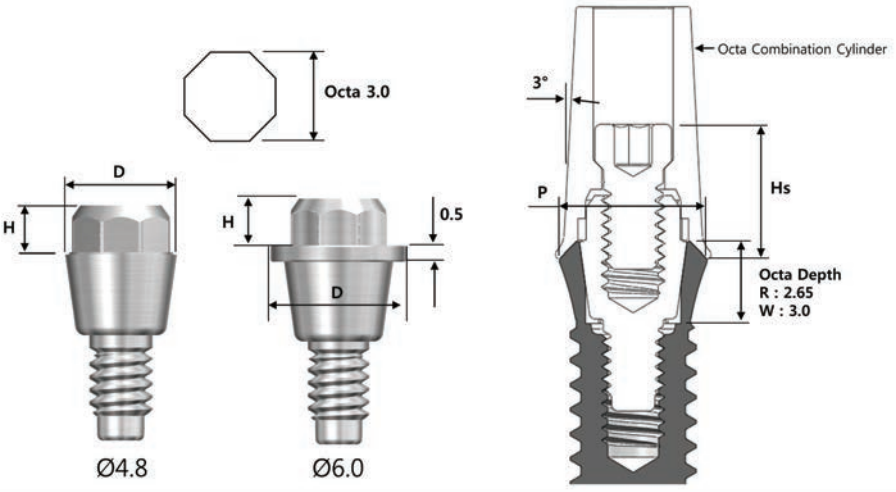
⑧ Octa abutment

Octa abutment allows screw-retained prosthesis by switching internal connection fixture (SSII, SSIII) to external connection fixture type and using gold cylinder above.

Internal connection fixture (SSII, SSIII) is developed based on cement-retained type prosthesis, and Octa abutment is developed to allow screw retained type prosthesis like external connection. Hence, when using Octa abutment, fixture and prosthesis is assembled with external connection, and is used to make screw retained type prosthesis in bridge cases with misaligned path.

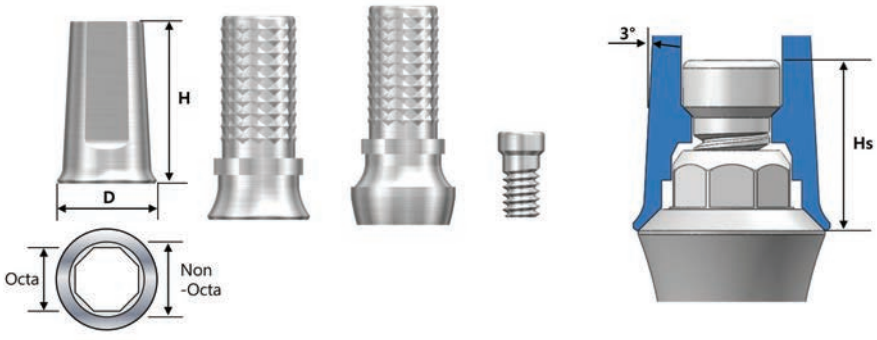
It requires minimum vertical clearance space of 4.5mm, and allows easy adjustment of prosthesis' configuration and angle depending on oral conditions. Cylinder attached above Octa abutment, depending on the material, can be divided into gold cylinder and plastic cylinder. Depending on the shape of part connecting to the abutment, it can be divided into single specific Octa cylinder and bridge specific Non-Octa cylinder. Use Octa driver to fasten Octa abutment with 30Ncm, and use 1.2 hex driver to fasten cylinder screw with 20Ncm. **(Table. 4-25~27)**

Table 4-25. Specification of Octa abutment



	Regular	Wide
Plat.Dia.(P)	ø 4.8	ø 6.0
Dia.(D)	ø 3.5	ø 4.3
Height(H)	1.5	1.5
Hs	4.4	4.5
Tightening Torque	30Ncm	30Ncm
Tightening driver	Octa Abutment driver	
Connection	8° Morse taper contact	

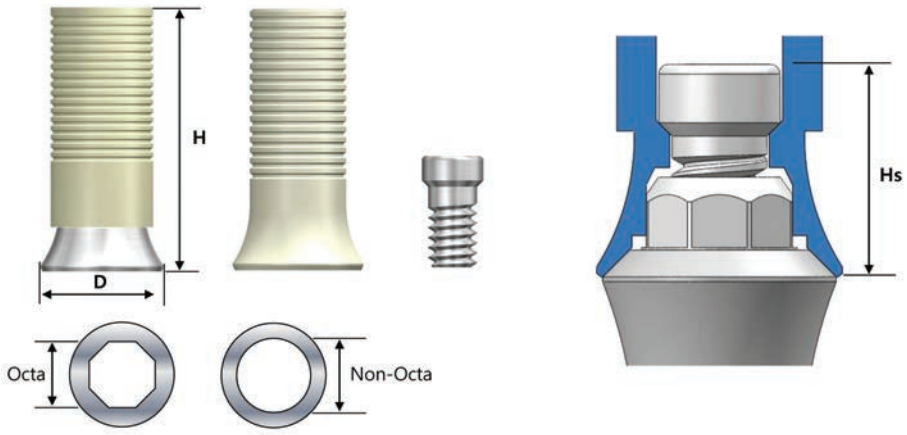
Table 4-26. Specification of Octa Combination & Temporary Cylinder



Special combined connection of Octa & Non-Octa type

		Regular	Wide
Plat.Dia.(P)		ø 4.8	ø 6.0
Dia.(D)	Combination cylinder	5.05	6.3
	Temporary cylinder	G/H 0:5.05 / G/H 2:5.5	G/H 0 : 6.3 / G/H 2 : 6.5
Heigh(H)	Combination cylinder	8	8
	Temporary cylinder	G/H 0 : 10 / G/H 2 : 9.5	G/H 0 : 10 / G/H 2 : 9.5
Hs		4.4	4.5
Octa / Non-Octa(ER structure)		3.0 / ø 3.1	3.0 / ø 3.1
Tightening Torque		20Ncm	

Table 4-27. Specification of the Octa Gold & Plastic Cylinder



		Regular	Wide
Plat.Dia.(P)		ø4.8	ø6.0
Dia.(D)		ø5.05	ø6.3
Height(H)	Gold cylinder	12	12
	Plastic cylinder	10	10
Hs		4.4	4.5
Octa / Non-Octa		3.0 / ø3.22	3.0 / ø3.22
Tightening Torque		20Ncm	

⑨ O-ring abutment

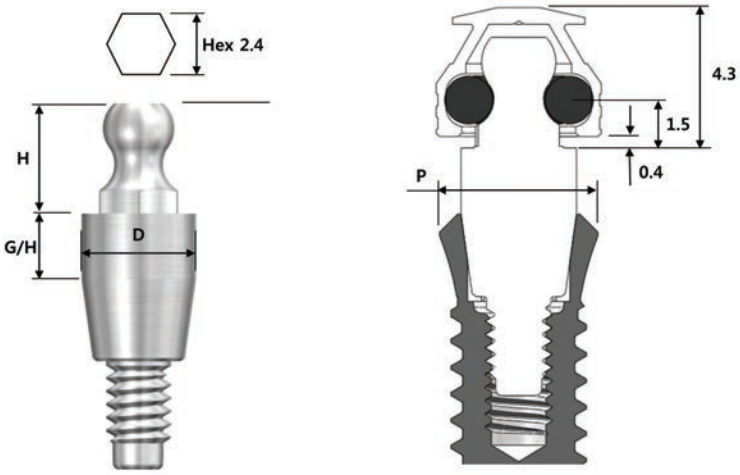
O-ring abutment is generally applied to prosthetic procedure that uses overdentures. The O-ring attachment retained abutment, connected to fixture, acts as the male counterpart.

It is used best when jaw bone resorption is severe, fixed type implant prosthesis is difficult, and full denture is deficient in retention and stability.

O-ring abutment is used along with retainer and O-ring. The retainer, in prosthetic procedure, is inserted inside denture during denture curing, and fastens the O-ring from the inside. The O-ring inserted in the retainer acts as the female counterpart. Black ring is used during prosthetic procedure, and yellow ring(4N) and orange ring (6N) are used when attaching (intraoral) final prosthesis. If retention diminishes during usage, replace with a new one. Fixture and abutment is connected with non-hex, and impression is taken in abutment level. Only O-ring abutment for platform 4.8 exists, so caution is advised. Multiple collar heights exist depending on gingival tissue height.

Tightening torque is 30Ncm, and use exclusive 2.4 hex O-ring abutment driver to tighten. **(Table. 4-28)**

Table 4-28. Specification of O-ring abutment



	Regular
Plat.Dia.(P)	ø 4.8
Dia.(D)	ø 3.5
Height(H)	3.3
G/H	0, 2, 4
Tightening driver	2.4 hex O-ring abutment driver
Tightening Torque	30Ncm
Connection	8° Morse taper contact

(3) Prosthetic abutments of internal implant: GS/TS system

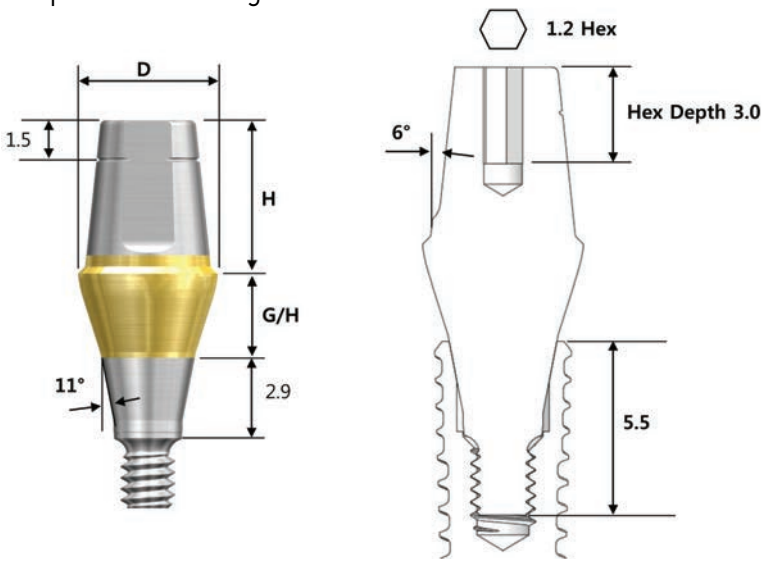
① Rigid abutment

In rigid abutment, fixture body and screw are one body. It is a 1-piece GS/TS exclusive cement-retained type prosthesis abutment and has 11 taper conical seal structure with stable connection.

For aesthetic purposes, Rigid abutment has area near Gingiva yellow colored through TiN coating. And it has 6 degree tapered anti-rotation surface same to that of body, which prevents interference during connection of prosthesis Because abutment and screw in solid abutment is a single piece, when attaching abutment, connection is made with rotation itself, not with hex. Hence, it is self-guiding and positioning is easy. Moreover, abutment is entirely made of Grade 5 titanium alloy and therefore has high fracture strength. Its connection mechanism which forms stable retention for abutment inside fixture does not depend on screw's length, but on friction caused between two conical inclines such as cold welding mechanism that prevents screw loosening. However, abutment cannot be replaced in the original circumferential direction after separation, because its single body rotates the anti-rotating surface after connection. Therefore, Rigid abutment needs to stay fixed inside the mouth, its final impression be taken after repeated fastening with final torque, and should not be further tightened after impression taking. If there are no modifications to abutment, take snap-on impressions using Rigid impression coping in abutment level. If abutment has been prepared, take direct impression by inserting retraction cord, or take direct impression after gingival sculpting using Rigid Retraction Cap., While Rigid abutment provides simple and convenient connection as single body abutment for cement retained type prosthesis, its retrievability is low when it needs to be removed. Moreover, because abutment and prosthesis may loosen counterclockwise if it is used as sole abutment in molar region where it is exposed to strong bite pressure, it should be used as abutment for 2 or more connected prosthesis in molar region.

Because of collar height, abutment diameter and height needs to be selected for Rigid abutment inside the mouth directly. It is convenient to assort all specifications of abutment in treatment room.
Ø4.0/Ø4.5 specifications have same abutment diameter, but are divided into Mini/Regular applicable fixtures. One must check whether the fixture specification is Mini or Regular, and choose the corresponding abutment specification. For abutment diameter of 4mm, tighten with Rigid Outer driver, for Ø4.5, Ø5.0, Ø6.0, use either Rigid outer driver or 1.2 hex driver, for Ø7.0, use 1.2 hex driver. Tightening torque is 30Ncm for all specifications. To prevent loosening of abutment screw, retightening with intervals (2~3 times) is recommended. **(Table. 4-29)**

Table 4-29. Specification of Rigid abutment



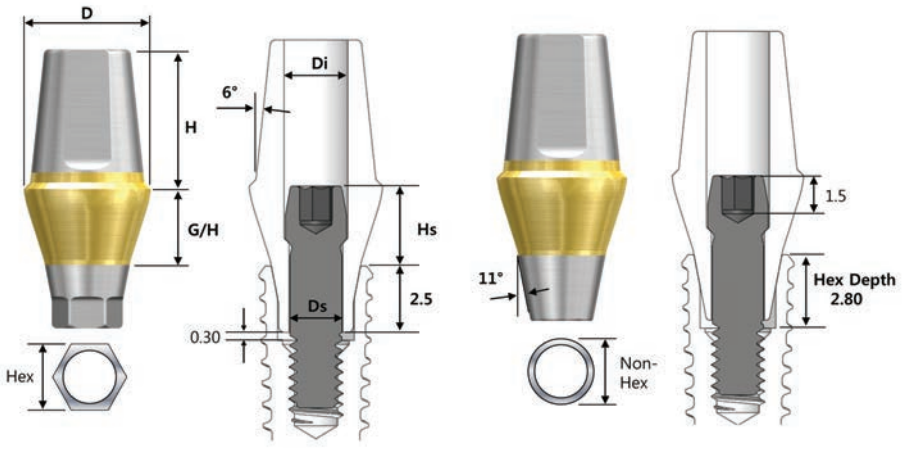
	Mini	Regular
Dia.(D)	ø4.0, ø4.5	ø4.0, ø4.5, ø5.0, ø6.0, ø7.0
Height(H)	4, 5.5, 7	4, 5.5, 7
G/H	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Tightening Torque	30Ncm	30Ncm
Tightening driver	ø4.0: Rigid Outer driver, ø4.5, ø5.0, ø6.0: Rigid Outer driver or 1.2 hex driver	
Remarks		ø7.0, only H 5.5 type

② Transfer abutment

In Transfer abutment, fixture body and screw are separate. It is the most often used abutment for 2-piece GS/TS exclusive cement-retained type prosthesis and has 11° taper conical seal structure with stable connection. For aesthetic purposes, Transfer abutment has area near gingiva yellow colored through TiN coating. And it has 6 degree tapered anti-rotation surface same to that of body, which prevents interference during connection of prosthesis. Because transfer abutment is two-pieced, attach abutment body first and then connect abutment screw by rotating.
There are Hex and Non-Hex type connection for abutment, and repositioning using Hex structure is possible (Non-hex can use transfer jig to reposition), so abutment can be transferred to and fro mouth and dental laboratory for prosthetic procedure.

Because it is possible to choose and modify abutment on working model after impression taking in fixture level, it is not necessary to assort all specifications of abutment in treatment room.
As the transfer abutment body's upper part has the same configuration as that of Rigid abutment, it is possible to take abutment level impression by using Rigid impression coping or Rigid Retraction cap. Connection mechanism of transfer abutment attaining stable retention inside fixture is maintained by height of abutment screw, and therefore is relatively less stable in its connection part than Rigid abutment. However, Preload was increased to enhance stability of connection part by using Ebony Gold screw which is a WC/C (tungsten carbide/carbon)coated titanium alloy. In addition, resistance to fracture strength is reinforced by using Titanium Grade 5 titanium alloy for abutment body and all abutment screws.
Because abutment misconnection may occur because of inaccurate seating of Hex and interruption by bone or adjacent tissue around fixture, connection area of fixture must be verified after abutment seating using X-ray photography. If possible, use healing abutment to sculpt soft tissue and remodel bone tissue before abutment connection. Transfer abutment can be used for cement retained type prosthesis, but is more convenient in its repair/maintenance than single bodied Rigid abutment, because it is possible to loosen abutment screw and remove superstructure through a hole in the occlusal surface in case of food packing or porcelain fracture which necessitates removal of prosthesis.
Moreover, for single rehabilitation cases, one can begin with SCRP. In other words, abutment and superstructure are connected with cement and such prosthesis can be fastened onto the fixture using screw hole in the middle. However when being used abutment for multiple connected prosthesis, the Hex may be a limiting factor for 'Path of insertion' of implant prosthesis in Hex-type abutment, and prohibit connection and disconnection of prosthesis. Thus, Non-Hex must be used.
If abutment diameter is 4.5mm, abutment has same diameter but needs distinction between Mini/Regular fixtures. It is necessary to confirm whether Mini or Regular specific fixtures were used, and use the corresponding abutment and EbonyGold screw. Inner connection of TS system's 3.5mm Mini Fixture is composed of conical seal, Hex structure, and two screw threads with different diameters.
Upper screw thread with 2mm diameter is used to connect to Mini Fixture exclusive 1-piece abutment as Rigid abutment, and lower screw thread with diameter 1.6mm is used to connect to 2-piece abutment as Transfer abutment. **(Fig. 4-6)** The total height for Mini Fixture's connection is 8.0mm because of the dual diameter thread structure. It is longer than 6.5mm of Regular Fixture, and Mini specific EbonyGold screw is also longer than that of Regular Fixture. Thin and long Mini specific EbonyGold screw may over-elongate and fracture if it is connected with a torque of 30Ncm. Hence, final connection torque is limited to 20Ncm.
1.2 Hex hand driver is used for initial screw seating, but 1.2 hex torque driver must be used for final torque loading. The tightening torque is 20Ncm for Mini, and 30Ncm for Regular. To prevent loosen-fracturing of abutment screw, retightening with intervals (2~3 times) is recommended.
Unlike Us, SS system, abutment may settle down into fixture (approximately 50㎛) depending on force that tightens EbonyGold screw in GS/TS system which uses 11 degrees taper connection. Hence, to minimize transformation of occlusion and misfit of prosthesis, abutment needs to be sufficiently slinked down by repeatedly tightening with final torque and then processing final prosthesis via abutment level impression.**(Table. 4-30, 31)**

Table 4-30. Specification of Transfer abutment



	Mini	Regular
Dia.(D)	ø4.5	ø4.5, ø5.0, ø6.0, ø7.0
Height(H)	5.5, 7	4, 5.5, 7
G / H	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Hex/Non-Hex	2.1 / ø2.0	2.5 / ø2.4
Di	ø2.3	ø2.4
Ds	ø1.7	ø2.1
Hs	3.1	3.0
Tightening Torque	20Ncm	30Ncm
Remarks	No H4.0mm type	No ø4.5 H4.0mm type

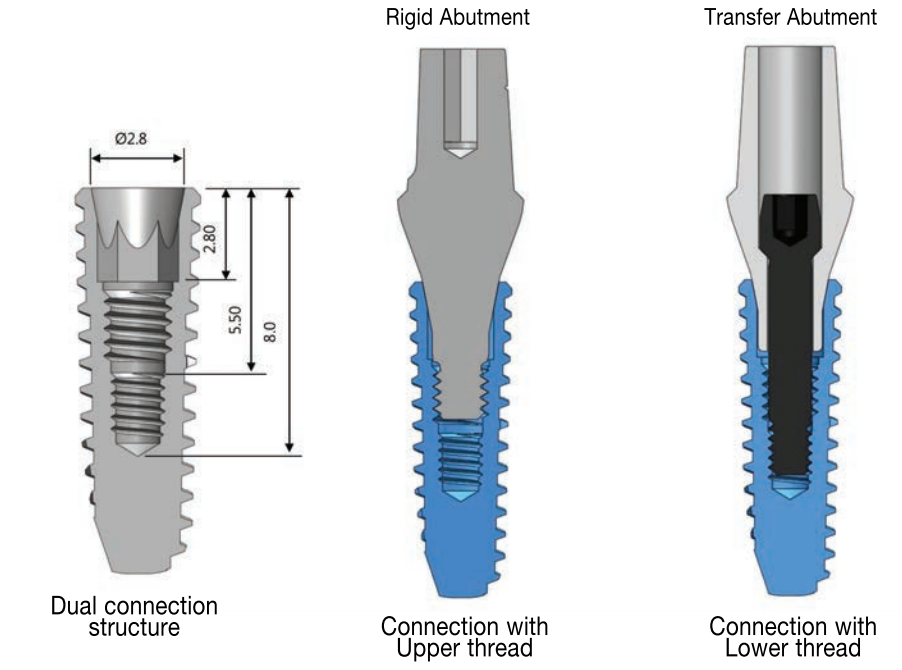
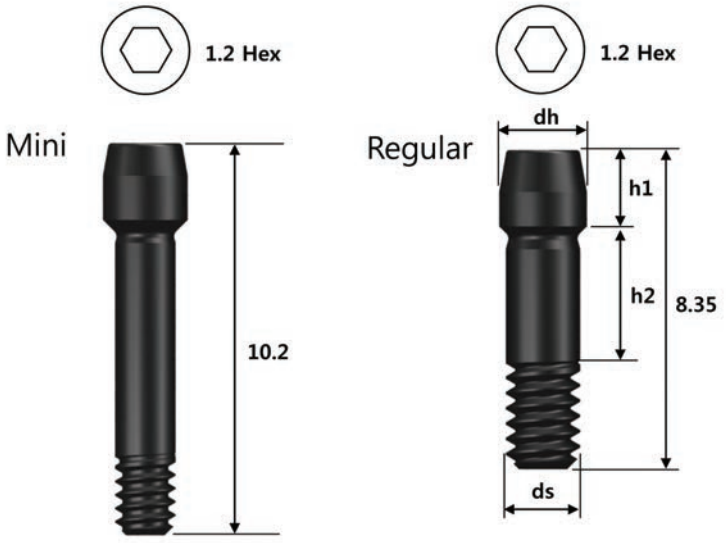


Fig. 4-6. Connection of TS System Mini ø3.5 Fixture and Abutment

Table 4-31. Specification of EbonyGold screw



	Mini	Regular
dh	ø 2,2	ø 2,3
ds	ø 1,6	ø 2,0
h1	2,0	2,0
h2	6,5	3,9
Tightening Torque	20Ncm	30Ncm

③ Angled abutment

In Angled abutment, fixture body and screw are separate. It is a 2-piece GS/TS exclusive cement-retained type prosthesis abutment and is used in cases that require path adjustment through its 17 degree Axial Angle.

For aesthetic purposes, the upper part of gingiva is yellow colored by TiN coating.

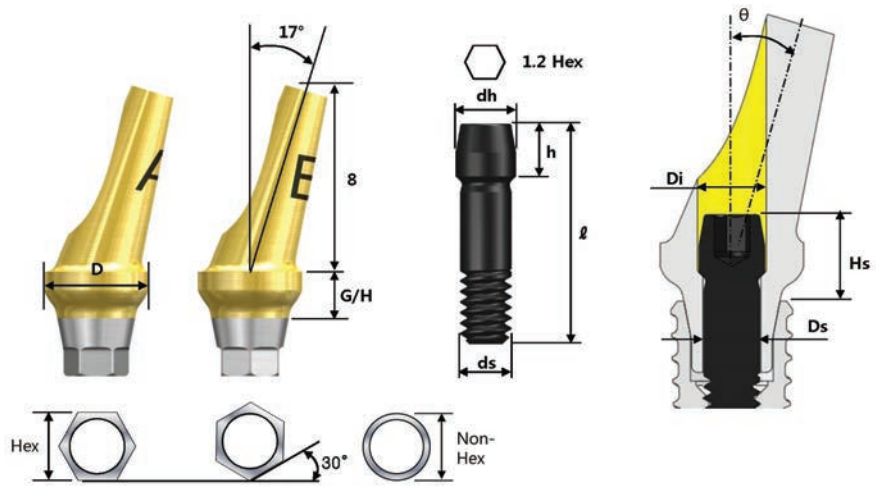
There are two types of connections in Hex type (Double Hex function) A and B, and only one in Non-Hex type connection. In clinic or lab, choosing the optimal A/B Hex Type using Angled Abutment Selector before choosing Angled Abutment can minimize preparation and thus allow rapid and precise prosthesis processing.

Angled abutment is useful in adjusting path in maxillary anterior region according to anatomic morphology, as well as compensating for misaligned path in multiple implant restorations.

TS Angled abutment has 17 degree axial incline and 6 degree taper body structure, and allows path compensation up to 23 degrees without abutment preparation. However, only using Angled abutment for Bridge case in molar region may elicit over cantilever force and is thus prohibited.

1.2 Hex hand driver is used for initial screw seating, but 1.2 hex torque driver must be used for final torque loading. The tightening torque is 20Ncm for Mini, and 30Ncm for Regular. To prevent loosen-fracturing of abutment screw, retightening with intervals (2~3 times) is recommended. **(Table. 4-32)**

Table 4-32. Specification of Angled abutmen



	Mini	Regular		Mini	Regular
Dia.(D)	ø 4.5	ø 5.0, ø 6.0	dh	ø 2.2	ø 2.3
Angle(θ)	17°	17°	ds	ø 1.6	ø 2.0
G/H	2, 4	2, 4	h	2.0	2.0
Hex(A, B)/Non-Hex	2.1 / ø 2.0	2.5 / ø 2.4	ℓ	10.2	8.35
Di	ø 2.3	ø 2.4	Tightening Torque	20Ncm	30Ncm
Ds	ø 1.7	ø 2.1	Remarks		
Hs	3.1	3.0			

④ ZioCera abutment

ZioCera abutment is a body-screw detachable, two piece GS/TS exclusive prosthetic abutment, either cement- or screw-retained type prosthesis abutment, and is used for aesthetic prosthesis.

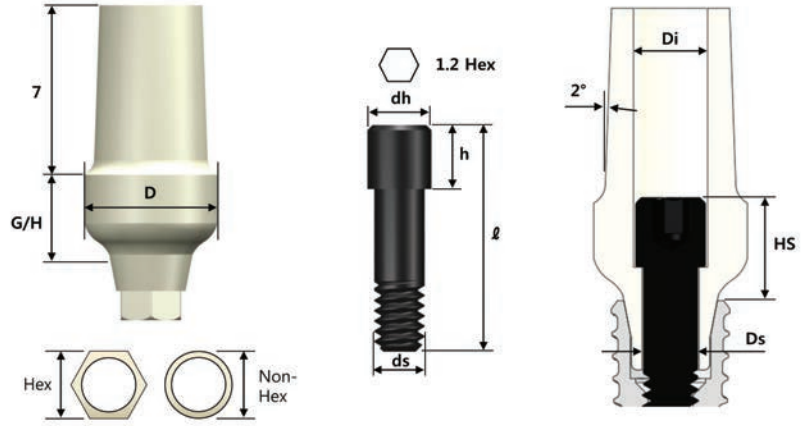
ZioCera abutment demonstrates excellent biocompatibility, is made of superb strength Zirconia material, and has ivory color similar to that of natural teeth. It is possible to make screw retained type prosthesis through direct porcelain Build-up. For increased operator's convenience, straight and 17 angled types exist. Each has hex and non-hex type In maxillary anterior region where its anatomy requires path control of abutment, utilizing ZioCera Angled abutment can decrease work for Abutment customizing, and increase applicability of screw retained type prosthesis. If an adequate path is obtained, using straight type ZioCera abutment allows free customization in various forms. ZioCera abutment is generally used as all ceramic prosthesis abutment for cement retained type prosthesis. The most aesthetically pleasing implant prosthesis can be manufactured by customizing abutment with bur for Zirconia in working model, fabricating adequate ceramic coping considering the patient's case, and building up exclusive porcelain powder.

Choosing adequate abutment specifications in ZioCera abutment which is harder to customize in comparison to titanium abutments is important as it can save time and reduce tool abrasion. Unlike titanium abutment, ZioCera abutment requires its own polishing tool for customization.

When customizing, use soft/medium level bur, and irrigate or soak abutment in water to minimize thermal shock during preparation process. If interocclusal space is between 1 and 1.5 mm after customization, it can be rehabilitated with screw retained type prosthesis using porcelain for zirconia. Being able to skip ceramic coping process unlike cement retained type prosthesis, allows economical and rapid prosthesis

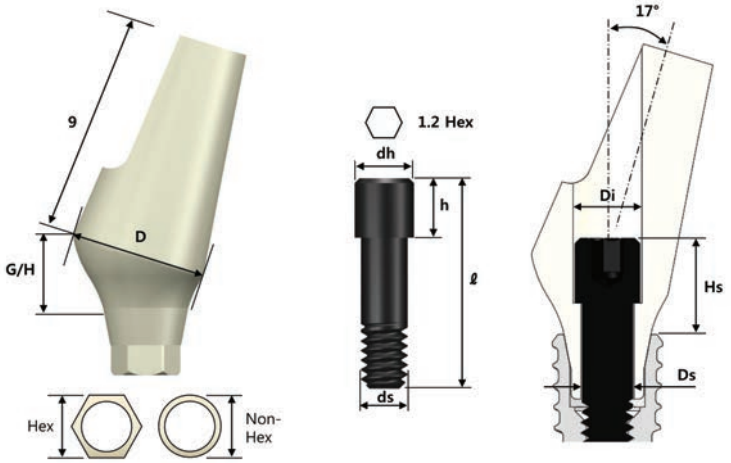
If porcelain's thickness exceeds 2mm it may lead to porcelain crack and one should make cement retained type prosthesis instead. 1.2 Hex hand driver is used for initial screw seating, but 1.2 hex torque driver must be used for final torque loading. The tightening torque is 20Ncm for Mini, and 30Ncm for Regular. To prevent loosen-fracturing of abutment screw, retightening with intervals (2~3 times) is recommended. **(Table. 4-33, 34)**

Table 4-33. Specification of ZioCera abutment



	Mini	Regular		Mini	Regular
Dia.(D)	ø4.5	ø4.5, ø5.5, ø6.5	dh	ø2.2	ø2.5
G/H	3.5, 5.0	3.5, 5.0	ds	ø1.6	ø2.0
Hex/Non-Hex	2.1/ø2.1	2.5/ø2.49	h	2.5	2.5
Di	ø2.3	ø2.6	ℓ	10.7	8.85
Ds	ø1.7	ø2.1	Tightening Torque	20Ncm	30Ncm
Hs	3.9	3.7			

Table 4-34. Specification of ZioCera Angled abutment



	Regular			Regular
Dia.(D)	ø5.5	ø6.5	dh	ø2.5
G/H	3.0	4.0	ds	ø2.0
Hex/Non-Hex	2.5/ø2.49		h	2.5
Di	ø2.6		ℓ	8.85
Ds	ø2.1		Tightening Torque	30Ncm
Hs	3.7		Remarks	Only Regular type

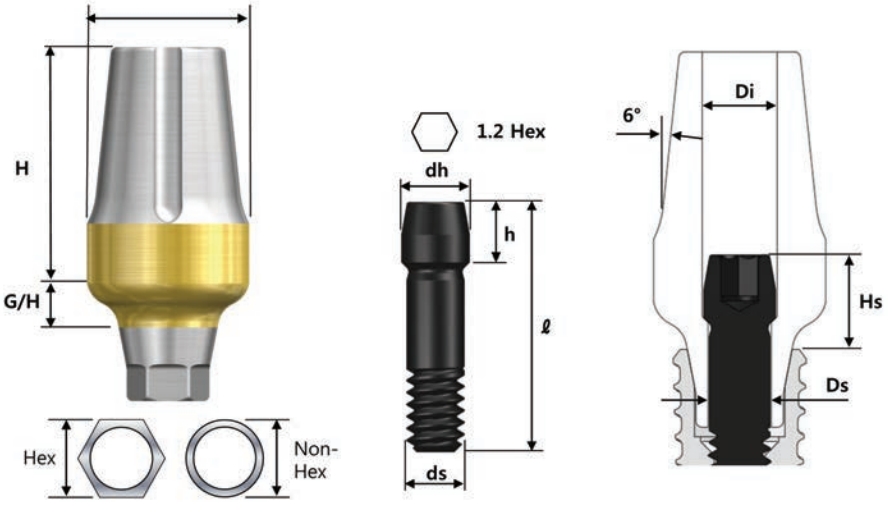
⑤ FreeForm ST abutment

In FreeForm ST abutment, fixture body and screw are separate. It is a 2-piece GS/TS exclusive cement-retained type prosthesis abutment and has 11° taper conical seal structure with stable connection. For aesthetic purposes, the TiN coating is applied in the gingival area for yellow coloring.

FreeForm ST abutment possess a straight margin area, and is useful for establishing or configuring prosthesis margin form and path adjustment because of its large volume. Because it is designed so that the location of margin can be flexibly set up according to the patient's conditions, FreeForm ST abutment allows free customizing and securing of sufficient supporting area after preparation. Restriction of using Transfer abutment/Angled abutment due to much reduction for path control can be overcome by using FreeForm ST abutment, which can be used to configure the gingival scallop shape, control the misalignment of bridge, and make bigger sized single crown than normal after customizing. Ø4.0 diameter abutment, after customizing, can be used in narrow interdental space, area such as the mandibular anterior region.

Tightening torque is 20Ncm for mini, and 30Ncm for regular.**(Table. 4-35)**

Table 4-35. Specification of FreeForm ST abutment



	Mini		Regular		Mini	Regular
Dia.(D)	ø4.0		ø4.0, ø5.0, ø6.0, ø7.0	dh	ø2.2	ø2.3
Height(H)	10.5	9.0	8.0	ds	ø1.6	ø2.0
G / H	1.5	3.0	1.5, 3.0	h	2.0	2.0
Hex/Non-Hex	2.1 / ø2.0		2.5 / ø2.4	ℓ	10.2	8.35
Di	ø2.3		ø2.4	Tightening Torque	20Ncm	30Ncm
Ds	ø1.7		ø2.1	Remarks	Straight type	ø4.0 is straight type
Hs	3.1		3.0			

⑥ GoldCast abutment

In GoldCast abutment, fixture body and screw are separate. It is a 2-piece GS/TS exclusive cement-retained type prosthesis abutment and has 11 taper conical seal structure with stable connection.

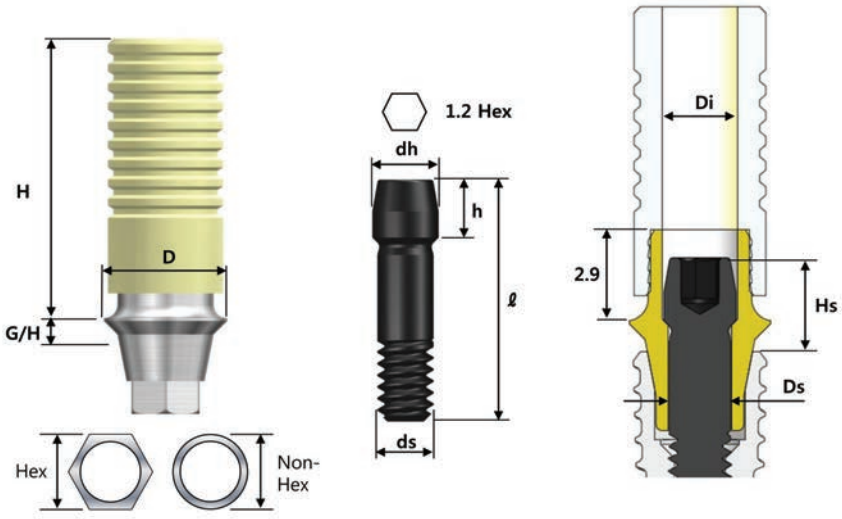
It is used when cement retained type prosthesis is difficult to make because of limitations in space and path, and requirements of aesthetics and precise customization. GoldCast abutment allows flexible and easy customizing, and through gold casting, all three methods (Screw/Cement/SCRP type) are possible to make the prosthesis.

Abutment is made of gold (Au, Pt, Pd Alloy, melting point 1450~1500) and plastic (POM). For easy distinction, Hex type's plastic is ivory and Non-Hex type's plastic is white. Prosthesis coping should be casted by dental technician after carving or sculpting POM area using pattern resin or wax. Dental technicians can personally manufacture custom abutment, and thus it is advantageous to apply this abutment to variety of cases.

There are Hex and Non-Hex type conections for GoldCast abutment. Compared to SS/US system, passive fit is unfavorable for TS system of Internal submerged type. Using GoldCast abutment Hex in bridge cases with misaligned path may cause passive fit to be impossible or lead to difficulties in prosthesis connection. Non-Hex specification should be used in bridge, and passive fit must be confirmed via X-Ray.

If path is off over 22 degrees, use of Convertible abutment is suggested. If applying cement retained type prosthesis is difficult because of insufficient space between abutment and opposing tooth, screw retained type prosthesis needs to be used. TS GoldCast abutment allows up to 4mm of space to make prosthesis. GoldCast abutment that has been customized with pattern resin or wax needs to be casted with dental precious gold alloy. It is recommended to use of gold alloy of under 1200C melting range as casting metal. Non-precious alloys as porcelain metal of Ni-Cr may cause transformation of cylinder and discoloration after casting, and should not be used. Tightening torque is 20Ncm for mini, and 30Ncm for regular.**(Table. 4-36)**

Table 4-36. Specification of GoldCast abutment



	Mini	Regular		Mini	Regular
Dia.(D)	ø4.0	ø4.5	dh	ø2.2	ø2.3
Height(H)	10	10	ds	ø1.6	ø2.0
G/H	1.0, 3.0	1.0, 3.0	h	2.0	2.0
Hex/Non-Hex	2.1/ø2.0	2.5/ø2.4	ℓ	10.2	8.35
Di	ø2.3	ø2.4	Tightening Torque	20Ncm	30Ncm
Ds	ø1.7	ø2.1	Remarks		
Hs	3.1	3.0			

⑦ NP-Cast abutment

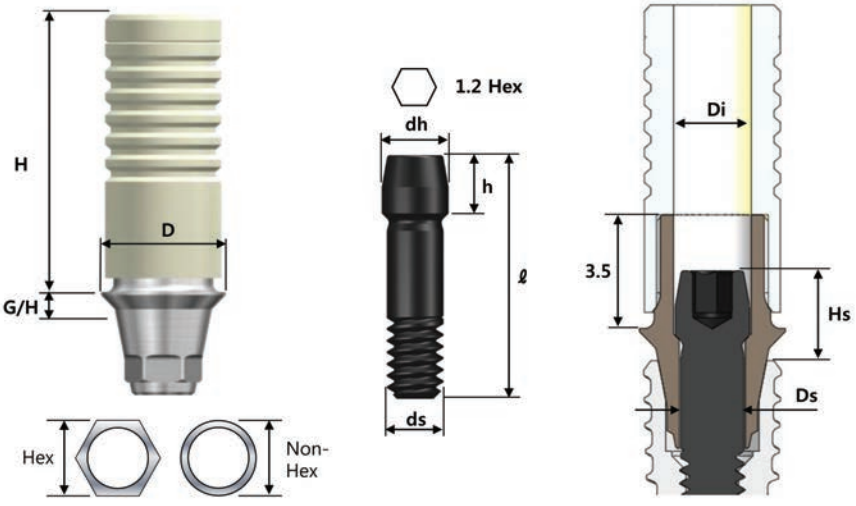
In NP-Cast abutment, fixture body and screw are separate. It is a 2-piece GS/TS exclusive cement-retained type prosthesis abutment and has 11° taper conical seal structure with stable connection.

It is used when limitations in space and path make cement retained type prosthesis difficult to make and aesthetics and precise customization are required. Abutment is made of Co-Cr-Mo alloy and plastic(POM). For easy distinction, Hex type's plastic is ivory and Non-Hex type's plastic is white. It possesses the same design, direction of use and advantages with basic GoldCast abutment. The difference is that NP-Cast, unlike GoldCast abutment, uses inexpensive dental non-precious alloy to cast and make prosthesis. Melting point of Co-Cr-Mo alloy is approximately above 1500℃ (Cr 1800℃, Co 1492℃, Mo 2450℃), and allows casting of most porcelain and Crown metal((Ni-Cr alloy m.p. 1250-1350℃) NP-Cast abutment is advantageous in that it allows PFM screw retained type prosthesis, and that it can be used as abutment for framework of Bar type Overdenture. Thus, NP-Cast abutment is an inexpensive substitute for GoldCast Abutment. While making prosthesis, beware when removing oxide layer formed on conical interface of abutment. Do not blast with aluminum oxide or use grinding tools as rubber point or rubber wheel, but instead blast with glass bead (4~6bar pressure) and then polish with cotton wheel.

Compared to GoldCast abutment, NP-Cast abutment is prone to misfit by casting shrinkage. In addition, if oxide layer of connection interface is not properly treated, conical connection part of fixture may be damaged, leading to damage to overall prosthesis stability in long term. Because using Co-Cr Alloy as casting material may cause excessive oxide layer formation and casting shrinkage, Ni-Cr Alloy is recommended.

Tightening torque is 20Ncm for mini, and 30Ncm for regular.**(Table. 4-37)**

Table 4-37. Specification of NP-Cast abutment



	Mini	Regular		Mini	Regular
Dia.(D)	ø 4.0	ø 4.5	dh	ø 2.2	ø 2.3
Height(H)	10	10	ds	ø 1.6	ø 2.0
G/H	1.0, 3.0	1.0, 3.0	h	2.0	2.0
Hex/Non-Hex	2.1/ø 2.0	2.5/ø 2.4	ℓ	10.2	8.35
Di	ø 2.3	ø 2.4	Tightening Torque	20Ncm	30Ncm
Ds	ø 1.7	ø 2.1	Remarks		
Hs	3.1	3.0			

⑧ SmartFit abutment

SmartFit abutment moves away from the traditional Wax-up & casting method using UCLA abutment, to milling titanium using CAD/CAM application technology to make individualized abutment for cement-retained type prosthesis. **(Fig. 4-7)**
It is used for cases with misplaced/misangled implant, with anterior region that requires aesthetic design, that require precise customization, with irregular gingival line, and with implant installed too deeply.
While Gold UCLA type abutment has been the standard choice for customized abutment, factors such as increase in gold price, in laboratory expenses and in abutment part price have made making individualized abutment through direct wax up-casting process using GoldCast abutment difficult. In contrast, SmartFit abutment provides a more affordable CAD/CAM customized abutment of desired design.

Advantages of SmartFit abutment are:

1. Applicable when implant path or position is inadequate
2. More esthetically pleasing prosthesis possible by forming optimized Emergence Profile that is similar to natural tooth prosthesis.
3. It is possible to make prosthesis with easy cement removal by forming scalloped gingival line and level considering gingival shape.
4. Overcomes limitations of readymade Stock abutment (collar length, abutment height, etc.)
5. Large volume and parallel abutment appearance allows support and maintaining of prosthesis, and prevention of porcelain fracture.
6. Because it uses non-precious Titanium Alloy (Ti-6Al-4V) via CAD-Cam, it is more biocompatible and affordable than traditional GoldCast UCLA abutment.
7. Stable connection interface between fixture and abutment.

Diagnostic wax up procedure is necessary if surpassing 4th bridge. If making abutment without diagnostic wax up, perspective difference in abutment designer and operator making final prosthesis may lead to additional abutment modifications and preparations. The concept of making the SmartFit abutment using CAD/CAM is to make a emergence profile similar to natural teeth by forming a margin similar to cross section of a natural tooth cervical area. To accomplish this, adequate running room or transition zone is required. That is, there needs to be adequate thickness in gingiva from top of implant fixture to gingival line by controlling installation depth, so that making cross sectional image of cervical area via soft tissue sculpting is possible. However, area where implant restoration is needed may have defect of hard tissue and soft tissue. Making an abutment with steep emergence angle solely based on design of abutment's lower structure to imitate natural tooth without considering such facts is inadequate. There are 3 types of emergence width to choose from, considering the patient's oral conditions and surgical conditions. While wider emergence width allows more natural crown, abutment connection may be difficult because of compression of the gingiva.

Order and fabrication method

1. Send working model made from fixture level impression, opposing teeth, bite, order sheet to Osstem Implant CAD/CAM Center.
2. 3D interactive abutment Design confirmation
3. Send Finished SmartFit abutment and transfer jig to dentistry.
4. Working time : 5~7days

Fig. 4-7. SmartFit abutment

⑨ Convertible abutment

Convertible abutment allows screw-retained prosthesis with gold cylinder or titanium cylinder above by switching internal connection fixture (GS/TS) to external connection fixture.

Internal connection fixture is developed based on cement retained type prosthesis, and Convertible abutment is developed to allow screw retained type prosthesis like external connection.

Convertible abutment assembly consists of abutment, cylinder, and cylinder screw. Hence, fixture and abutment are connected using internal friction fit connection method, and abutment and prosthesis are connected using external slip fit connection method.

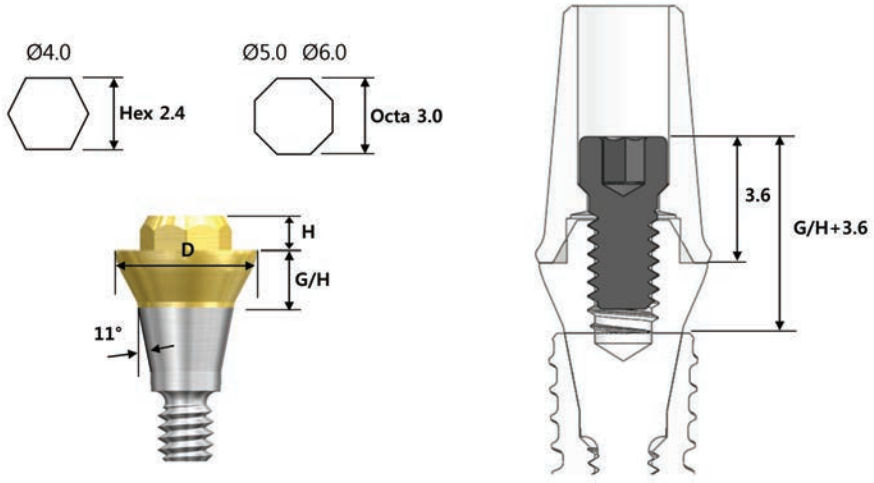
Tighten Convertible abutment for mini implant whose upper connection is Hex type with 2.4 O-ring abutment driver, and tighten diameter 4.0 abutment for regular implant whose upper connection is hex type with 2.4 O-ring abutment driver. Tighten diameters 5.0 and 6.0 abutment

whose upper connection is Octa type with Octa abutment driver in 30Ncm. Tighten Cylinder screw with 1.2 Hex driver in 20Ncm.

Cylinders that can be connected above Convertible abutment are: Combination / Angled Cylinder, GoldCast Cylinder, Temporary Cylinder, and Plastic Cylinder.

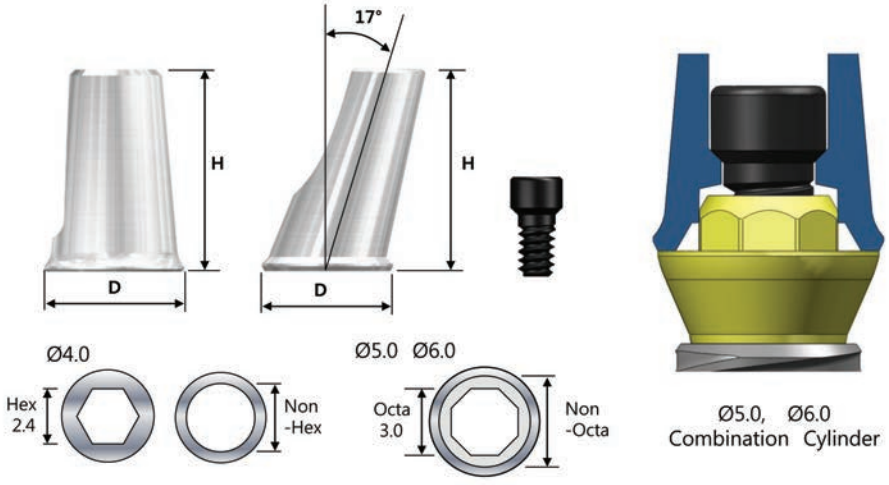
In particular, Combination/Angled Cylinder's connection is designed with a similar concept to that of ER abutment, and is useful for making Combination prosthesis (SCRP). **(Table. 4-38~40)**

Table 4-38. Specification of Convertible abutment



	Mini	Regular	
Dia.(D)	ø 4.0	ø 4.0	ø 5.0, ø 6.0
Height(H)	10	10	1.2
G/H	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4, 5
Upper Connection	Hex	Hex	Octa
Tightening Torque	30Ncm	30Ncm	30Ncm
Tightening driver	O-ring abutment driver		Octa abutment driver

Table 4-39. Specification of Convertible Combination / Angled Cylinder



Connection		Mini	Regular	
Dia.(D)		ø 4.8	ø 4.0	ø 5.0, ø 6.0
H	Combination cylinder	ø 5.05	7.0	
	Angled cylinder	12	8.0	
Type		10	Hex / Non-Hex	Octa & Non-Octa(ER structure)
Tightening Torque		20Ncm		

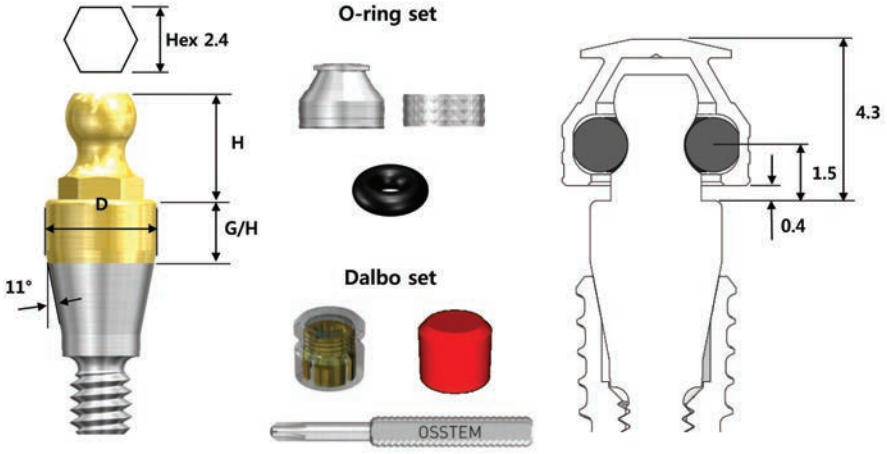
Table 4-40. Specification of Convertible Cylinder

Connection		Mini	Regular	
Dia.(D)		ø 4.0	ø 4.0	ø 5.0, ø 6.0
H	GoldCast cylinder	12.0	12.0	
	Temporary cylinder	10.0	10.0	
	Plastic cylinder	10.0	10.0	
Type		Hex / Non-Hex	Hex / Non-Hex	Octa & Non-octa(ER structure)
Tightening Torque		20Ncm		

⑩ Stud abutment

Stud abutment is generally applied to prosthetic procedure for overdentures. Stud attachment is an O-ring attachment retained abutment, connected to fixture, acts as the male counterpart. It is used best when jaw bone resorption is severe, fixed type implant prosthesis is difficult, and full denture is deficient in retention and stability.
It is possible to choose not only O-ring but also CM Corporation's Dalbo attachment depending on patient's condition. Stud abutment consists of two types of Retainer and O-ring. In general, use easily detachable Retainer cap. With limitations of vertical dimension, applying Retainer can decrease 1.5mm of dimension.
If retention diminishes during usage, replace O-ring for easy retention recovery. Stud abutment can compensate path up to 20 degrees. The more misaligned vertically, the shorter the interval of O-ring replacement becomes. Hence, one needs to pay close attention in path adjustment during fixture installation.
Dalbo system is retained by precious metal lamella, and allows convenient adjustment of retention from 2 to 15 N. Retention recovery is also possible by rotating the driver clockwise in case of retention decrease. Dalbo system allows path compensation up to 20 degrees, and may lead to lamella fracture if exceeding 20 degrees.
Stud abutment is made of Titanium alloy (Ti-6Al-4V), and Dalbo attachment housing is made of Ti CP-Gr4. Dalbo attachment lamella is made of Au-Pt alloy. Checking connection status between abutment and fixture via X-ray photography is necessary because the confusion between Mini and Regular specification may lead to fixture misconnection. Because the diameter of Stud abutment is 3.5mm, using exclusive slim Healing abutment is convenient in prosthesis procedure. Fixture and abutment is connected with Non-Hex, and impression should be taken in abutment level. There are various heights of collar depending on the height of gingival tissue. Detail specifications are in **(Table. 4-41).**
Tightening torque is 30Ncm, and use exclusive Hex O-ring abutment driver to tighten.

Table 4-41. Specification of Stud abutment



	Mini	Regular
Dia.(D)	ø 3,5	ø 3,5
Height(H)	3,3	3,3
G / H	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6
Tightening Torque	30Ncm	30Ncm
Tightening driver	O-ring abutment driver	

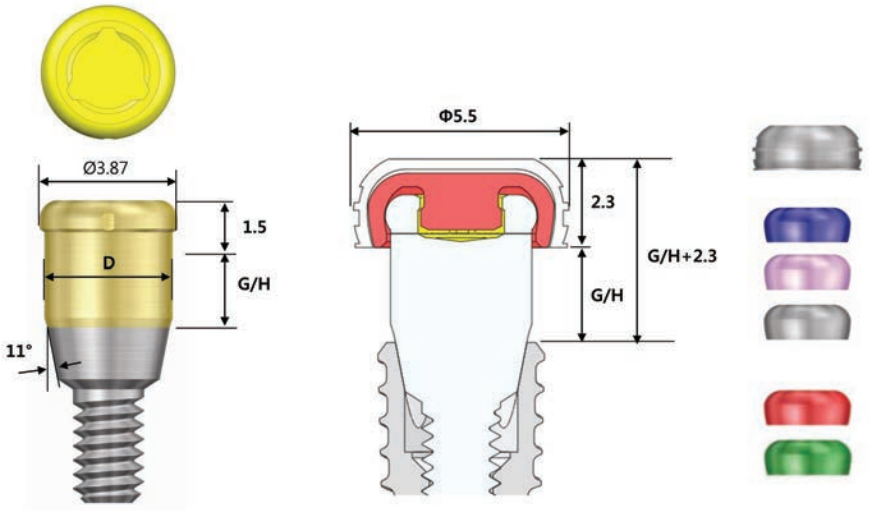
⑪ HG Locator abutment

HG Locator abutment is generally applied to prosthetic procedure of overdentures. Connected to fixture, it acts as a female counterpart. It is used best when jaw bone resorption is severe, fixed type implant prosthesis is difficult, and full denture is deficient in retention and stability.**(Fig. 4-8)** It consists of locator abutment, denture cap, and replacement male that each has various retentions.

Its advantages are:
1. Obtaining stable denture retention by dual retention structure
2. Replacement Males with various retentions
3. Excellent Retention allows applications in cases with ridge absorption
4. Compensation of path up to 40 degrees (2 implant standard in case of 2 implants)
5. Expansion of indication due to low vertical dimension.

Connect Locator abutment with exclusive locator torque driver, and switch replacement male using locator core tool. Because the diameter of Locator abutment is 3.7mm, using slim healing abutment is convenient in prosthesis procedure. Fixture and abutment is connected with non-hex, and impression should be taken in abutment level. There are various heights of collar depending on the height of gingival tissue. Abutment specification chosen should be either same as thickness of gingival, or one step above. Use extended replacement male (red or green) if divergence angle between implants is 20~40 degrees, and use replacement male if angle is 0~20 degrees. There are 3 types of locator replacement male. Use blue male (retentive force 6N) with weakest retention initially. If lacking retention, use pink male (12N) or clear male (22N).
Locator abutment is made of titanium alloy (Ti-6Al-4V), and its tightening torque is 30Ncm.**(Table. 4-42)**

Table 4-42. Specification of HG Locator abutment



	Mini	Regular
Dia.(D)	ø 3.7	ø 3.7
G / H	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Tightening Torque	30Ncm	30Ncm
Tightening driver	Locator torque driver	

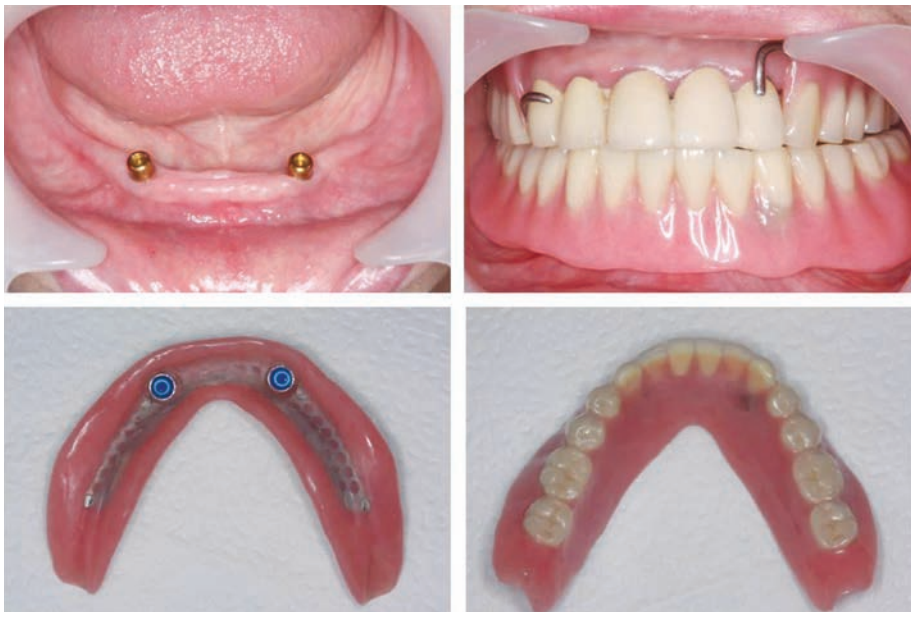


Fig. 4-8. Clinical case of HG Locator abutment

■ **Abutment Screw Selection Guide**

US System's Cement abutment, ER abutment, UCLA abutment, Angled abutment and SS Syatem's ComOcta abutment, ComOcta plus abutment, ComOcta Gold abutment use same screws when diameter of fixture is regular, but ComOcta Angled abutment and Hanaro abutment have their own exclusive screws.
Ebony Gold screw is the basic component for TS System abutments with the exception of ZioCera abutment which uses its own exclusive EbonyGold Screw. Ti screw is provided for Temporary abutment. **(Table. 4-43)**

Table 4-43. Abutment Screw Selection Guide

TS			SS		US					
ABT.	Screw		ABT.	Screw	ABT.	Screw				
	Mini	Regular				Mini	Regular	Wide	Wide-PS	R-type
Transfer	GSABSM	GSABSS	ComOcta	ASR200	Cement	USABSM	ASR200	ASW200	ASR200	RASW200
Temporary	GSABSMT	GSABSST	ComOcta Plus	ASR200	Angled	USABSM	ASR200	ASW200	ASR200	RASW200
Angled	GSABSM	GSABSS	Hanaro	SSHAS	ZioCera	ASM200	ASR200	-	-	-
ZioCera	GSASM	GSASR	ComOcta Angled	ASS200	UCLA Gold	USABSM	ASR200	ASW200	ASR200	RASW200
GoldCast	GSABSM	GSABSS	ComOcta Gold	ASR200	NP-CAST	USABSM	ASR200	ASW200	ASR200	-
NP Cast	GSABSM	GSABSS	ComOcta NP-CAST	ASR200	UCLA Plastic	USABSM	ASR200	ASW200	ASR200	RASW200
SmartFit	GSABSM	GSABSS	ComOcta Temporary	ASR200	UCLA Temporary	USABSM	ASR200	ASW200	ASR200	RASW200
FreeForm ST	GSABSM	GSABSS			ER	USABSM	ASR200	ASW200	ASR200	-

5) Selecting implant abutment (focused on TS system)

Implant abutment is the transmucosal component that connects implant fixture and mouth. It promotes soft tissue and hard tissue recovery, as well as acts as an intermediate connector between fixture and final prosthesis.
Healing abutment is the first abutment to be connected on top of fixture. It is used after installation for 1-stage surgery, and is used temporarily from 2nd surgery until final prosthesis connection for 2-stage surgery
In second stage of surgery, first connect Healing abutment, and select and connect final abutment after completion of soft tissue and hard tissue's recovery. Or, take fixture level impression first, keep healing abutment connected, and remove Healing abutment right before final prosthesis connection. Healing abutment provides enough time to select the final abutment, and allows easy connection of final abutment by sculpting soft and hard tissues around it.
TS Healing abutment is divided into Fixture Mini specific and Regular specific, and are not compatible. For Mini, there are diameters of 4.0, 4.5 and heights of 3, 4, 5, 7mm. For regular, there are diameters of 4.0, 5.0, 6.0, 7.0, and heights of 3, 4, 5, 7mm. **(Fig.4-9)**

Healing abutment should be selected after examining inter-occlusal space between opposing tooth. It should expose 1~2mm above gingival, and should have similar diameter to that of abutment for final prosthesis. However, if implant is placed to deep or suturing of soft tissue is difficult, begin with products of smaller diameter (4.0,5.0) and later expand to Healing abutment that fits final abutment. **(Fig.4-10)**

Using over 5mm height is recommended, because short healing abutment with large width may be stuck on bone or be pressed by gingival, and thus improperly connect, invading biologic width and causing undesired bone resorption and prei-mucositis.

Moreover, if foreign body or blood remains inside fixture when connecting healing abutment, it may lead to locking phenomenon. Therefore, clean thoroughly with saline, suction, and connect with Hex driver for hand (5~8Ncm).

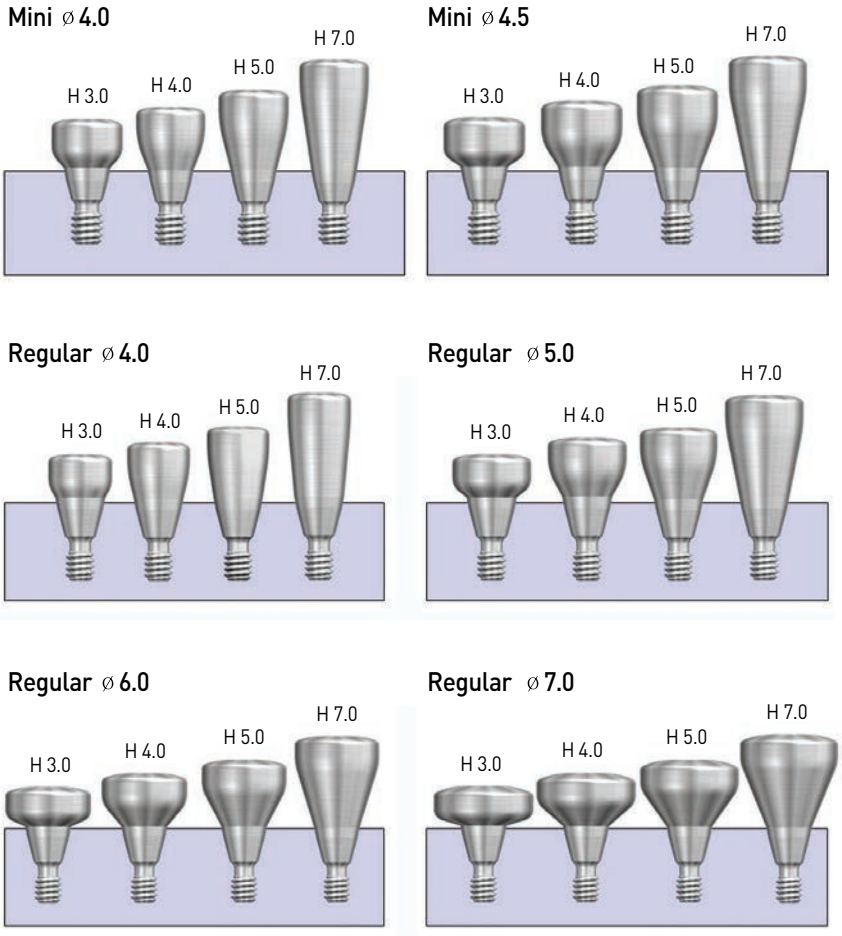


Fig. 4-9. TS Healing abutments

Healing abutment Change from narrow diameter to wide diameter

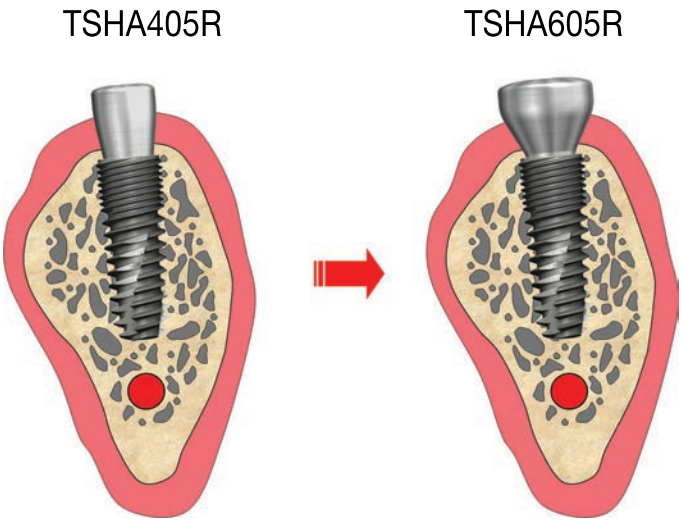


Fig. 4-10. Selection guide for TS Healing abutment

There are various specifications of prosthesis abutment depending on implant systems.
Abutment can be classified in multiplr group: various stock, readymade, premade abutments from manufacturers, and custom made abutments from dental technicians for CAD/CAM applications. Titanium, Gold alloy, Non-precious metal alloy (Co-Cr-Mo), Ceramic, Zirconia, and Plastic are material for abutment. **(Fig. 4-7)**
Abutment type influences the function and aesthetics of prosthesis, and therefore should be carefully chosen considering each patient's case. The standard for abutment may differ depending on installed fixture's type and diameter, mesiodistal diameter of tooth that will be replaced, gingival height, interocclusal space, and crown height. (Table. 4-44)

Table 4-44. Considering factors for abutment selection

Considering Factors for Abutment Selection
• Single tooth, partial bridge, full fixed bridge • Fixture position - upper or lower jaw anterior or posterior • Implant type, diameter, angulation • Mesio-distal dimension • Interocclusal space • Soft tissue levels & thickness • Marginal bone level • Esthetic demands • Cement retained or Screw retained • Rigidity • Screw loosening

Abutment height of cement-retained type prosthesis' superstructure requires minimum 4mm for increased cement-retention. For occlusal surface prosthesis, minimum sum of 1.5~2.0mm between metal framework's thickness and cement space is required. Gingival collar (cuff) must also not invade biologic width, and thus 8~9mm of adequate vertical dimension is needed. **(Fig.4-11)**

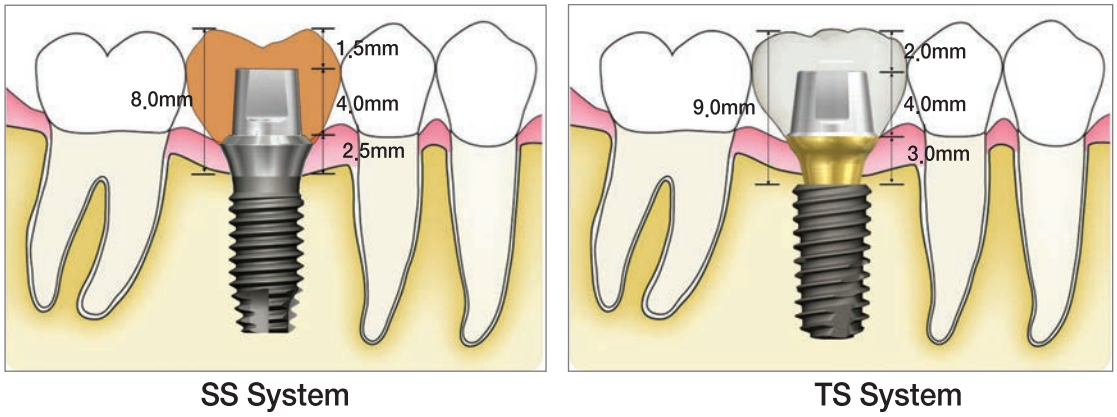


Fig. 4-11. Proper crown height space for implant prosthesis

Not considering treatment of opposing tooth in cases that show smaller interocclusal space, screw-retained type prosthesis is preferred to cement-retained type prosthesis. Also, in cases with excessive interocclusal space due to vertical resorption of alveolar bone, use UCLA abutment or SmartFit abutment (CAD/CAM abutment) instead of readymade abutment to make a customized abutment that carefully considers space depending on material of occlusal surface.

It is important to properly determine vertical position of implant installation to secure adequate vertical dimension. To accomplish such goal, length of fixture's mount can be used. If the end of mount does not touch the opposing tooth after final installation in any of US, SS, TS System, space for restoration has been secured.**(Fig.4-12, 13)**

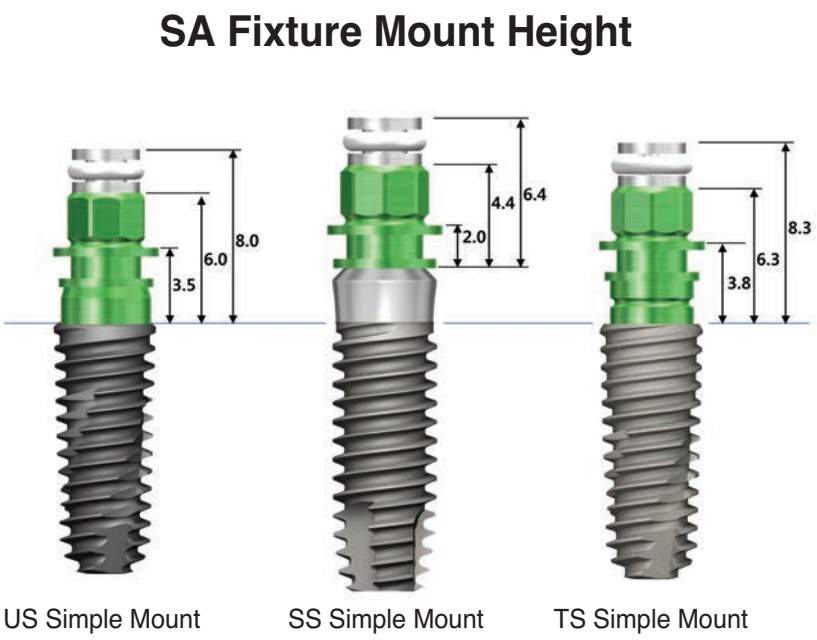


Fig. 4-12. SA Fixture Mount Height

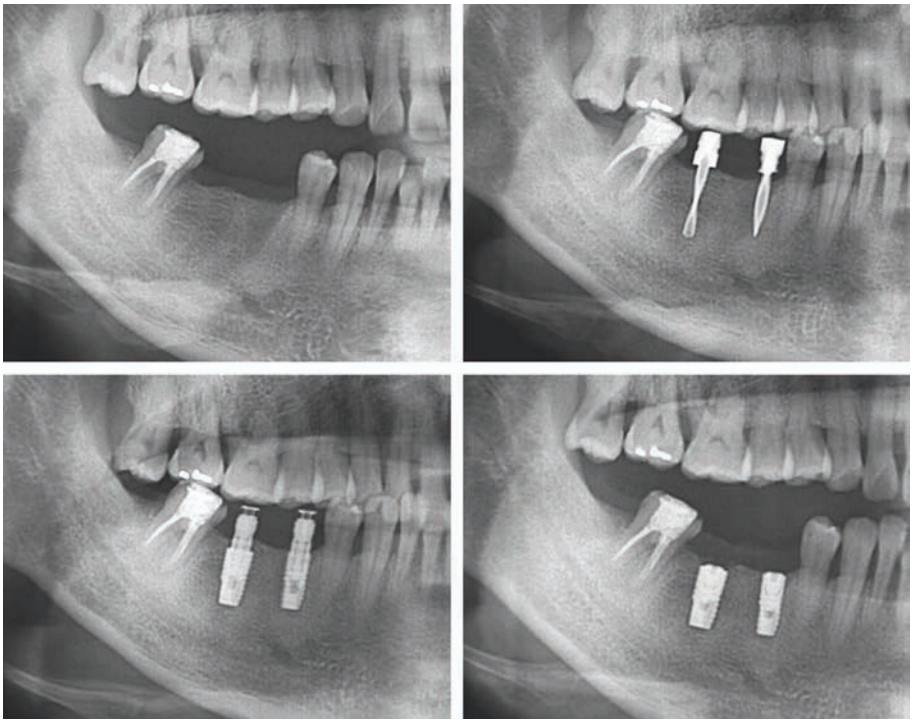


Fig. 4-13. Implant must be installed where it can secure space for final prosthesis, not where it fits the given bone.

Abutment diameter may be different depending on installed fixture diameter. Choosing an abutment most similar to cervical diameter of natural tooth reproduces emergence profile most harmonious with adjacent teeth. However, implants installed are usually smaller in diameter than natural tooth, except for cases where implants are immediately installed after extraction. Hence, abutment diameter has to decrease as well.

Abutment diameter depends on which implant system is being used. Superstructure's cervical diameter in gingival level implant systems as SS system is decided by implant shoulder's diameter. Abutment is only connected internally from the implant, and is not the final factor that decides diameter. Hence, with final superstructure's emergence profile in mind, implant installation depth and shoulder diameter (regular/wide neck) needs to be considered. In bone level implants as TS System in which abutment is attached via conical seal connection, one can use various collar diameter and abutment height depending on fixture diameter. Thus, it is convenient in selecting an abutment fit to superstructure's emergence profile.**(Fig.4-14)**

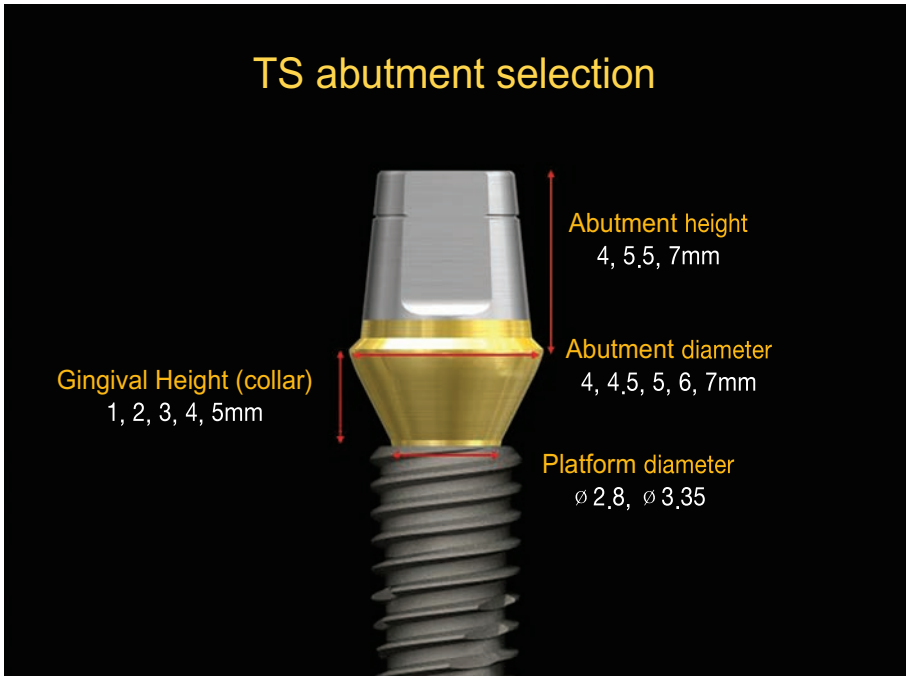


Fig. 4-14. Selection of TS System ready-made abutment

Abutment depending on gingival height is decided after selecting the location of prosthesis margin. In the posterior region where esthetic is relatively not important compared to anterior region, prosthetic margin would be positioned on the level of supra-gingival height or equi-gingival height, while in the anterior region where esthetics is highly demanded, it would be positioned on 1.0~1.5mm sub-gingival level considering gingival recession after prosthetic delivery. Emergence profile of implant prosthetics is decided by emergence angle depending on diameter and collar height of finally used abutment. **(Fig.4-15)** Abutment with excessive diameter and short collar height may lead to peri-implantitis accompanying bone resorption as by the same mechanism of healing abutment. When selecting abutment, considering reproduction of natural root apical shape and biologic width is very important. Abutment with 1mm collar height is not recommended but rather control abutment installation depth to 3mm under gingival line of final prosthesis to 3mm collar height.

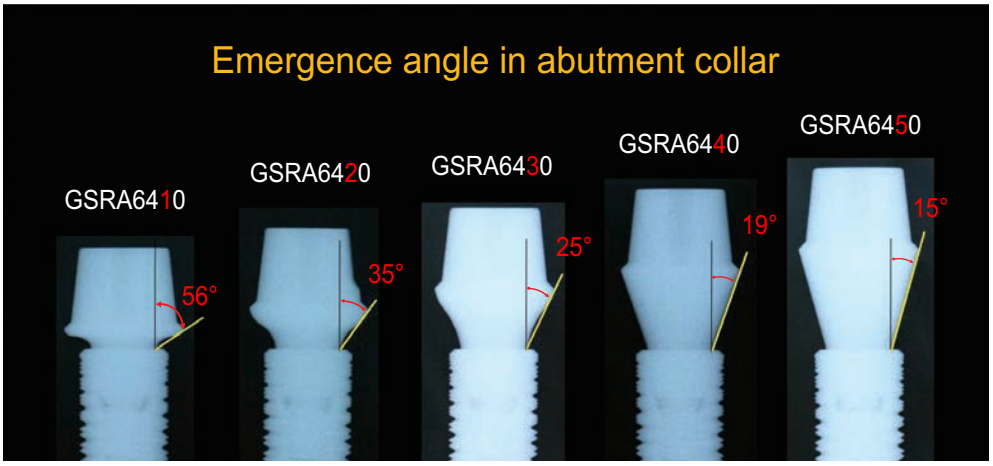


Fig. 4-15. Emergence angle of GS System ready-made abutment

It is difficult to establish a uniform standard for implant, abutment, and selection of prosthetic option in all cases. However, chartering criteria for wide range of cases is undoubtedly possible and is necessary for everyday clinicians. In this article, the author has made efforts to organize such relative yet widely applicable standards. The prosthetic flow diagrams for TS Systems are organized in **fig. 16~19.**

Prosthetic Flow Diagrams for TS System

Cement Retained Restoration : Rigid & Transfer Abutment • Mini, Regular

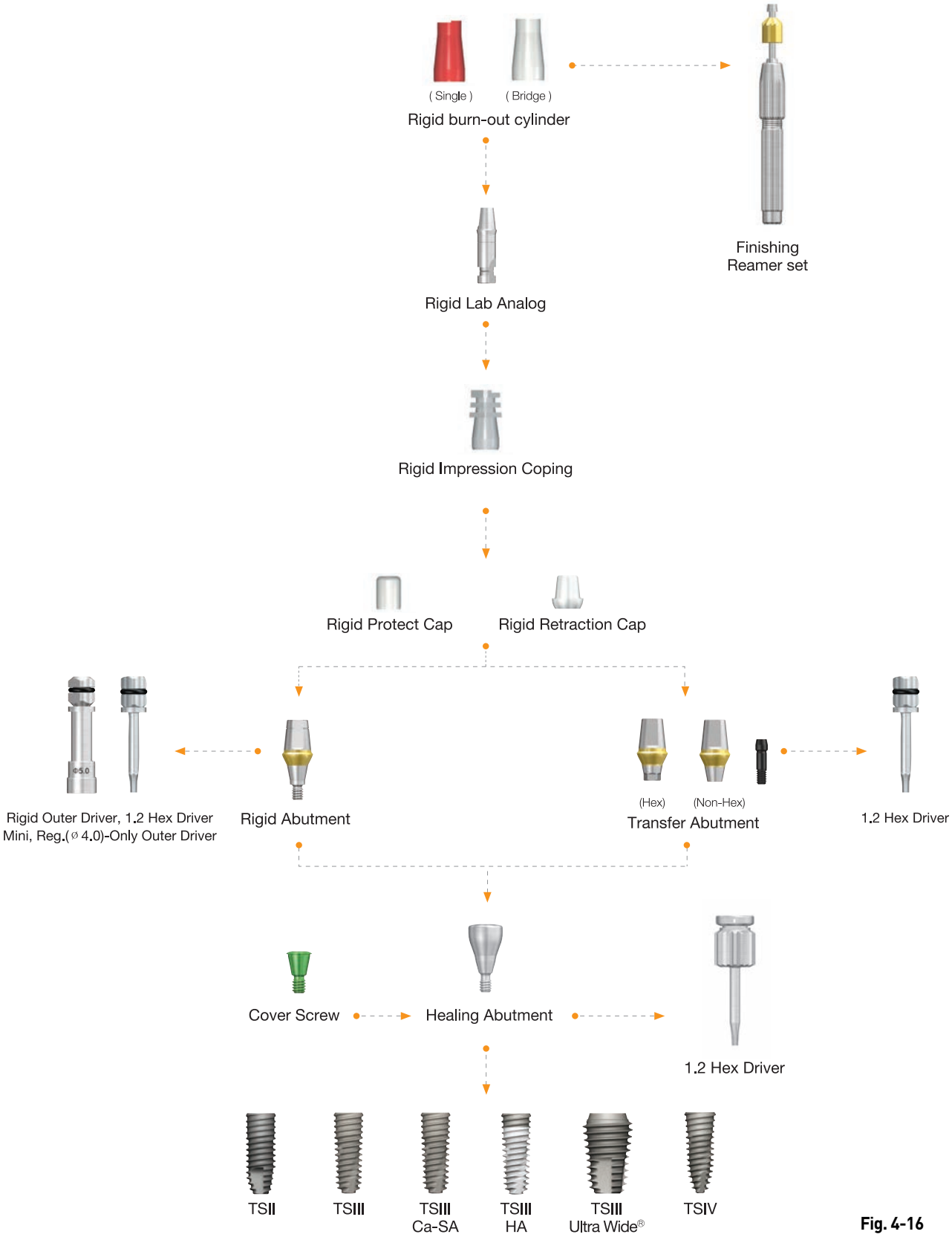


Fig. 4-16

Prosthetic Flow Diagrams for TS System

Cement Retained Restoration : Transfer, Angled, ZioCera, ZioCera Angled, GoldCast, CustomFit, NP-CAST, FreeForm ST
Screw Retained Restoration : ZioCera, ZioCera Angled, GoldCast, Temporary, NP-CAST Abutment • Mini, Regular

Fig. 4-17

Prosthetic Flow Diagrams for TS System

Screw & Cement Retained Restoration : Convertible Abutment • Mini, Regular

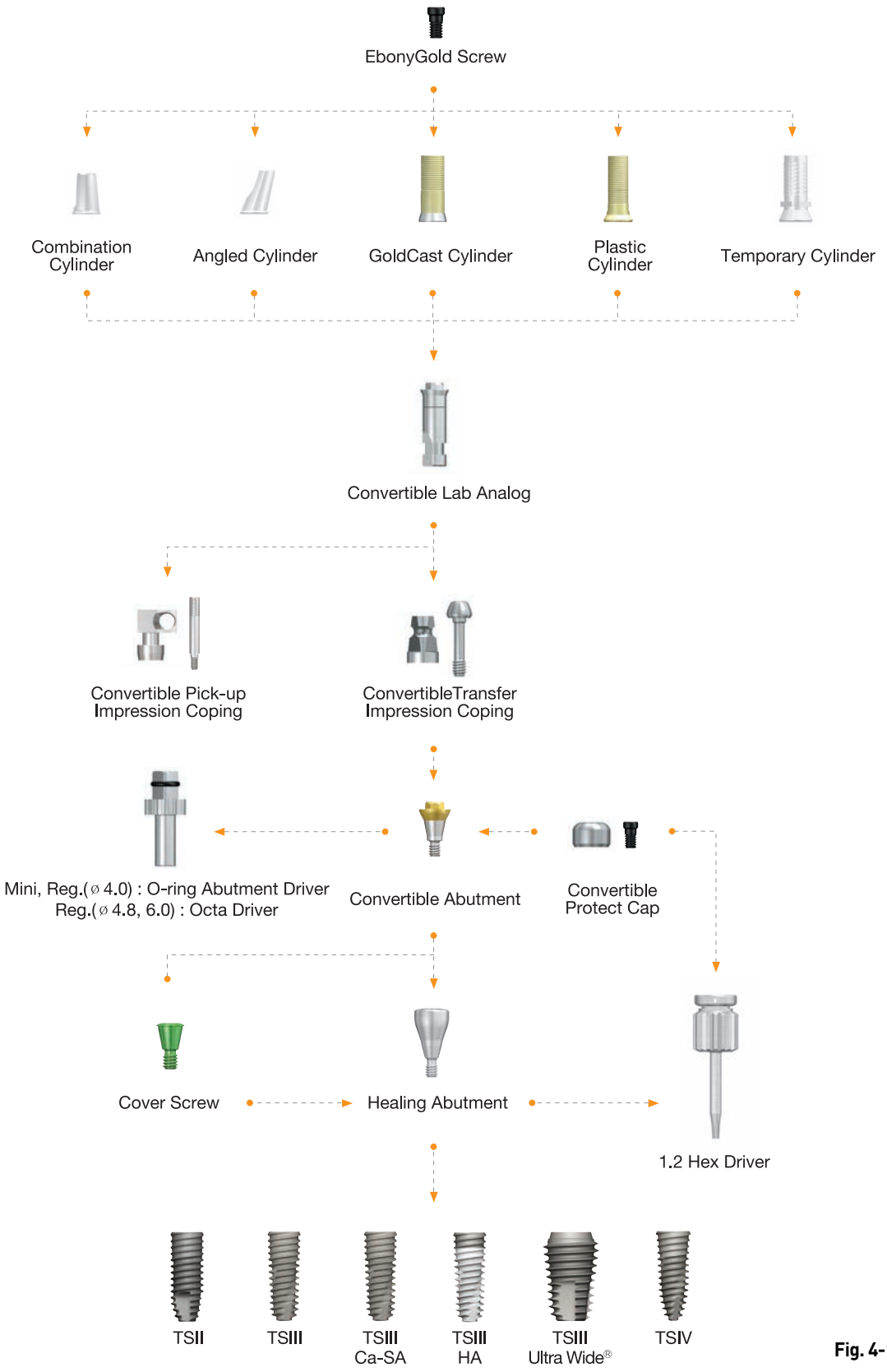


Fig. 4-18

Prosthetic Flow Diagrams for TS System

Overdenture Retained Restoration : Stud / LOCATOR® Abutment • Mini, Regular

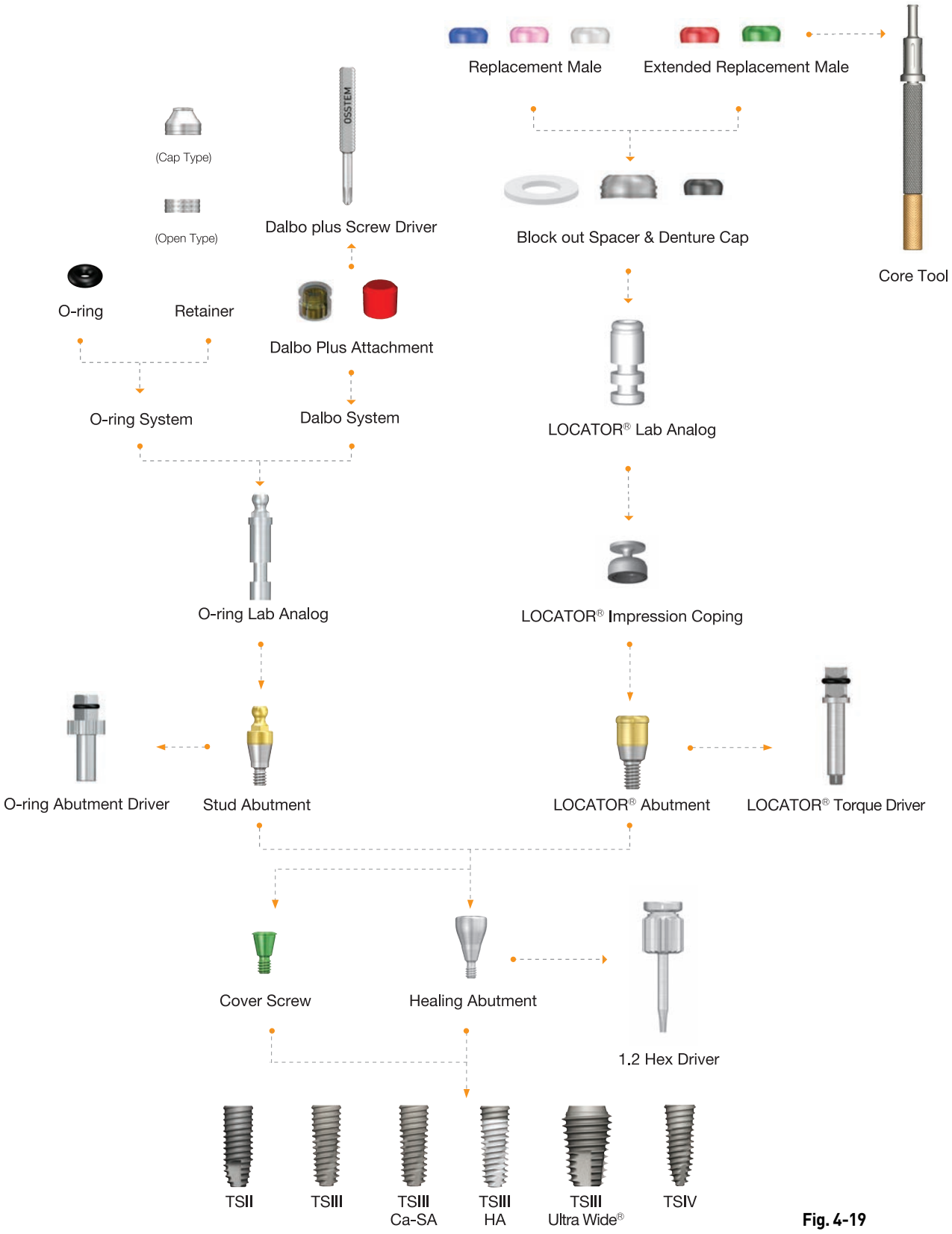
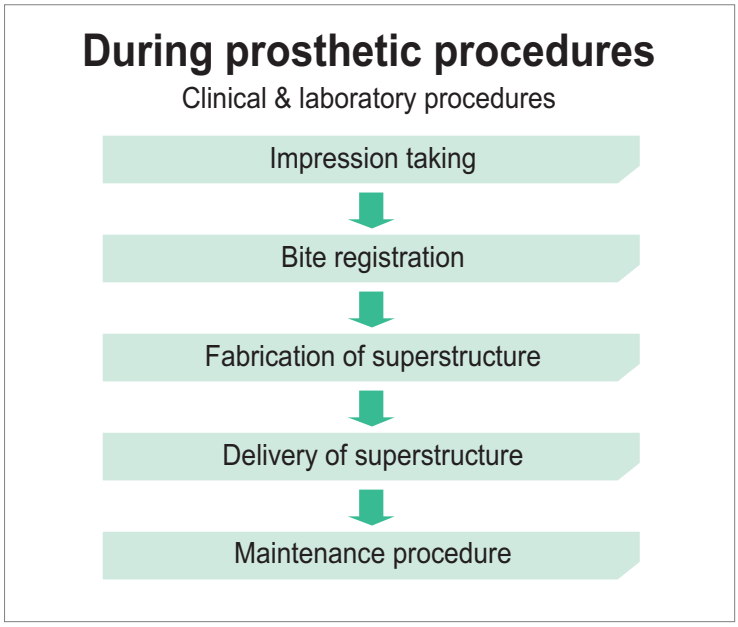


Fig. 4-19

2. Impression taking methods to fabricate an implant superstructure - By Dr. Kim, Se-Woung

An implant therapy involves several steps; a diagnosis and a treatment planning, a surgical procedure to place the implant, a prosthetic procedure to fabricate an implant superstructure, and a maintenance phase. Each of the steps is important for a long term success of the dental implant. Details of prosthetic procedure are in **Table. 4-45** Although there are prosthetic considerations during the diagnosis and treatment panning procedure, clinically actual first step for a prosthetic procedure is exactly an impression taking.

Table 4-45. Clinical and laboratory procedures to fabricate an implant superstructure.



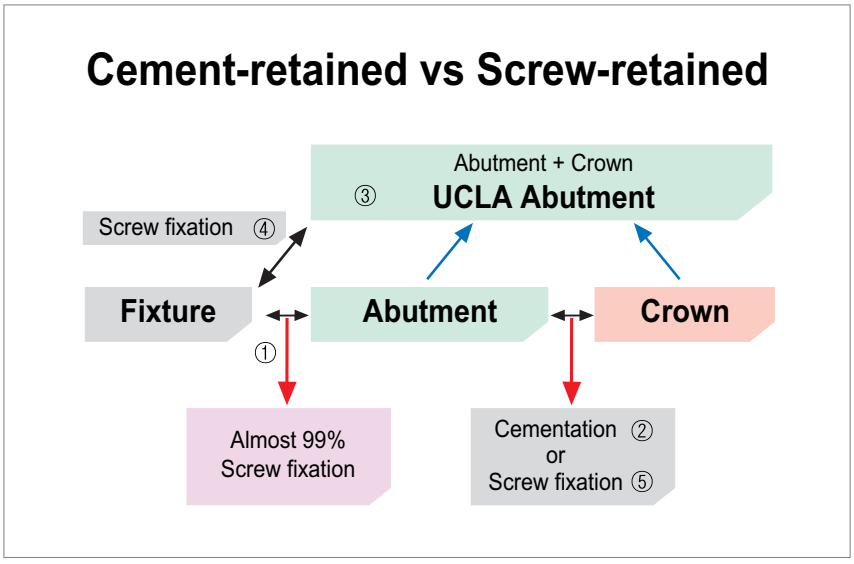
The fabrication of an implant superstructure is almost similar to that of a prosthetic procedure of the natural teeth, but has several differences. A natural tooth permits some movement during the oral function because of a periodontal ligament which buffers an occlusal load. However, a dental implant permits little but only a micro-movement by bone elasticity. Hence, it requires more accurate works than natural tooth prostheses which can be made by routine prosthetic procedures. In case of natural tooth prosthesis, unavoidable errors from contraction or expansion of the dental materials during clinical and laboratory procedures can be compensated by cement space and tooth movement. Of course, a cement-retained type restoration can compensate some errors with cement space. However, in case of multiple screw-retained type restorations or errors caused during an impression taking procedure result in the failure of a passive fit. An implant superstructure without passive fit affects a long term success of the implant by various kinds of negative effects. It is better to make an effort to minimize the error during the prosthetic procedures as possible. Especially, the clinical importance of an accurate impression taking cannot be overemphasized

because it is the first step among prosthetic procedures. There are several questions related to an impression taking when an implant superstructure is going to be made. When and how to take an impression, the best method of an impression taking depending on various clinical situations, the types of errors during an impression taking and how to minimize them, as well as what kinds of impression material should be used for simple and accurate impression taking. In this chapter, impression taking methods for an implant superstructure and the types of errors during an impression taking will be discussed.

1) Basic concept of impression taking for implant

Grossly, the connection method of an implant superstructure can be classified as a cement retained type and a screw retained type. As shown in **Table. 4-46** and **Fig. 4-20**, an abutment that will be selected in a cement retained and a screw retained type is usually connected by a screw(①), and depending on the type of a connection between each abutment and final prosthesis, they are classified as a cement retained type, a screw retained type, a SCRP type and so on. Generally, in a cement retained type, a final prosthesis is cemented(attached) over the abutment with a temporary or permanent dental cement(②), and in a screw retained type, a final prosthesis is fabricated using UCLA abutment (③) and fixed into the fixture by means of an abutment screw(④). In other words, UCLA abutment and a final prosthesis will be one bodied by a laboratory work (a casting process) and fixed into the fixture. Although decreased in usage recently, there is another method in a screw retained type prosthesis, in which a tran-mucosal abutment such as a convertible abutment in TS/GS implant system is connected to a fixture, and then a screw retained type restoration that was fabricated using a gold or plastic cylinder in a laboratory side is fixed on this abutment with a specific cylinder screw. It will be mentioned later.

Table 4-46. An illustration related to the connection method in a cement retained and a screw retained type prosthesis



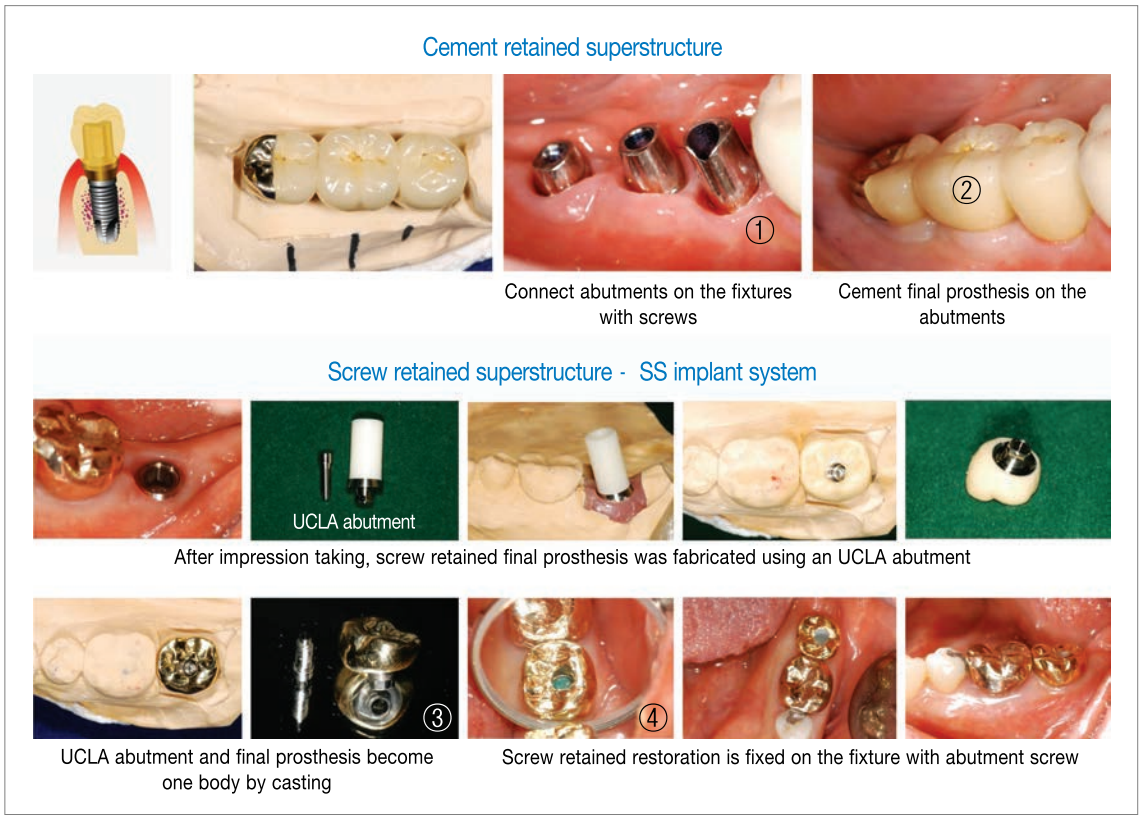


Fig. 4-20. Difference between a cement retained and a screw retained type prosthesis

To understand impression taking methods easily, at first, as shown in **Fig. 4-21**, a cement retained type restoration can be related to post & core of a conventional prosthesis. That is to say, a fixture corresponds to a root rest, an abutment to a core, and an abutment screw to a post. A cement retained type is same as a conventional prosthesis in which a crown is cemented on the abutment. An impression taking is the prior step for implant prosthesis and can be determined according to the connection method of an implant superstructure or the kinds of abutment.

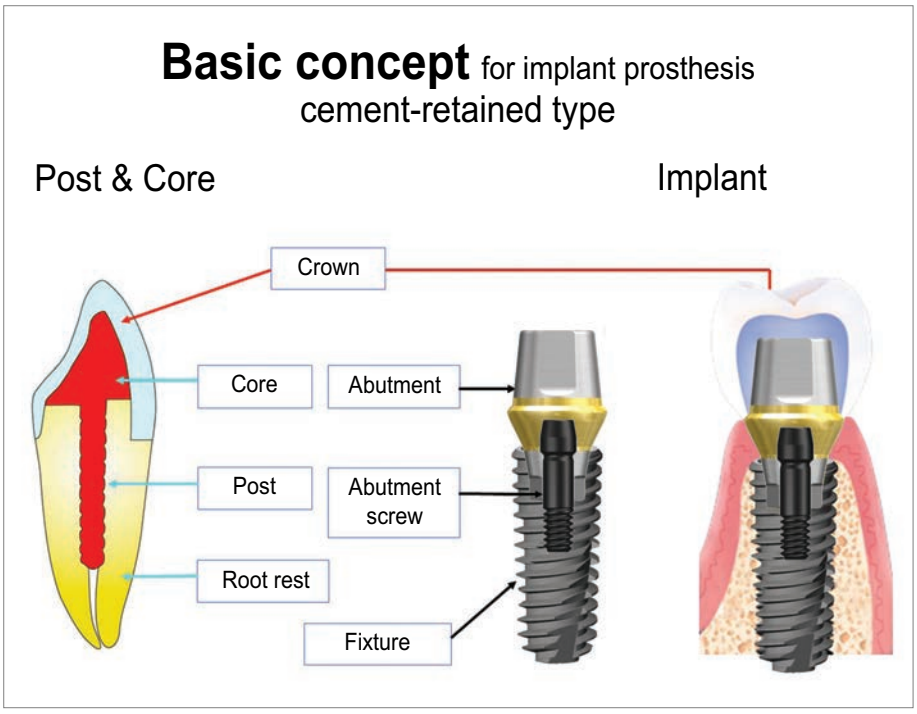


Fig. 4-21. Comparison of a post & core and an implant superstructure

Roughly, an abutment for a cement retained type restoration can be classified as with or without a hexa (octa) geometry **(Fig, 4-22).** An abutment with a hexa geometry is usually selected for a fixture level impression, and an abutment without a hexa for an abutment level impression **(Fig, 4-22, 23).** It depends on clinician's preference, so only general methods will be mentioned in here.

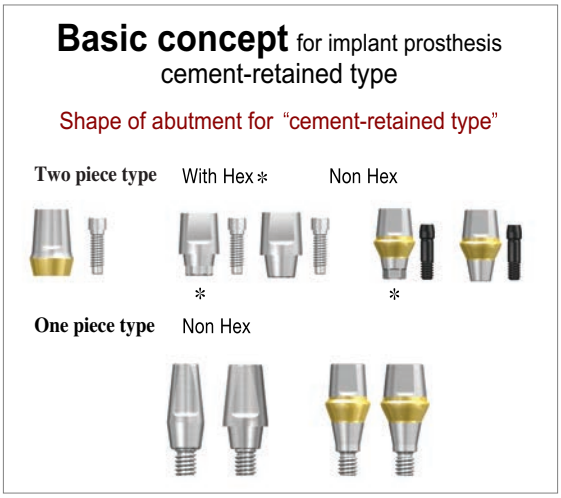


Fig. 4-22. Kinds of abutment for a cement retained type

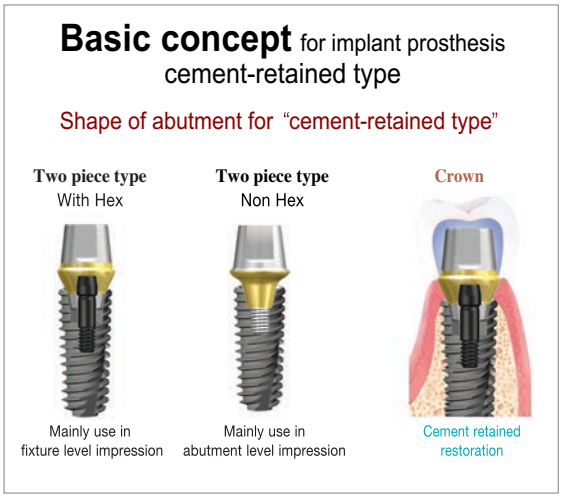
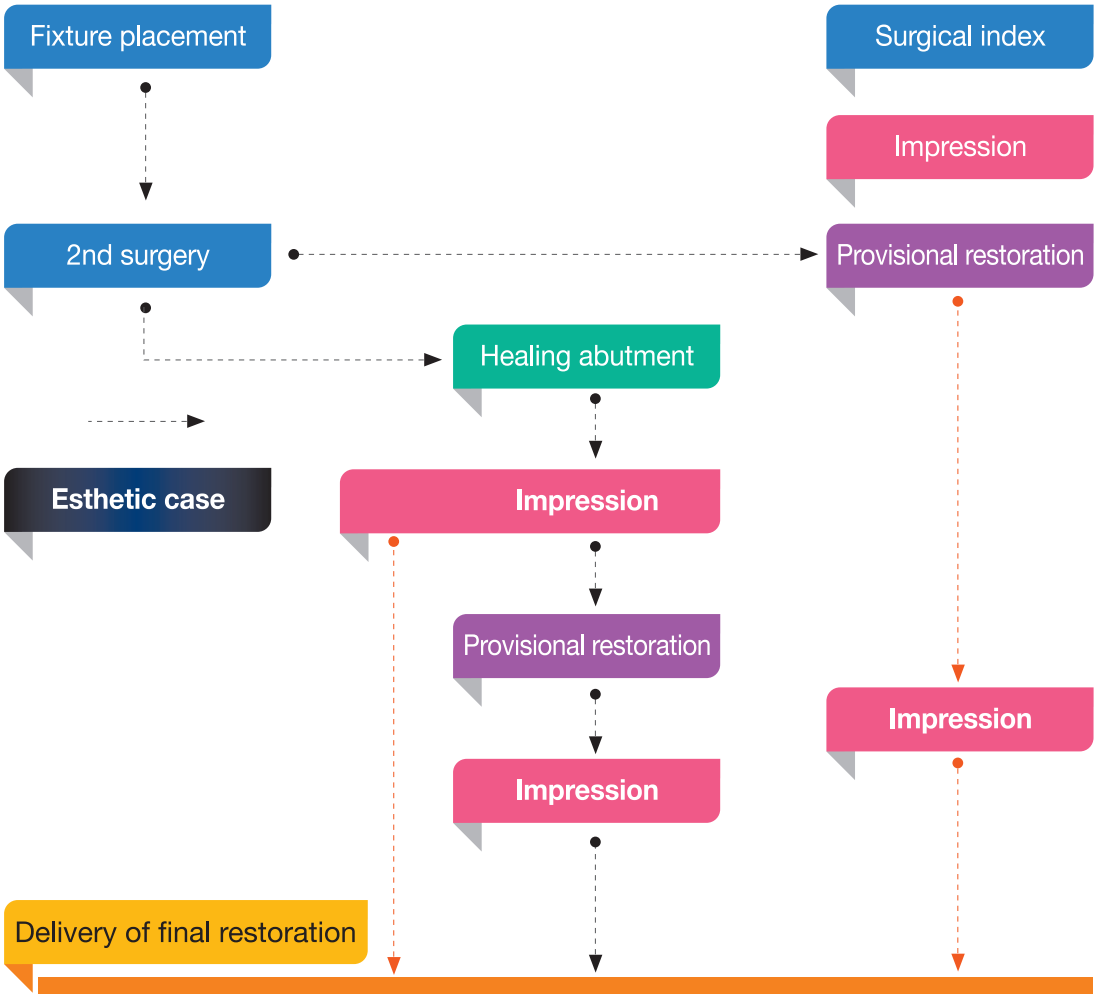


Fig. 4-23. Cement retained type superstructure

2) Timing of an impression taking

Table 4-47. Mimetic diagram of the timing of an impression taking



We can consider the timing of an impression taking as shown in **Table 4-47**. After an successful osseointegration, an impression can be taken without a second stage surgery in 1 stage implant surgery, or with a second stage surgery, wait gingival healing for 1~2 weeks and take an impression in 2 stage implant surgery. This type of an impression can be applied in a posterior region where esthetics is not so important and a total treatment period will be shortened **(Fig. 4-24)**

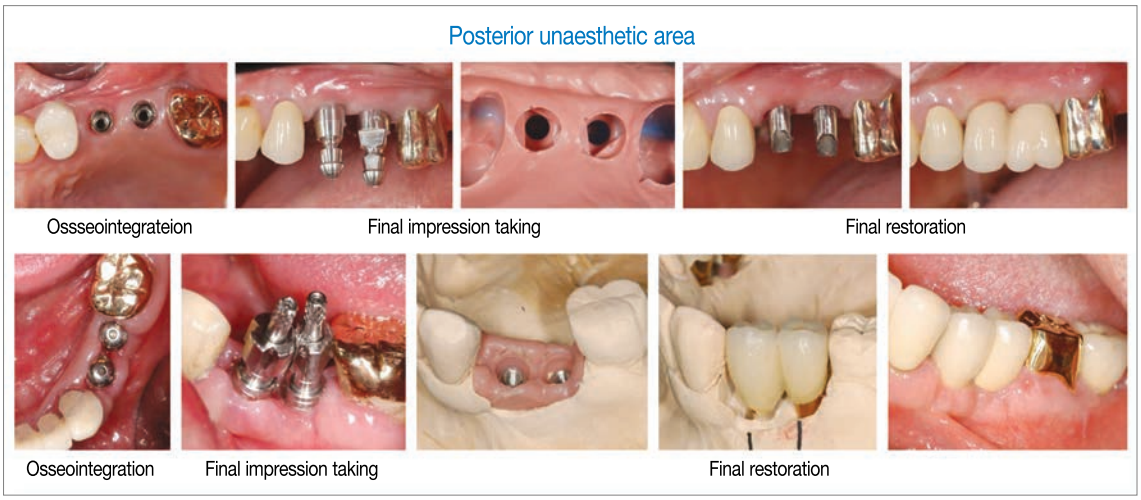


Fig. 4-24. In a posterior region, except in special situations, a final prosthesis can be fabricated after taking an impression just once.

However, a maxillary anterior region, where esthetics is very important, requires a gingival maturation process or a gingival sculpting (remodeling or creeping method) **(Fig. 4-25)**. A provisional restoration is required to evaluate occlusal scheme or patient related factors in a full mouth fixed type restoration **(Fig. 4-26)** and to perform a progressive loading in a sinus bone graft case **(Fig. 4-27)**. After achieving some objectives, we take an impression once more and fabricate a final prosthesis. Besides, an impression can be taken at the day of implantation to perform an immediate loading or to deliver provisional restoration immediately after a second stage surgery (using a surgical stent or an impression coping or a fixture mount) **(Fig. 4-28)**.

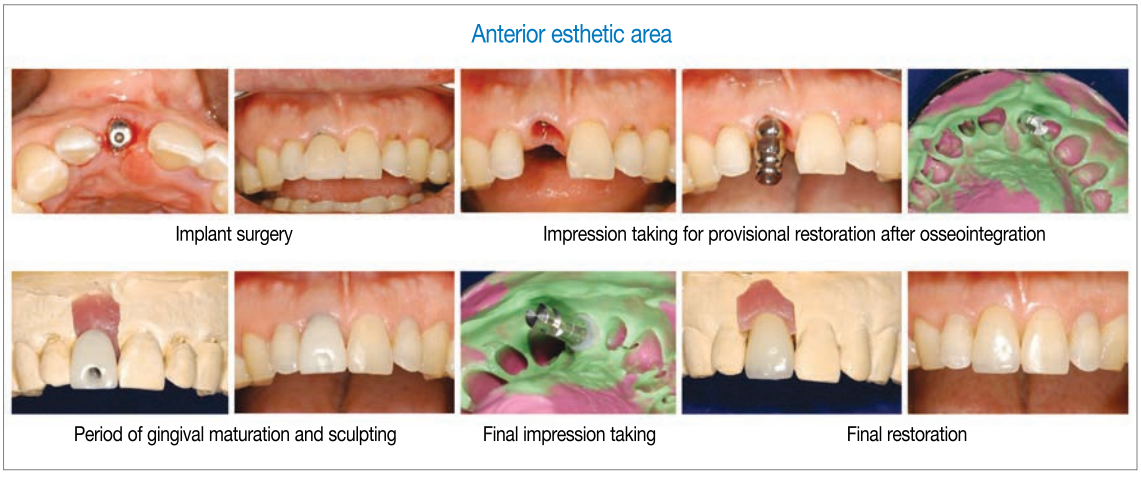


Fig. 4-25. Use a provisional restoration to mature or sculpt gingiva for a better esthetic result

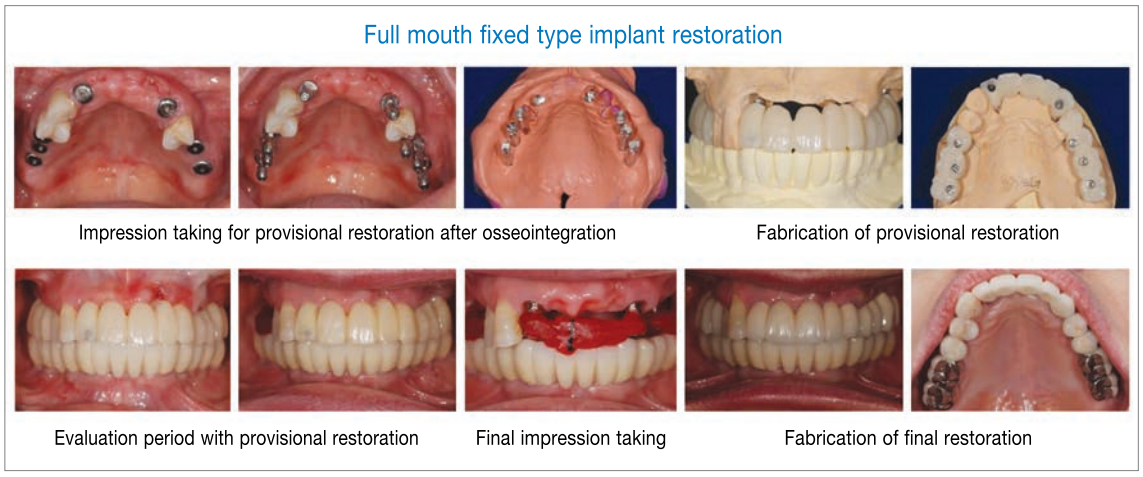


Fig. 4-26. Evaluation period using a provisional restoration is required in a full mouth rehabilitation or an extensive restoration case.

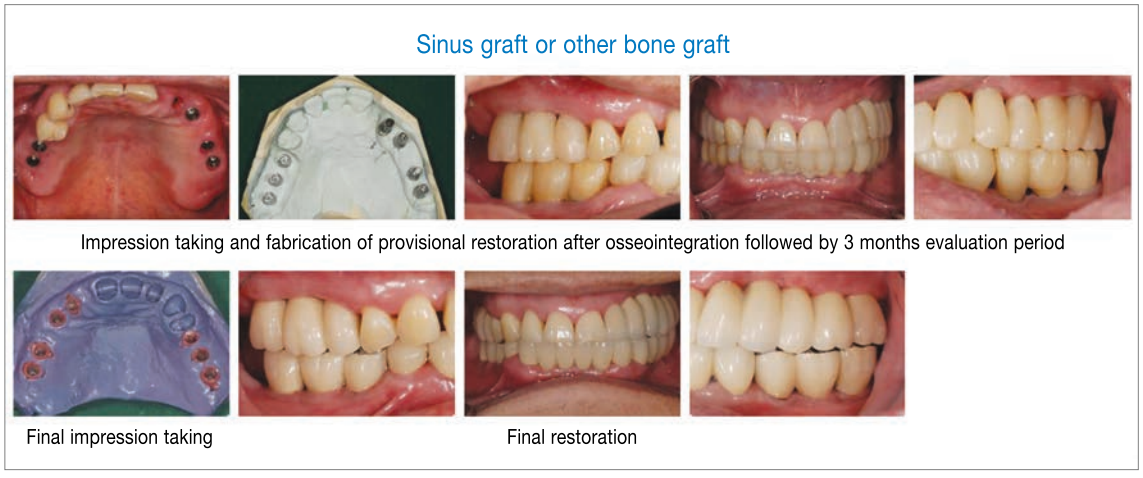


Fig. 4-27. Provisional restoration for a progressive loading in a sinus bone graft case

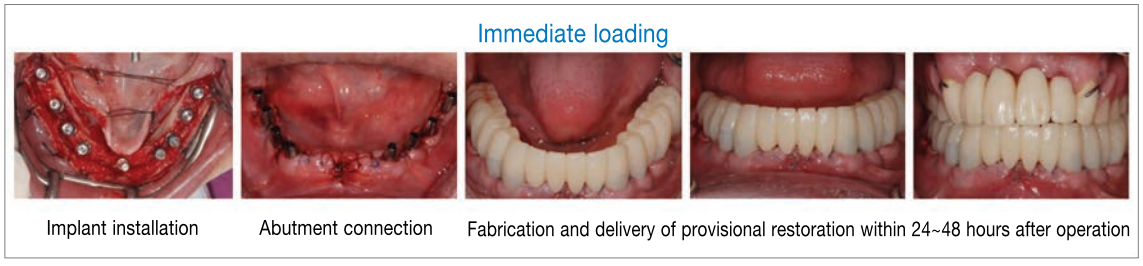


Fig. 4-28. After an implant placement, an impression was taken at the same time and a provisional restoration was fabricated and delivered for an immediate loading 1 day later.

3) Impression taking methods for a dental implant

Most of all, it is important that an impression taking should be as simple and accurate as possible like in conventional prosthetic treatment. In a conventional prosthetic therapy, duplicating the gingival margin of a prepared (reduced) tooth into a master model is the key of success in a final restoration. The significance of an impression taking during implant prosthetic procedures is to accurately duplicate the 3-dimensional shape and position of a fixture should be transferred into a master model in a fixture level impression. The 3-dimensional shape of a fixture means an internal or an external geometry of an implant, like a hexa, an octa, a morse taper design and so on. The position of a fixture means a mesio-distal, a bucco-lingual and an apico-coronal position of an implant. Also, the angulation of a fixture should be included. In an abutment level impression, the 3-dimensional shape and position of an abutment should be transferred into a master model **(Fig. 4-29)** If the internal geometry (hexed or octa type) of a fixture, the shape of an abutment or its 3-dimensional position is not accurately duplicated into a master model due to impression errors, and hence all the following prosthetic procedures would be highly stressful for clinicains.

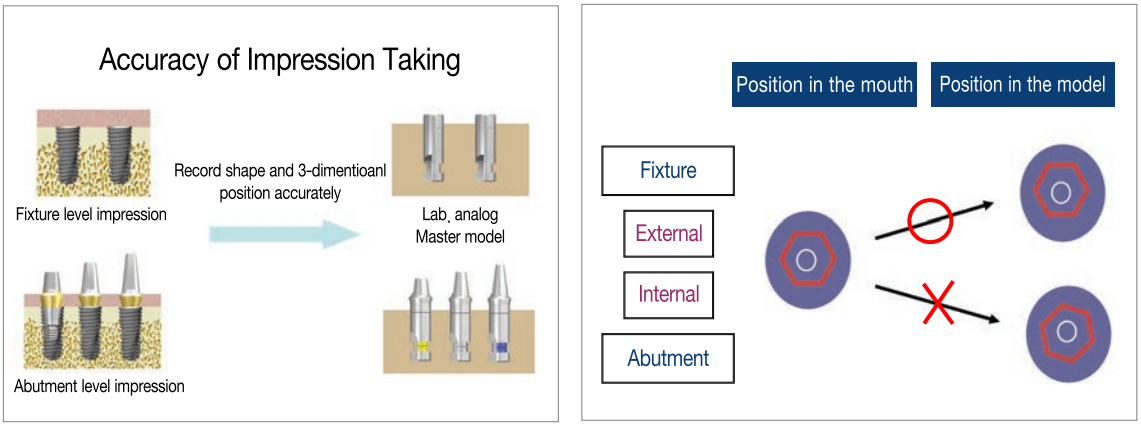


Fig. 4-29. Illustration about the Importance of an accurate impression taking

Occasionally, a final restoration can be fabricated even when the internal geometry of a fixture is not accurately duplicated due to just a rotational change of an impression coping. Maybe, it is possible to make a final restoration by using a non-hexed type component (abutment). For example, if both horizontally and vertically 3-dimentional position of a fixture or an abutment is going to be accurately duplicated into a master model, we can fabricate a final prosthesis by selecting a non-hexed type UCLA abutment **(Fig. 4-30)** or a non-hexed type NP cast abutment **(Fig. 4-31)** in TS/GS implant system when we are planning to make a splinted screw-retained prosthesis using multiple implants or a bar type implant overdenture, although a little rotational impression error happened. Some clinicians like to use non-hexed type impression coping from the beginning to avoid inconvenience and to compensate minor error during an impression taking procedure. However, it is absolutely necessary to use a transfer key (jig) or a repositioning jig in order to transfer an abutment in a master model into a mouth accurately when a cement retained type restoration is made using a non-hexed type abutment **(Fig. 4-32)**

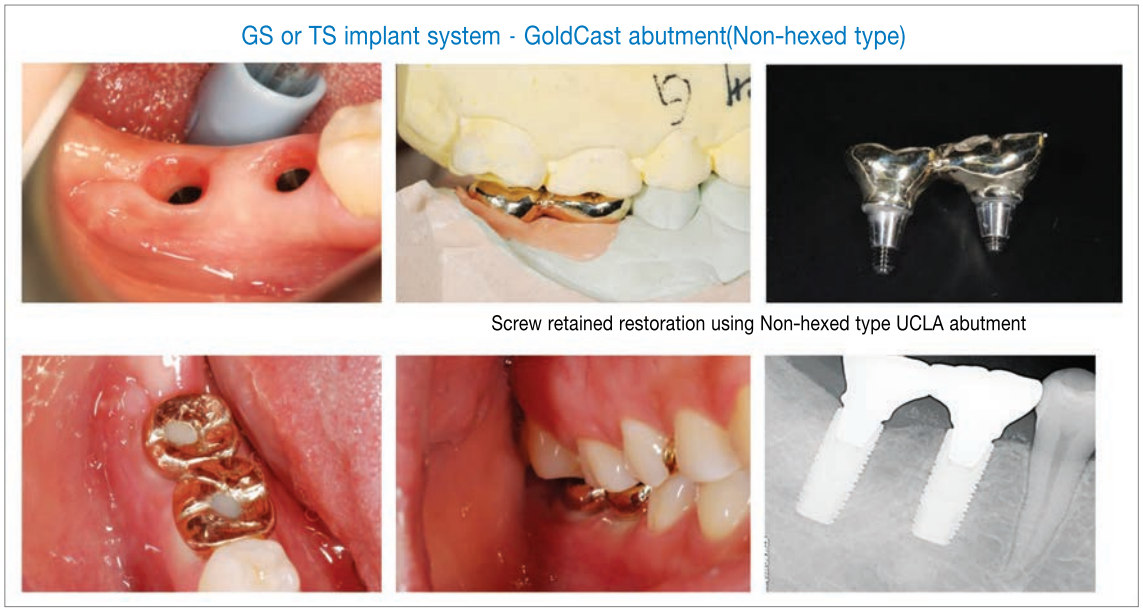


Fig. 4-30. An example of a screw retained type restoration using non-hexed type GoldCast abutment

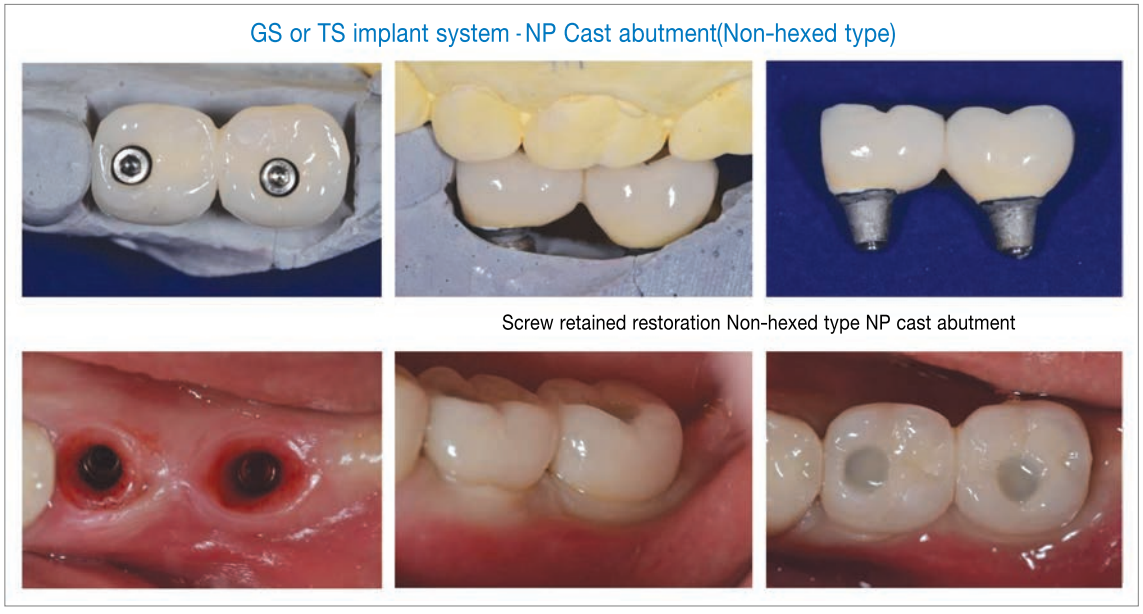


Fig. 4-31. An example of a screw retained type restoration using non-hexed type NP cast abutment

Fig. 4-32. It is necessary to use a transfer key so as to transfer an abutment into a mouth accurately when a cement retained type restoration is made using a non-hexed type abutment

From my clinical experience point of view, I prefer a hexed-type impression coping in every cases when a fixture level impression is going to be taken, and in general I like to use a hexed type abutment in a single or multiple cement retained type and a single screw retained type restoration, but like to use a non-hexed type abutment in case of a splinted screw retained prosthesis using multiple implants. It is desirable there is no negotiation in an impression taking procedure regardless of fabricating a final prosthesis using any type of abutments. That is because you can experience certain limitation of making a final prosthesis if you will take an impression only by using a non-hexed type impression coping. The impression method for a dental implant can be classified as a fixture level impression and an abutment level impression depending on an impression level.

(1) Fixture level impression

Literally, a fixture level impression means that an impression coping is directly connected to a fixture with a retaining screw. A master model can be fabricated through this impression taking and there is a lab. analog which indicates the shape and position of a fixture inside the master model **(Fig. 4-33)**

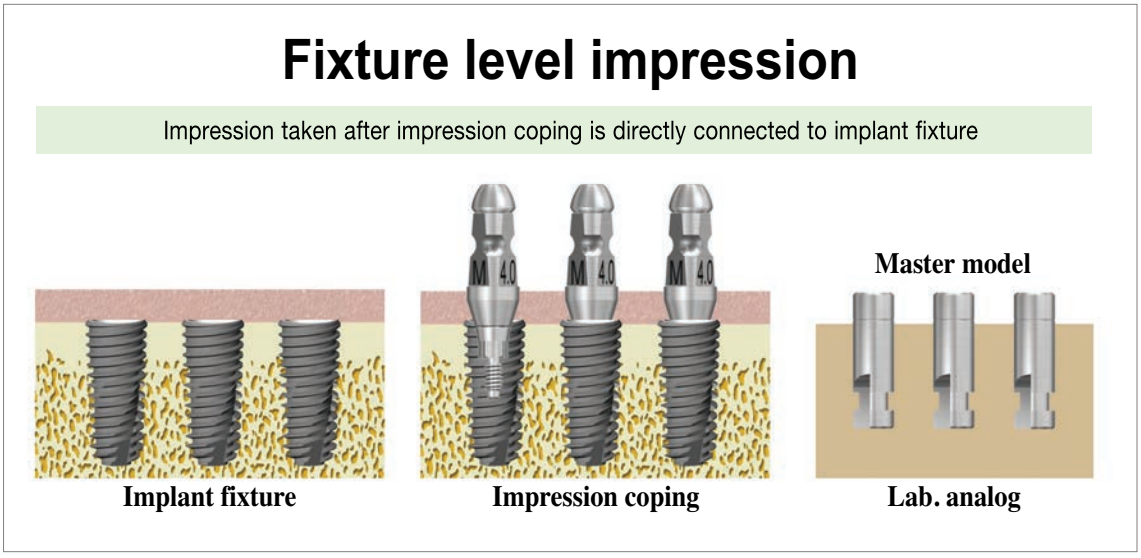


Fig. 4-33. Illustration of a fixture level impression

This impression method follows fabricating a master model, selecting an abutment and making a final prosthesis in a dental laboratory room. For example, this impression method can be selected usually when we are going to fabricate a cement retained type restoration using such as transfer abutment **(Fig. 4-34)** or a screw retained restoration using GoldCast (UCLA) abutment in TS/GS implant system. **(Fig. 4-35)** A fixture level impression is divided into two kinds of method according to an impression coping, which is a transfer impression and a pick-up impression method.

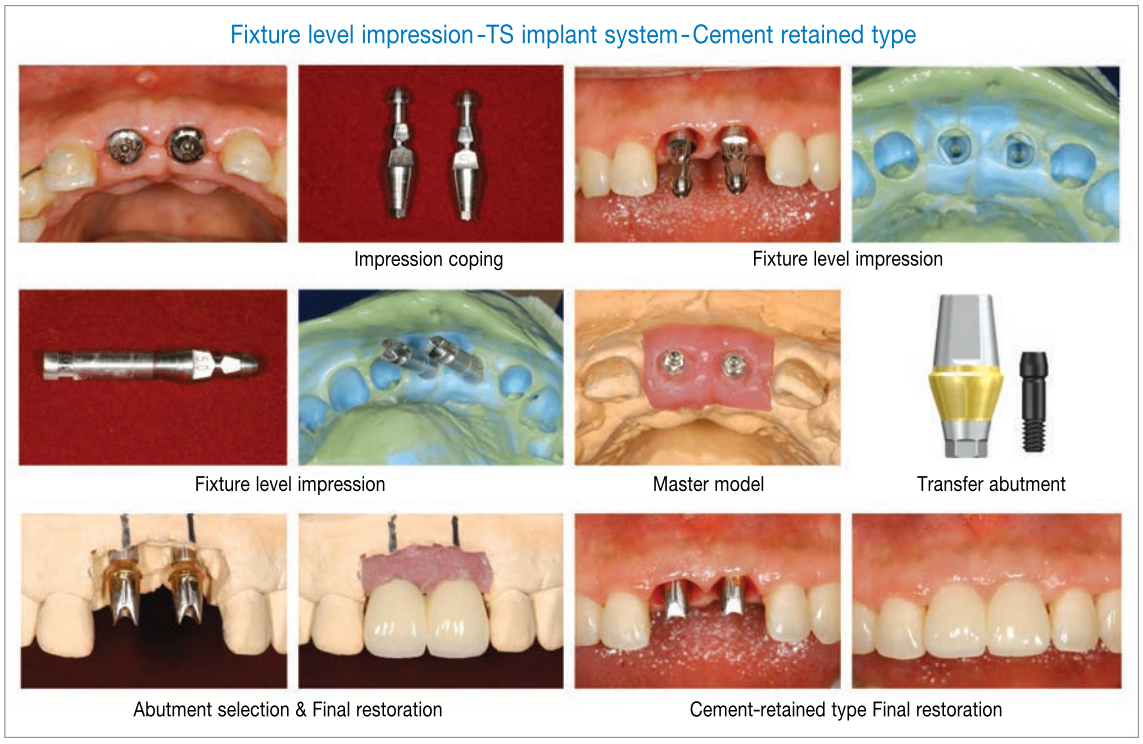


Fig. 4-34. This case shows that a cement retained type was fabricated using transfer abutment after a fixture level impression in TS implant system

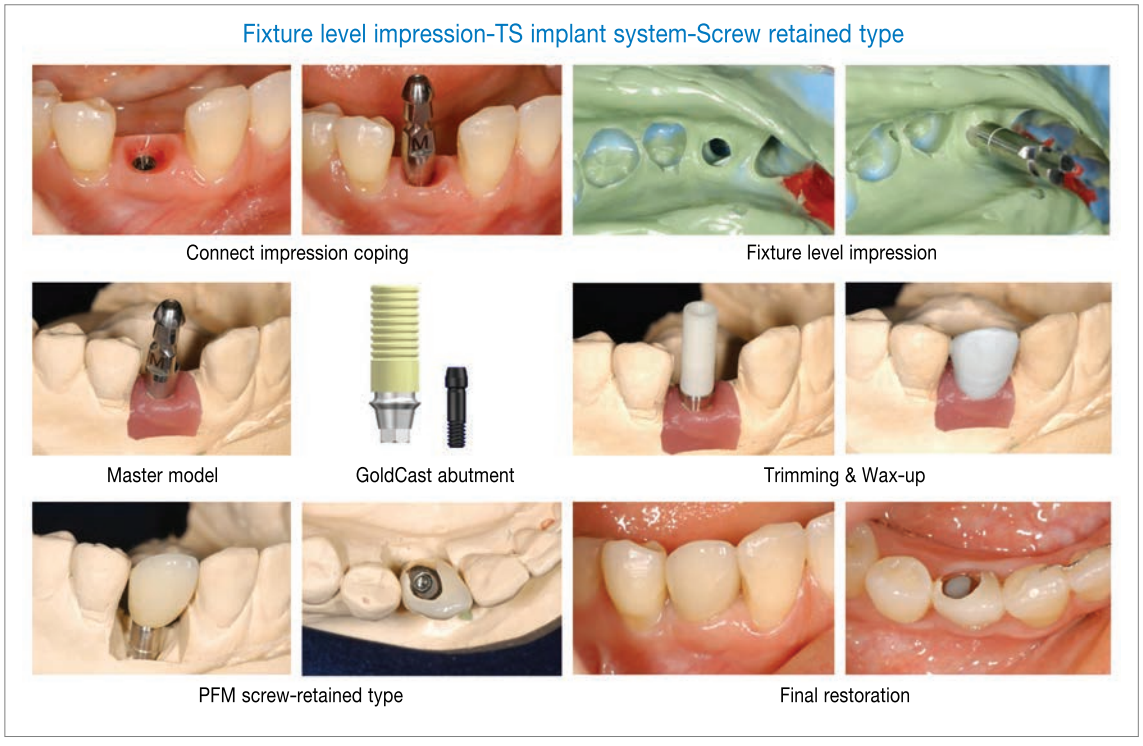


Fig. 4-35. This case shows that a screw retained type was fabricated using GoldCast abutment after a fixture level impression in TS implant system

① Transfer impression method

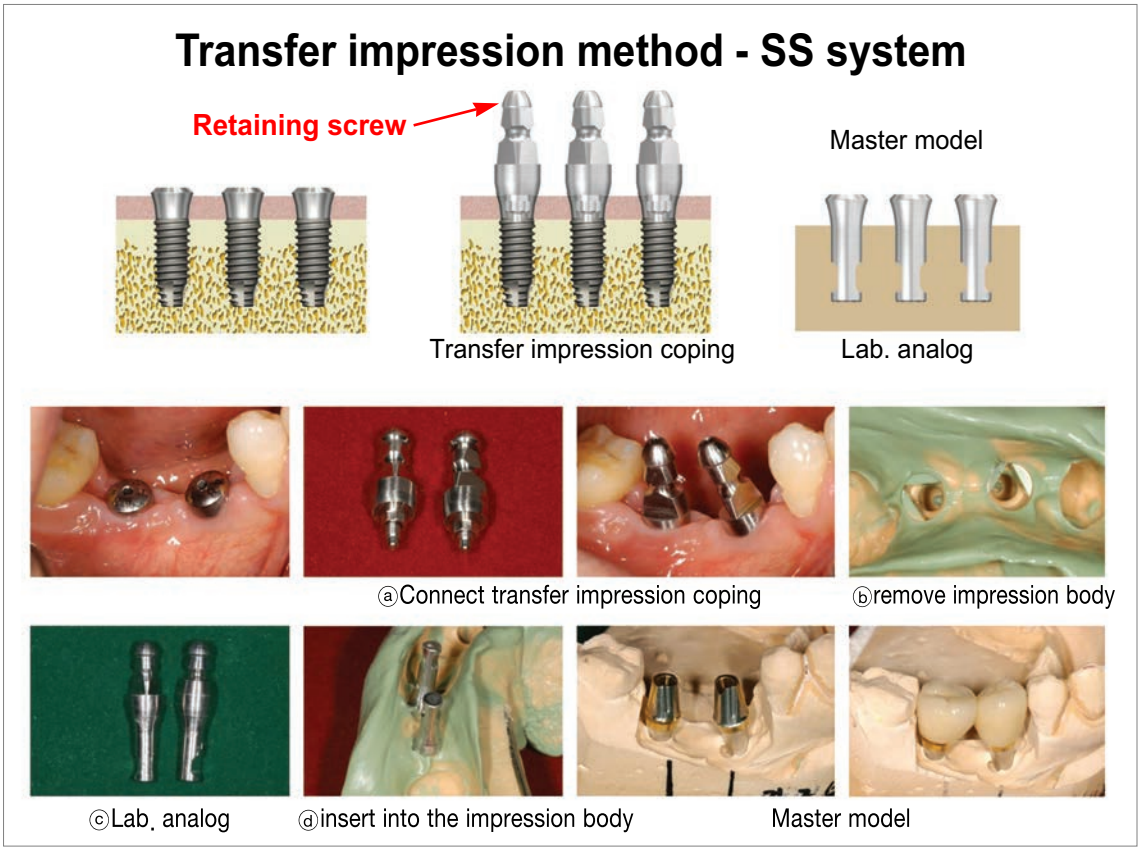


Fig. 4-36. This case is an example of a transfer impression method in SS implant system

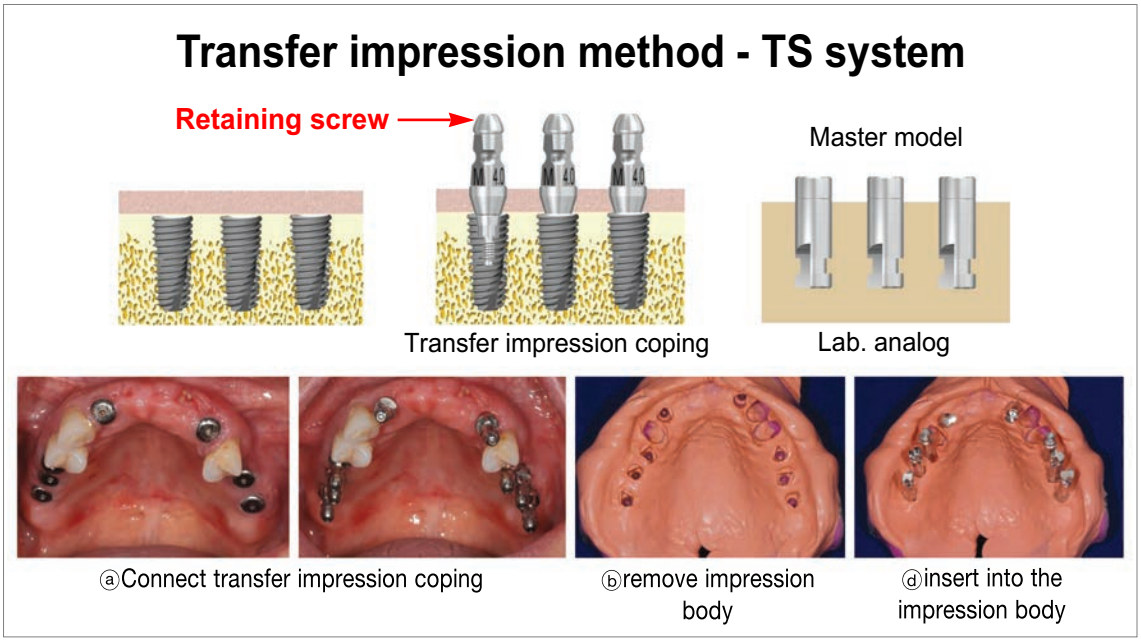


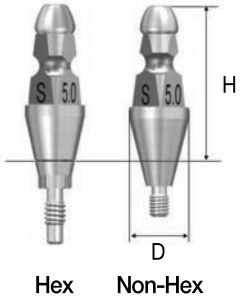
Fig. 4-37. This case is an example of a transfer impression method in TS implant system

A transfer impression is a method of taking an impression after connecting a transfer impression coping to a fixture with a retaining screw (ⓐ). The transfer impression coping, which is connected to a fixture, still remains in a patient's mouth when the impression body is removed from a mouth after the setting of an impression material (ⓑ). And then, the transfer impression coping is removed from a fixture after unscrewing a retaining screw and connected to a lab. analog (ⓒ), and inserted into the negative shape of an impression body(ⓓ). Hence, it is called "Transfer". This method is named either an indirect method or a closed tray technique because a stock or a metal tray is used. **(Fig. 4-36, 37)**

There are two types of transfer impression coping, one-piece and two-piece type. One-piece type has only non-hexed type because an impression coping and a retaining screw is one body. Therefore, it can be used for a preliminary impression to fabricate an open tray or for a final prosthesis using a non-hexed type abutment. Generally, we use two-piece, hexed type impression coping. **(Fig. 4-38)**

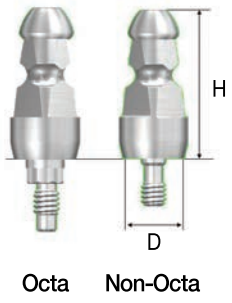
Fixture level Impression coping - Transfer impression coping

• TS implant system



Connection	Mini	Regular
Diameter(D)	ø 4.0	ø 4.0, ø 5.0, ø 6.0, ø 7.0
Height(H)	11 / 14	11 / 14
Type	Hex / Non-Hex	Hex / Non-Hex

• SS implant system



Connection	Regular	Wide
Diameter(D)	ø 4.8	ø 6.0
Height(H)	9.5 / 12.5	9.5 / 12.5
Type	Octa/ Non-Octa	Octa/ Non-Octa

Fig. 4-38. Specification of a transfer impression coping

Clinically, a transfer impression method is selected in following cases.

(1) When the path of fixtures are relatively parallel to each other - When the implants are not paralleling, if you choose a transfer impression method, it is very hard to remove an impression body from a mouth due to the undercut area. And even when the impression body was removed from the mouth by your forced handling, the impression material got torn or deformed. This is one of a transfer impression error.

(2) When planning a cement retained type restoration using 1~3 implants - Some sort of a minor impression error can be compensated by cement space that is applied between a final prosthesis and an abutment.

(3) When planning a screw retained type restoration using 1~2 implants - It is desirable that the number of implants should be limited to 1 or 2 in a screw retained type because there is no simple method to compensate unavoidable errors during clinical and laboratory procedures.

(4) Preliminary impression for an open tray - A preliminary impression by means of a transfer impression gives your dental laboratory technician some information of the path or position of a fixture to make more accurate open tray which saves clinical time for the modification of an open tray during a clinical procedure.

(5) When fabricating a provisional restoration - Minor errors during an impression taking can be corrected in a clinical side.

(6) When you are going to take an impression in a patient who has a limited mouth opening - A pick-up impression is difficult in a patient with a mouth opening limitation because in general, the retaining screw of a pick-up impression coping is relatively long. Therefore, a short-sized transfer impression coping is more effective in this this type of a situation.

(7) When fabricating a final restoration using a non-hexed type abutment - Some rotational error during an impression taking is not so problematic if a non-hexed type abutment is going to be used.

In a transfer impression taking, please keep in mind following instructions to reduce an impression error.
First, as shown in **Fig. 4-39**, all the whole negative shape of a transfer impression coping should be duplicated into an impression body. Two triangular surfaces (①) are designed to prevent a horizontal or a rotational transfer impression error during repositioning a transfer impression coping into the impression body, and a lower cross sectional surface (②) is designed to prevent a vertical transfer impression error. These surfaces should be accurately duplicated into an impression body. Voids or air bubble were formed due to the saliva or the impression material was not uniformly or evenly filled around the impression coping result in unstable repositioning of a transfer impression coping. Also, when the artificial gum is applied or the master model is fabricated, the possibility of a distortion may be high. This is a reason why the position of an impression coping can be changed during clinical and laboratory procedures. Hence, the whole negative shape of these parts must be recorded in the impression body precisely. A lower cross sectional surface is related to both the length of a transfer impression coping and a gingival height, so it may be recorded inaccurately in the impression body if it is positioned below the gingiva because of the depth of an implant or the thickness of a gingiva. **(Fig. 4-39)**

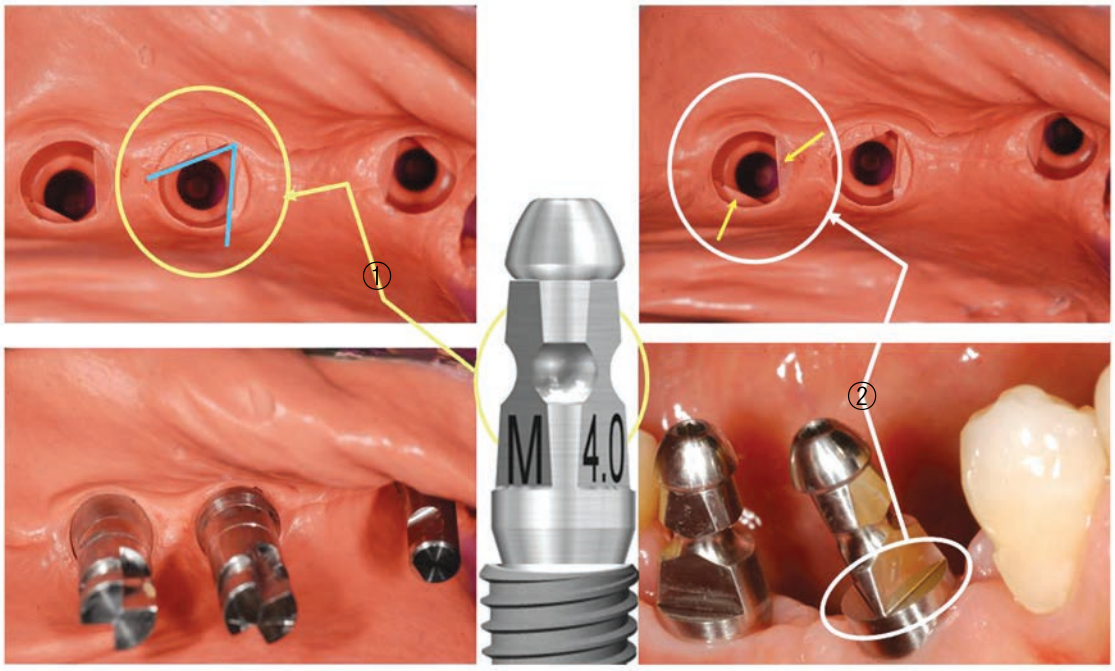


Fig. 4-39. An impression method to reduce a transfer impression error.

Especially, TS Implant system tends to be placed slightly deep. Therefore, it is desirable to select the proper length of a transfer impression coping considering a gingival height. It is difficult to have confidence in the exact vertical position of a transfer impression coping if a lower cross sectional surface is not well recorded in the impression body. In addition, there is a risk of deformation during the master model fabrication, because the part of an impression body which holds an impression coping is short. **(Fig. 4-40)**

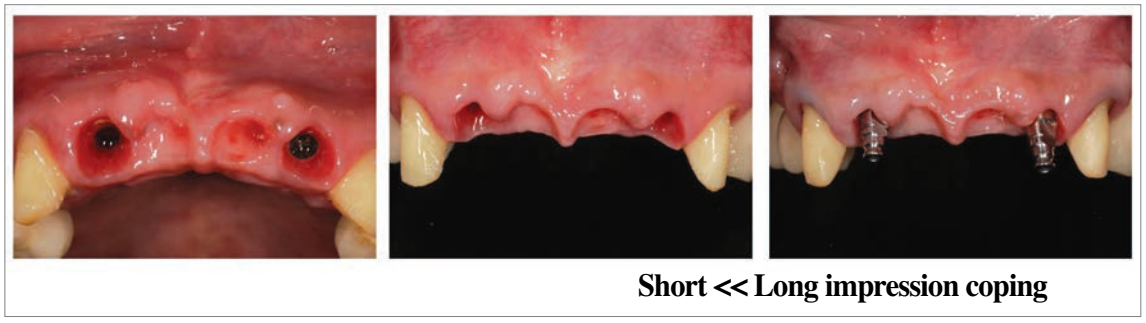


Fig. 4-40. An impression method to reduce a transfer impression error.

Consequently, It is better to use longer sized transfer impression coping or to select a pick-up impression coping when the lower part of a transfer impression coping is covered by a gingiva because of a deep implant position or a thick gingiva. As shown in **Fig. 4-38**, the length of a transfer impression coping is 11 and 14mm in TS implant system. Whereas, SS implant system has 9.5 and 12.5mm transfer impression coping. **Second,** if the height of a transfer impression coping much longer than that of neighboring teeth, which means there is too much height difference with adjacent teeth, when you insert the impression tray into the mouth, the impression tray would be unstable during the setting time of a rubber impression material. Also, the impression body could be deformed or distorted, if a patient moves tongue or swallows saliva. **(Fig. 4-41)** Hence, it is better to select a suitable transfer impression coping which does not make too much height difference with adjacent teeth. It is more likely to cause a transfer impression error. Especially, in case of a non-submerged type implant such as OSSTEM SS implant system. As you know well, SS implant is a gingival level and one stage implant system, which means the top of a fixture could be located at a relatively high position compared with other implant system such as US or TS implant. **(Fig. 4-42)**

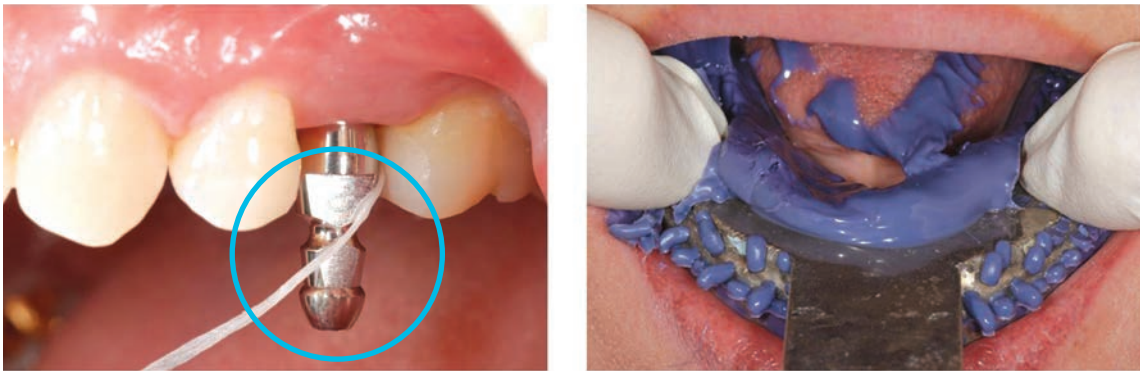


Fig. 4-41. An impression taking procedure will be unstable when using a relatively longer sized transfer impression coping than that of adjacent teeth.

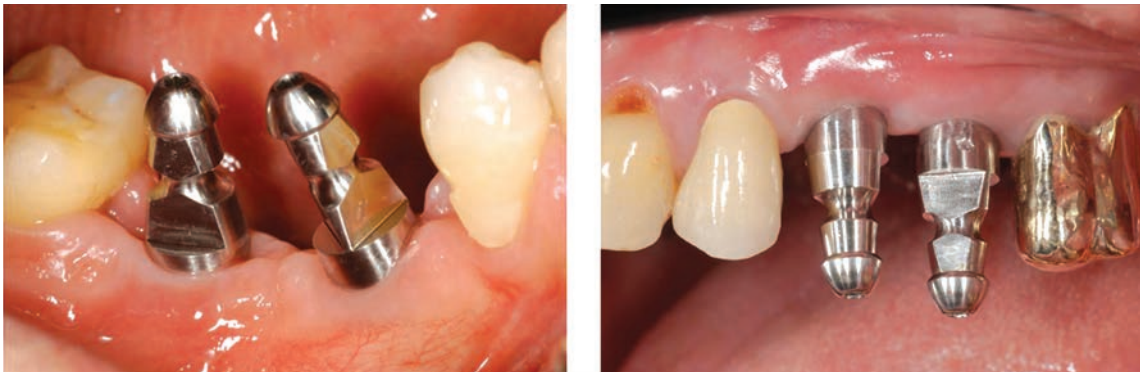


Fig. 4-42. It is important to select a suitable height of a transfer impression coping.

Third, you should make sure that an impression coping doesn't come in contact with an adjacent tooth or the other impression coping due to the improper path or position of implants before the impression taking. This leads to an impression error. Generally, the retaining screw or an impression coping can be tightened even though the position of an impression coping is dislocated slightly in its place. If it is neglected before the impression taking, it can be noticed by evaluating an impression body. If there is no impression material between an impression coping and an adjacent tooth in the proximal contact area, which means that an impression coping touches a neighboring tooth. Also, an impression material will be torn during the removal of an impression body if an impression coping is in contact with an adjacent tooth. Therefore, when it looks too close during connecting an impression coping to a fixture and when you are doubtful of an adjacent tooth interference, it is better to evaluate whether an impression coping touches a neighboring tooth or not with a dental floss silk **(Fig. 4-41)** and you should adjust the impression coping if it contacts.
Fourth, we can consider the access hole of a retaining screw, which can cause a vertical impression error in a transfer impression taking. As you can see in **Fig. 4-42**, one access hole of a retaining screw was filled with Caviton® and the other was not. If you are looking into an impression body after a transfer impression taking, maybe, there can be the positive shape of an access hole like **Fig. 4-42** (①). That's because the impression material flowed into an access hole during an impression taking. This could be one cause of a vertical transfer error. Actually, whenever I insert a transfer impression coping into an impression body, I felt this positive shape of an access hole interferes with the position of a transfer impression coping in its place. Although all the part of an access hole is recorded in the impression body, the inner hex part of a retaining screw and the positive shape of an access hole will be mismatched because of a tolerance between a fixture and a lab. analog and/or a different force connecting a lab. analog to a fixture with a retaining screw. Additionally, the positive shape of an access will be recorded incompletely in the impression body. As a result, the impression coping will push it outside during the transfer impression coping is inserted into the impression body **(arrow in Fig. 4-43)**. Clinically, to prevent this type of an error, it is recommended that the access hole of a retaining screw is blocked up with a utility wax or it is better to remove the positive shape of an access hole inside an impression body using a spoon excavator before you'll insert a transfer impression coping in its place. As shown in **(Fig. 4-43)**, you can find the clear difference between before and after the removal of it.

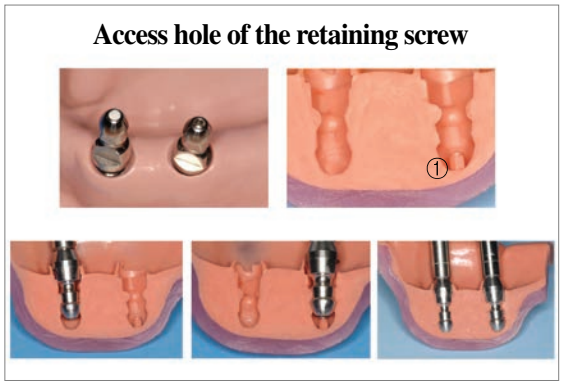


Fig. 4-42

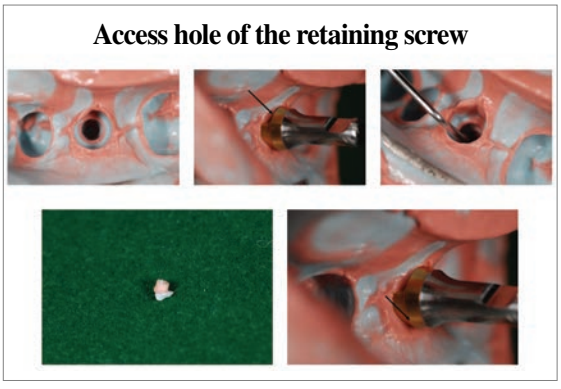


Fig. 4-43

By keeping above instructions, you can take a transfer impression more accurately because a transfer impression coping has asymmetrical structure in its design. And it is easier or more convenient than a pick-up impression method that will be explained in next chapter.

② Pick-up impression method

A pick-up impression is a method of taking an impression after connecting a pick-up impression coping to a fixture with a retaining screw(ⓐ). It is named so because an impression coping is picked-up together with an impression body(ⓑ) after the setting of an impression material. And then a lab. analog is connected to a pick-up impression coping inside an impression body with a retaining screw again after the removal of an impression body(ⓒ). In order to unscrew the retaining screw of a pick-up impression coping before removing the impression body, the length of a retaining screw should be longer than that of a transfer impression coping to protrude over the impression tray which must have a hole. For this reason, a pick-up impression is called as an open tray technique or a direct method. **(Fig. 4-44~46)**

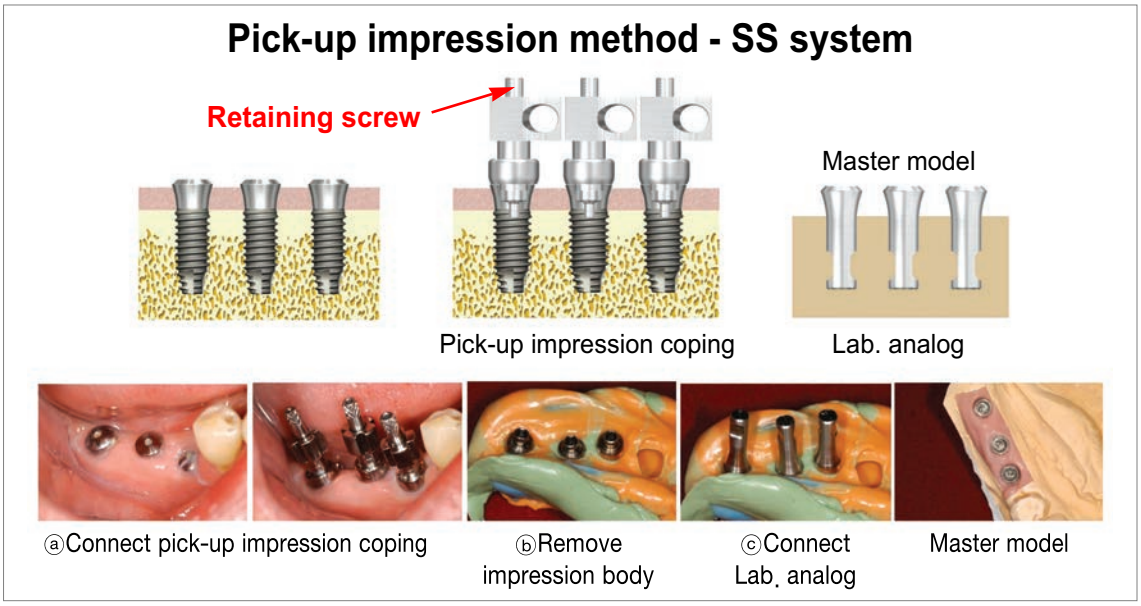


Fig. 4-44. This case is an example of a pick-up impression taking in SS implant system.

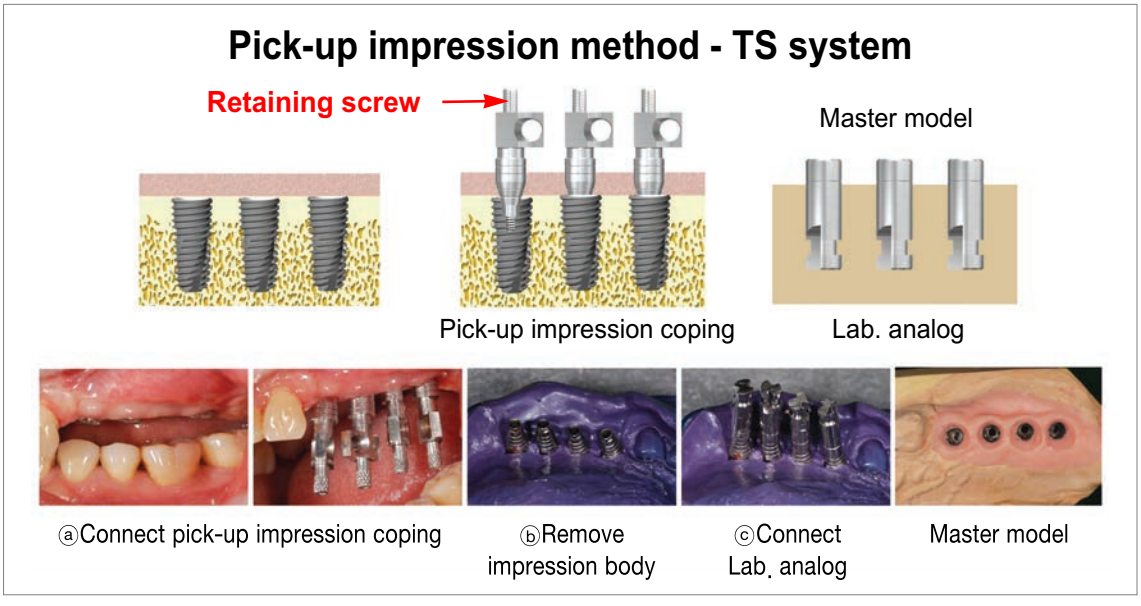


Fig. 4-45. This case is an example of a pick-up impression taking in TS implant system.

Generally, a transfer impression coping has less curve or undercut to prevent an impression material from getting torn when an impression body is removed from the mouth, while a pick-up impression coping is designed with a hole and undercut structure to be removed with an impression body. **(Fig. 4-46, 47)**

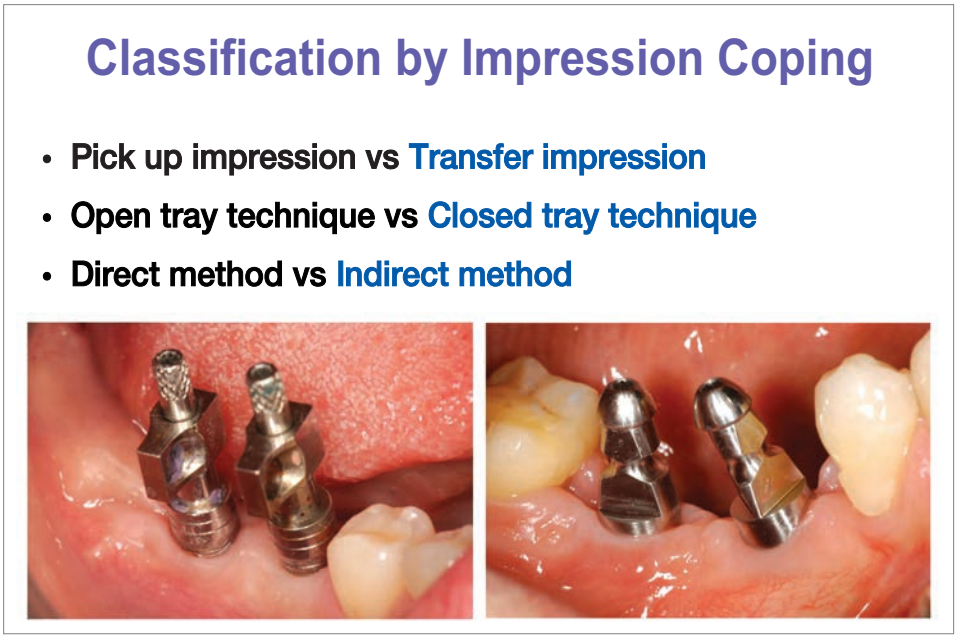
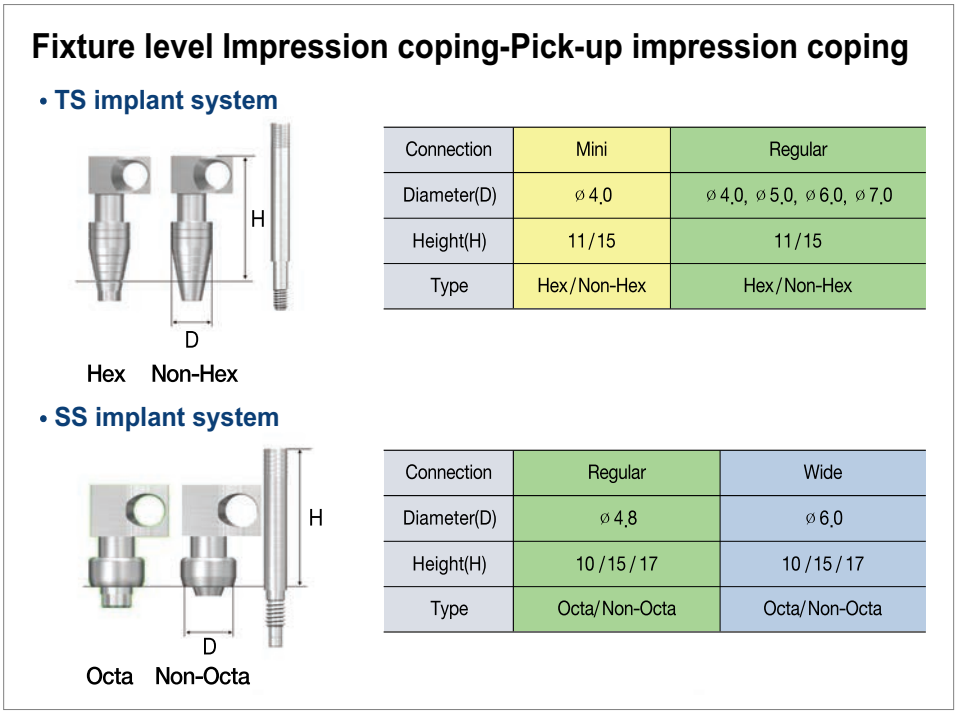


Fig. 4-46. Difference of a pick-up impression coping and a transfer impression coping



Connection	Mini	Regular
Diameter(D)	ø 4.0	ø 4.0, ø 5.0, ø 6.0, ø 7.0
Height(H)	11/15	11/15
Type	Hex/Non-Hex	Hex/Non-Hex

Connection	Regular	Wide
Diameter(D)	ø 4.8	ø 6.0
Height(H)	10/15/17	10/15/17
Type	Octa/Non-Octa	Octa/Non-Octa

Fig. 4-47. Specification of a pick-up impression coping

From a clinical point of view, a pick-up impression taking is slightly inconvenient than a transfer impression taking. But because it has no transferring process of impression coping and less chance of transfer-related errors, it can be a good choice in case which requires more accurate prosthesis. Of course, a recent transfer impression coping is well designed to minimize impression errors, if you keep in mind the aforementioned warnings, you can get clinically acceptable impression with only a transfer impression method. **(Fig. 4-37)** The pick-up impression taking is indicated as in the following cases.

(1) When the path of fixtures is not so paralleling.

(2) A cement retained type restoration using 4 or more implants.

(3) A screw retained type restoration using 3 or more implants.

(4) A full mouth fixed type implant restoration

(5) In case of a bar type implant overdenture

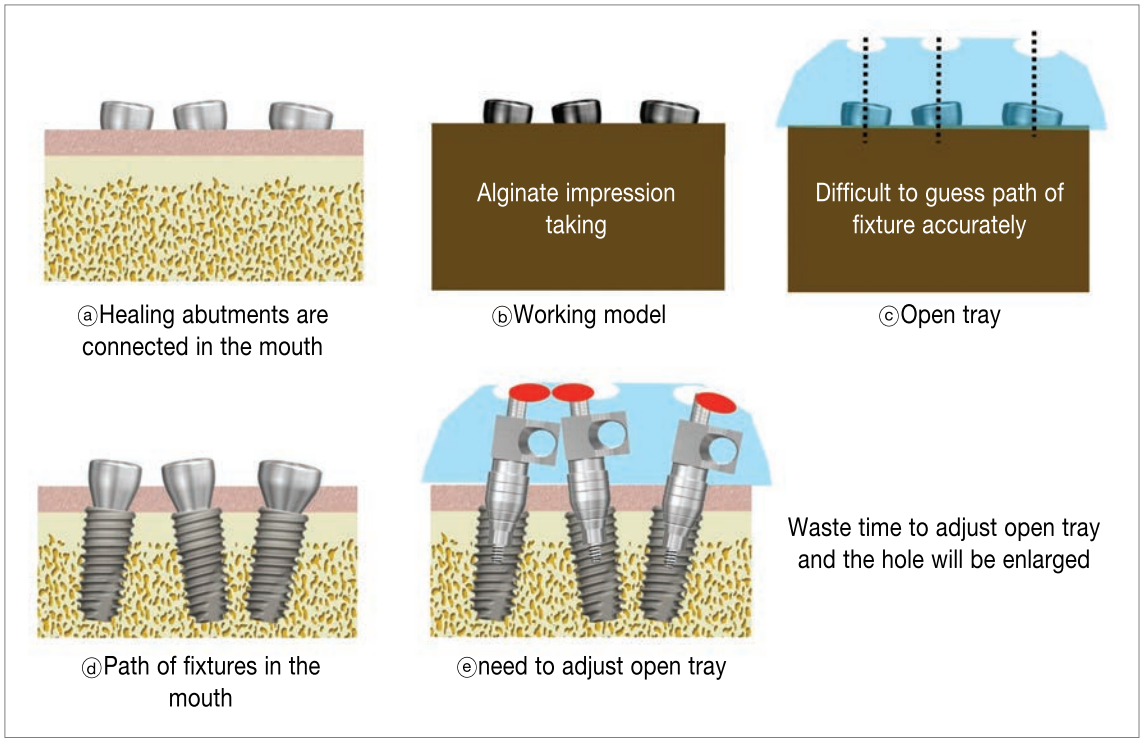


Fig. 4-48. Illustration of open tray fabrication process.

There are two kinds of method to make an open tray for a pick-up impression taking. **First,** we can take a preliminary impression with alginate or silicone rubber impression material to duplicate only the state of a healing abutment connection in the mouth (ⓐ, ⓑ). But, if the working model is fabricated in this way, this method does not inform a dental laboratory technician the path or angulation of implants or the dimension of pick-up impression copings that are going to be used for a final impression by a dentist in a clinical side, and hence a dental laboratory technician will make an open tray by guesswork (ⓒ). Therefore, it is clinically necessary to adjust the position of a hole on the open tray or the interference by impression copings inside the open tray (ⓓ, ⓔ) after connecting pick-up impression copings to implants in the patient's mouth. As a result, the chair time will increase and the hole size becomes bigger or larger. On the other hand, it is somewhat difficult that the impression material is not uniformly or evenly filled around pick-up impression copings, because enlarged hole leads to the loss of an impression material to the outside of an open tray when a dental hygienist put an impression material into the open tray or during the impression tray is inserted and positioned into the patient's mouth. **(Fig. 4-49)** This is a reason why an impression error happens. In other words, the decreased stability of an impression coping elicits a little positional change of the impression coping during the connection of a lab. analog and the fabrication of a master model. Hence, it will be helpful to block up the widened hole with a paraffin wax before an impression taking if the open tray was made in this way.**(Fig. 4-51)**

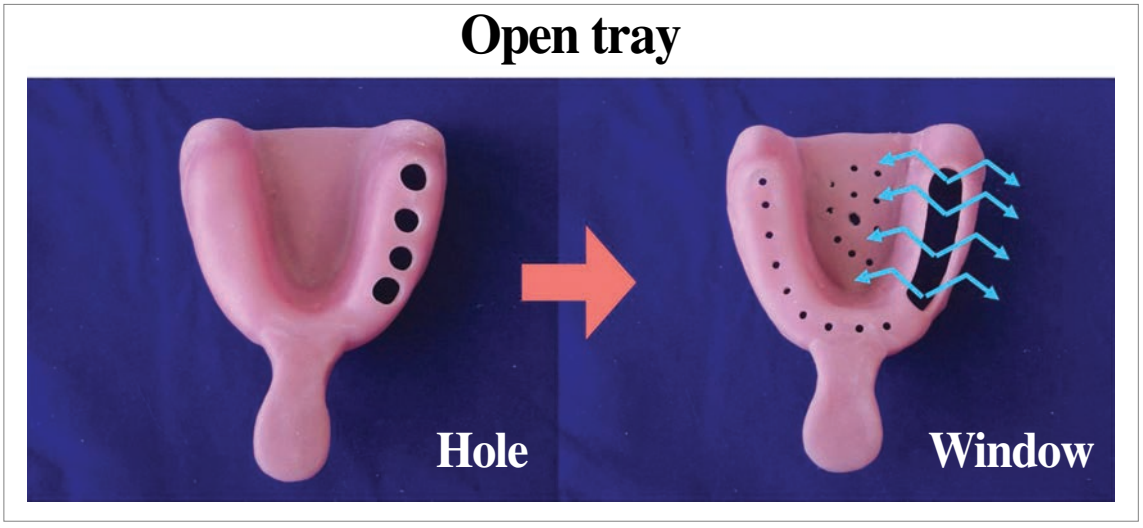


Fig. 4-49

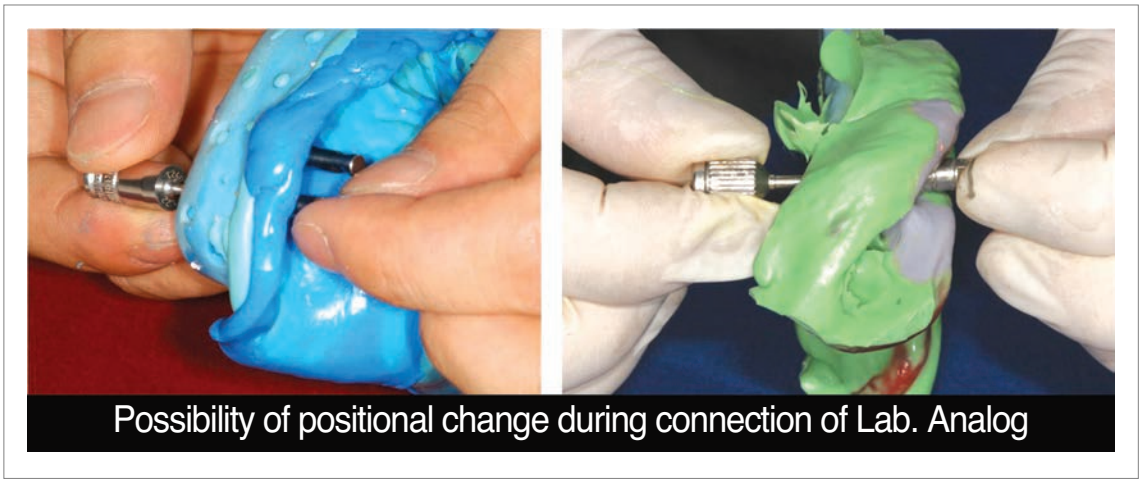


Fig. 4-50. To prevent a positional change of an impression coping, do not hold an impression body during connecting and tightening of a lab. analog with a pick-up impression coping. Be careful especially when the impression material is not uniformly or evenly filled around pick-up impression copings.

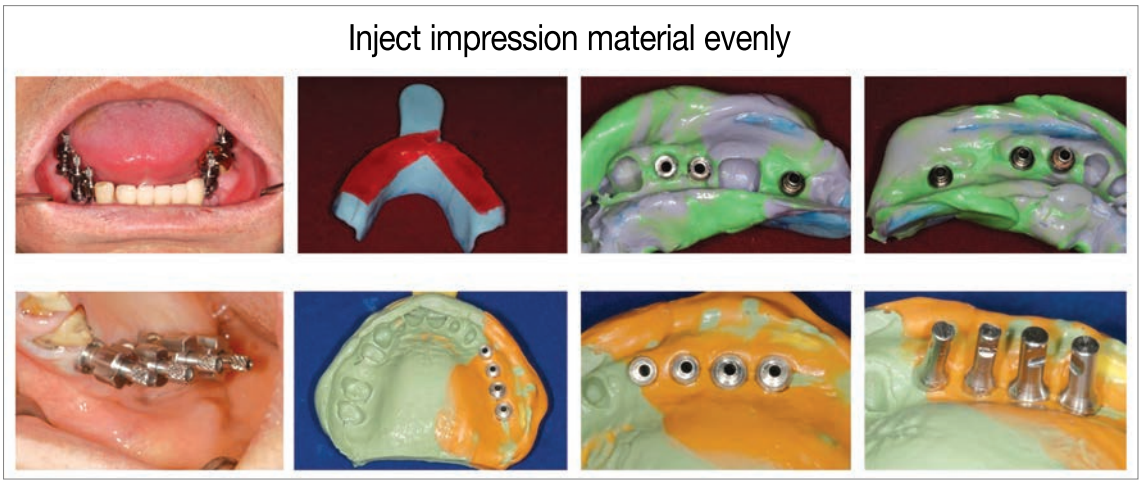


Fig. 4-51

Consequently, it is better to fabricate such kind of open tray only when the path of implants is relatively parallel. Meanwhile, some dentists can also use a special open tray for implant that was made of metal or a plastic disposable open tray is available in the dental market. **(Fig. 4-52)**

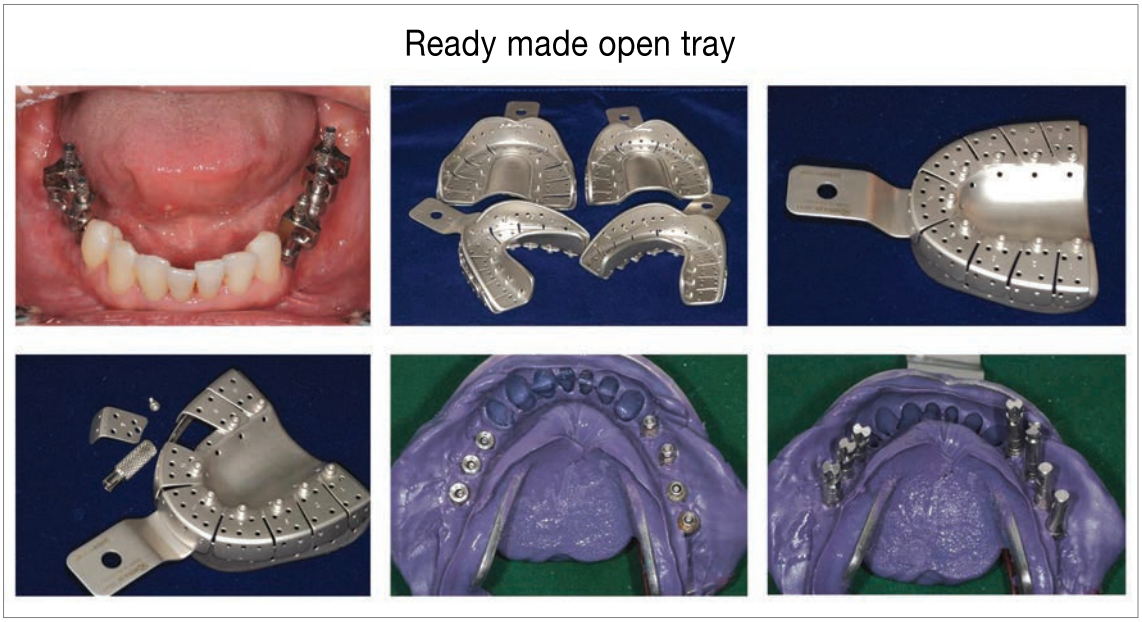


Fig. 4-52. A special implant tray for a pick-up impression taking

Second, I'd like to recommend the following method when the position or path of implants is not ideal or in case of a multiple implant restoration. As shown in **Fig. 4-53**, you take a preliminary impression using a transfer impression coping and give information of the accurate implant path and position to a dental laboratory technician, so that he can make a favorable open tray which does not require modification or adjustment in a clinic side. **(Fig. 4-53)** First, you connect transfer impression copings to implants and take a transfer impression with alginate impression material (ⓐ). And then, you send pick-up impression copings to the dental lab. side with an impression body, which are going to be used later in the clinic (ⓑ).
A laboratory dental technician will fabricate a working model and connect pick-up impression copings to lab. analogs on this model after transfer impression copings are removed (ⓒ). After a suitable block-out with paraffin wax considering the space for impression material and amount of retaining screw which will be exposed outside of the open tray, fabricate an open tray using a self-curing or light curing resin (ⓓ).
This method enables you to make a more precise open tray considering 2 kinds of length and shape in pick-up impression coping and the position and/or path of implants.

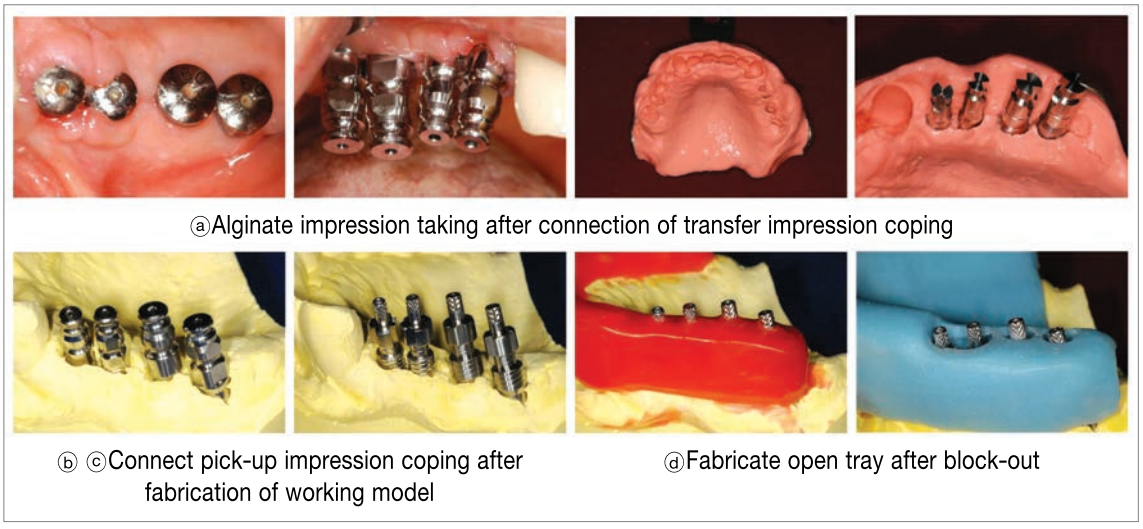


Fig. 4-53

Recently, the design of a pick-up impression coping has been improved. As shown in **Fig. 4-54**, it has a wing portion like an eccentric flag with a hole in the middle. It is designed to prevent the positional change of a pick-up impression coping when connecting lab. analog and to solve the problem without modification of the impression coping by changing direction when it contacts each other or adjacent tooth because of the path or distance of implant. **(Fig. 4-54)** You can see the effectiveness of an open tray fabricated by this method in case of **Fig. 4-55**.

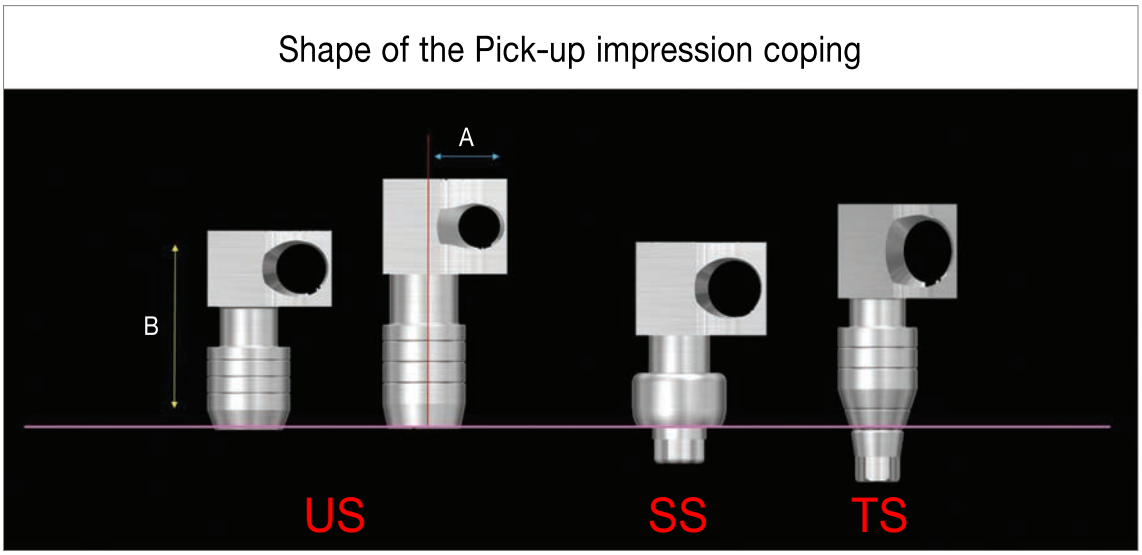


Fig. 4-54

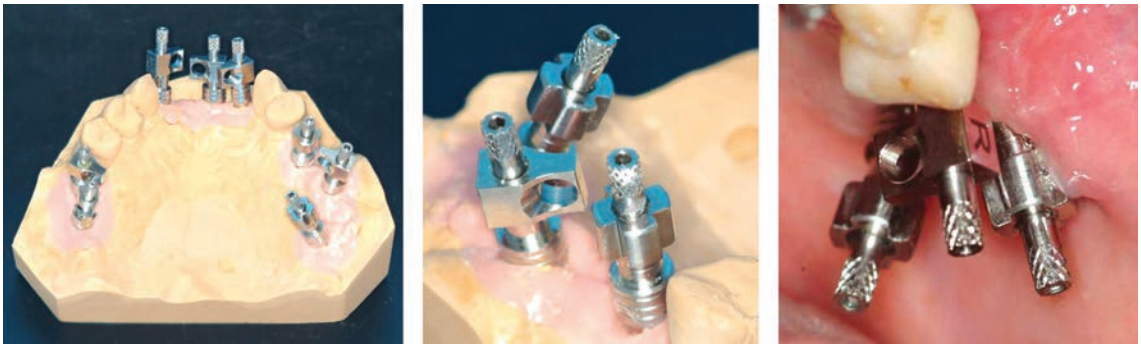


Fig. 4-55. In case of poor implant position or path, it is better to fabricate an open tray by means of the second method.

③ Opinion on a splinted pick-up impression taking

The idea that a splinted pick-up impression taking, which means pick-up impression copings are connected one another with a self-curing resin like pattern resin or Duralay®, is more accurate is controversial. Articles which studied the accuracy of a pick-up impression depending on splinting or not reported different results, some were on the positive side while others argued a splinted pick-up impression is more inaccurate than a non-splinted one. However, here I don't want to focus on the splinting itself. From an actually clinical point of view, it is more important to keep the cautions in mind about splinting pick-up impression copings one another by considering clinical problems that may occur during an impression taking.

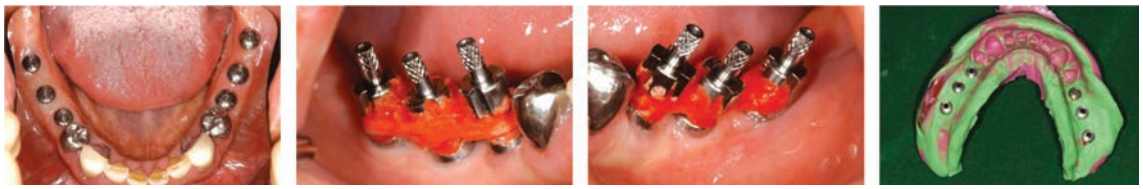


Fig. 4-56. Splinted pick-up impression taking

Without splinting, you should be careful not to cause a positional change of an impression coping during connecting a pick-up impression coping with a lab. analog. To achieve this, as mentioned before, the impression material should be evenly or uniformly filled around a pick-up impression coping **(Fig. 4-51)**, and please bear in mind that a retaining screw should be tightened firmly in this manner, Don't grab the impression body at the end of an applied tightening force. Just grab a lab. analog and a driver when connecting lab. analog. **(Fig. 4-51)** Especially, be careful when the rigidity of impression material is relatively low. For this reason, some clinicians suggest it is better to choose high rigid impression material after setting. But, heavy body or polyether type impression material is too hard or rigid after setting; frequently, it is difficult to remove an impression body from the mouth and it is required to perform an adequate block-out at undercut area. This procedure is somewhat inconvenient. Aforementioned problems can be solved if we splint impression copings and use combination of regular and light body impression material which has a good elasticity recovery. **(Fig. 4-56)** However, the splitting of impression copings has another problem in current popular internal connection system when the path of implants is not parallel. Like TS implant system which has a deep connection part, it is not easy to remove the impression body when pick-up impression copings are splinted one another using a self-curing resin. **(Fig. 4-57)** Additionally, even if the impression body is removed by force, the splinted portion is more apt to be broken. This often leads to greater impression error because it is difficult that this broken portion would be repositioned in its place. **(Fig. 4-58)**

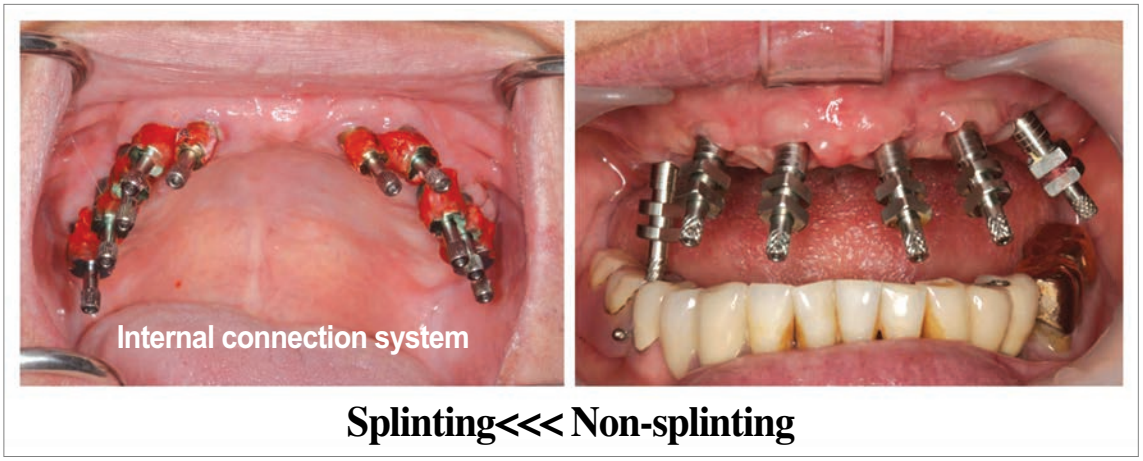


Fig. 4-57

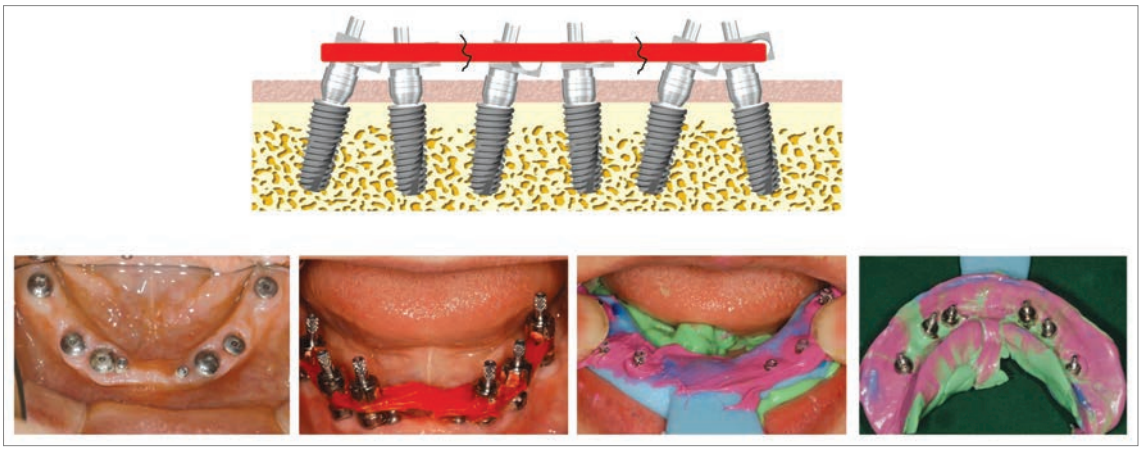


Fig. 4-58

For that reason, some clinicians claim or recommend that it would be better to apply a convertible abutment for solving a path problem when the angulation of implants is not parallel one another in TS implant system by changing it into an external connection structure. But this method causes a high productive cost, therefore, you should make an effort to place implants as parallel as possible. **(Fig. 4-59)**

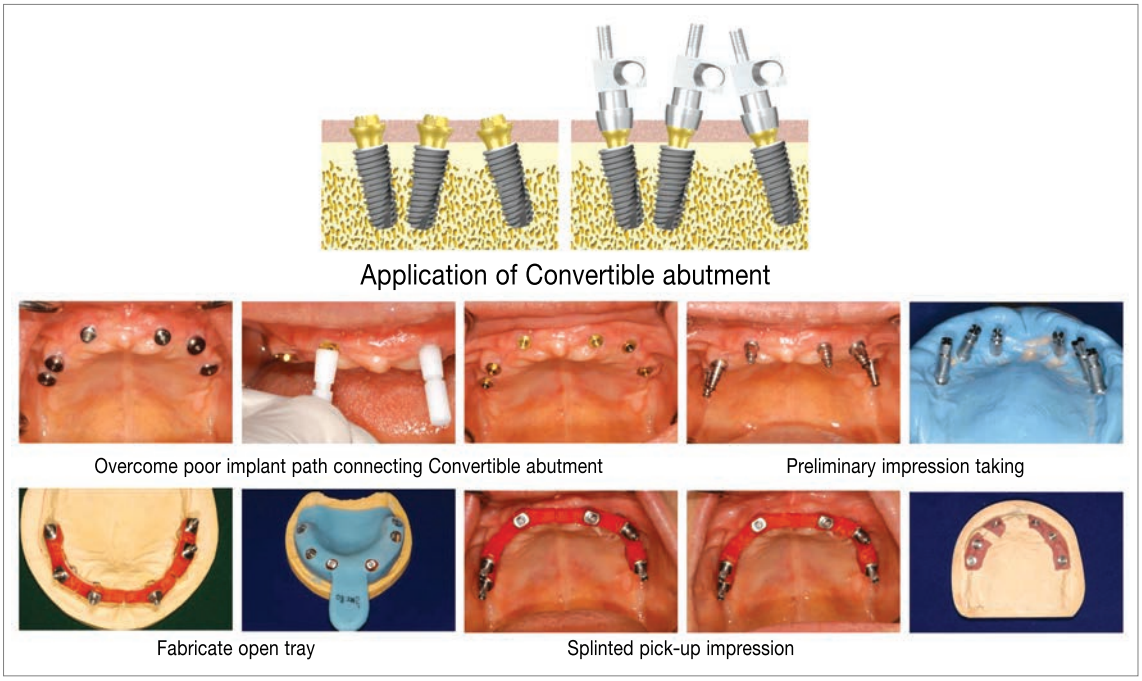
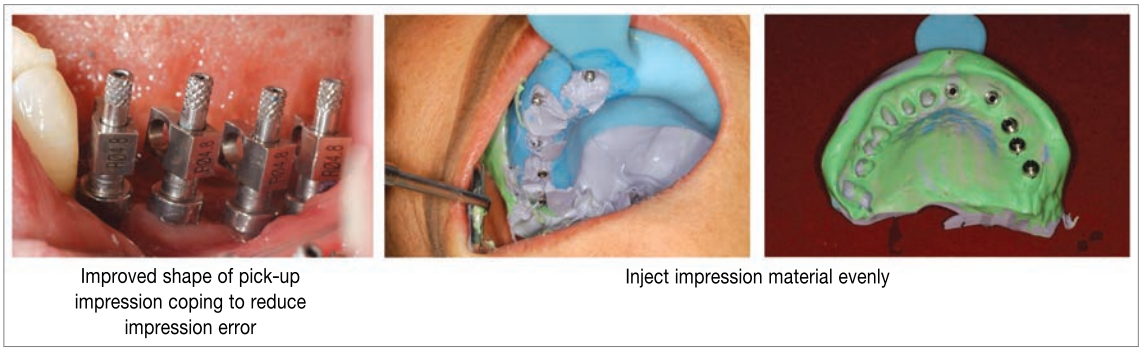


Fig. 4-59

Consequently, connecting pick-up impression copings for an accurate impression taking seems to be having the opposite or negative effect. Because a current pick-up impression coping is designed to minimize an impression error during connecting a lab. analog with a pick-up impression coping inside an impression body **(Fig. 4-60)**, it is better to not splint pick-up impression copings and choose impression material with a good elasticity recovery and above all things, you should pay attention to inject impression material evenly. **(Fig. 4-60)**



Improved shape of pick-up impression coping to reduce impression error

Inject impression material evenly

Fig. 4-60

In my clinic, I often choose a splinted pick-up impression method only when I°Øm going to make a plan an implant bar overdenture. Because I like a polysulfide impression material to make a border molding for a sufficient working time, but this impression material tends to be unstable after setting. The rigidity of this impression material is very low, which means the possibility of a distortion may be high during clinical and laboratory procedures because of its relatively poor elasticity recovery ability compared to other impression material. **(Fig. 4-61)**

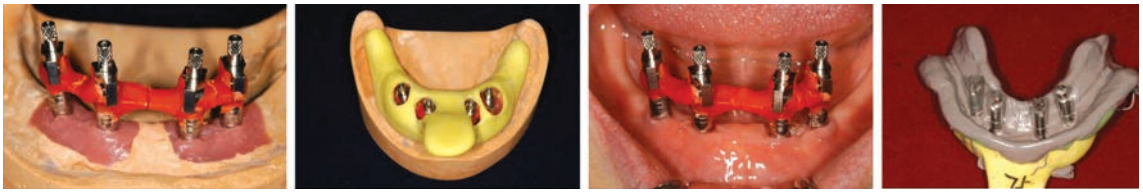


Fig. 4-61

④ Hexed type vs Non-hexed type

Whether to choose a hexed type or a non-hexed type impression coping depends on the abutment selection for an implant superstructure. It is desirable to select a hexed type impression coping to duplicate the hexagonal position of an implant into the master model precisely. Either a hexed or a non-hexed type is possible if you are going to make a final implant restoration by means of a non-hexed abutment. As I mentioned before, some clinicians prefer a non-hexed type component to avoid the inconvenience of an impression taking procedure or for easy abutment connection. However, for the diverse prosthetic design or option of a final restoration, using a hex type impression coping is more advantageous. Because you can select either a hexed or a non-hexed abutment according to various clinical situation.

⑤ When do you select a fixture level impression?

Generally a fixture level impression is selected as the following situations.

(1) On the anterior esthetic region - It is necessary to adjust an abutment in many ways for an esthetic approach such as the location of a gingival margin, the compensation of an improper path, an ideal emergence profile and so on. Hence, it is more effective to do work in a laboratory room after a fixture impression taking than selecting an abutment and working in a patient's mouth.**(Fig. 4-62)**

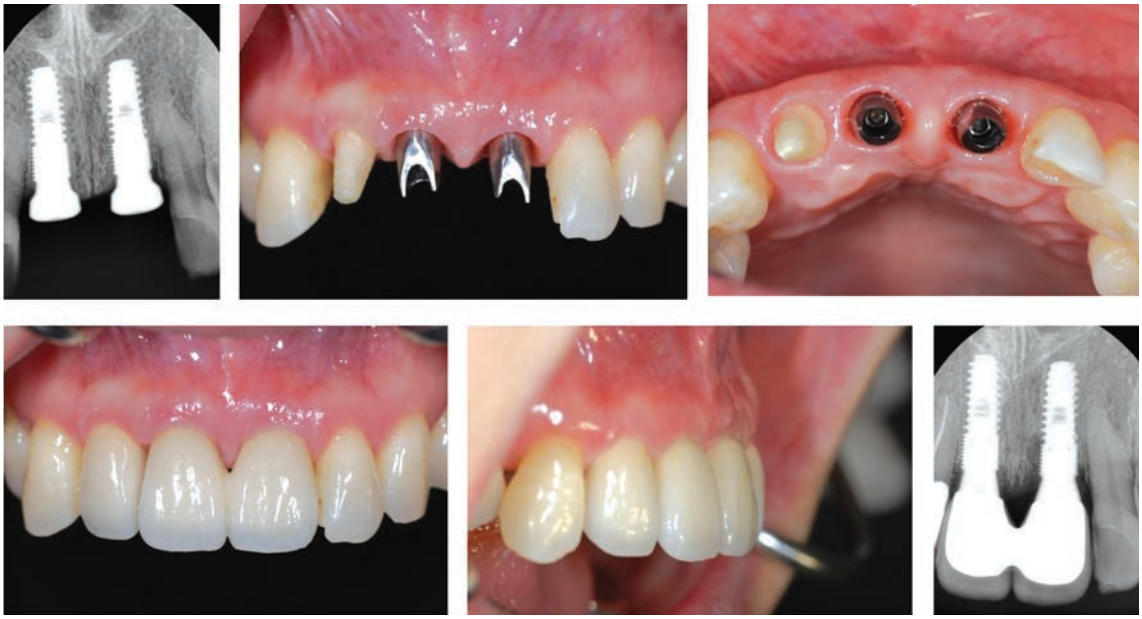


Fig. 4-62

(2) On the posterior region - When the path or angulation of implants is not parallel one another and the distance between implants or between an implant and a neighboring tooth is inappropriate or unfavorable, it is difficult to select and adjust an abutment in a patient's mouth. Therefore, it is better to do work at a laboratory room after a fixture level impression. **(Fig. 4-63)**

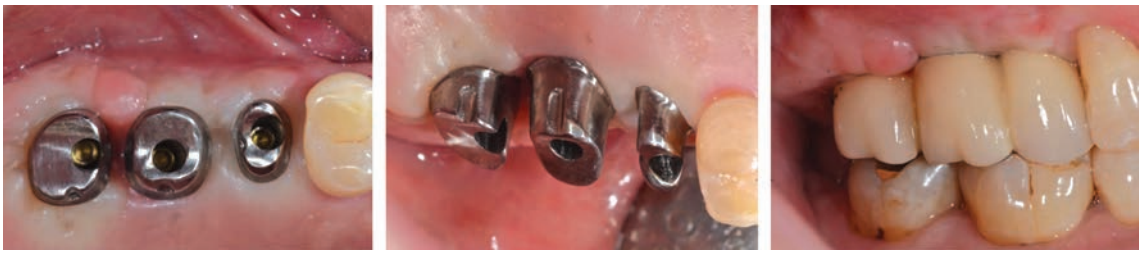


Fig. 4-63. CAD-CAM titanium customized abutments were used instead of ready-made abutments after a fixture level impression taking because of the improper distance and path of implants.

(3) A screw retained type restoration should be fabricated in case of a limited vertical space - A screw retained restoration is fabricated after a fixture level impression. **(Fig. 4-64)**

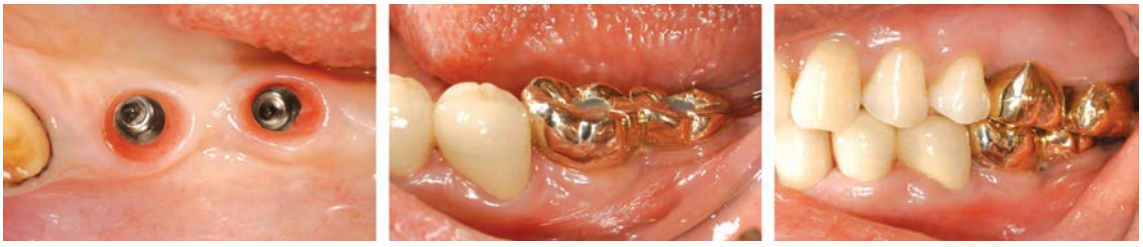


Fig. 4-64. A screw retained type restoration was fabricated using GoldCast(UCLA) abutment after a fixture level impression.

(4) Full mouth fixed type implant restoration - It requires multiple steps in abutment selection and adjustment procedure for an ideal final restoration, hence an abutment level impression has many limitations and insufficiencies. **(Fig. 4-65)**

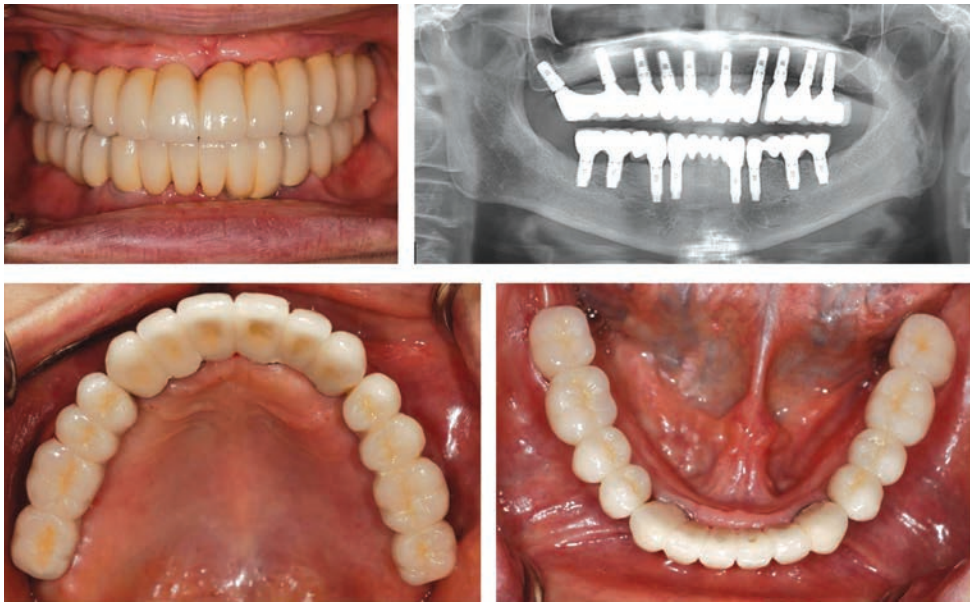


Fig. 4-65

(5) Bar type implant overdenture - Generally a bar type overdenture is fabricated as a screw retained type. **(Fig. 4-66)**

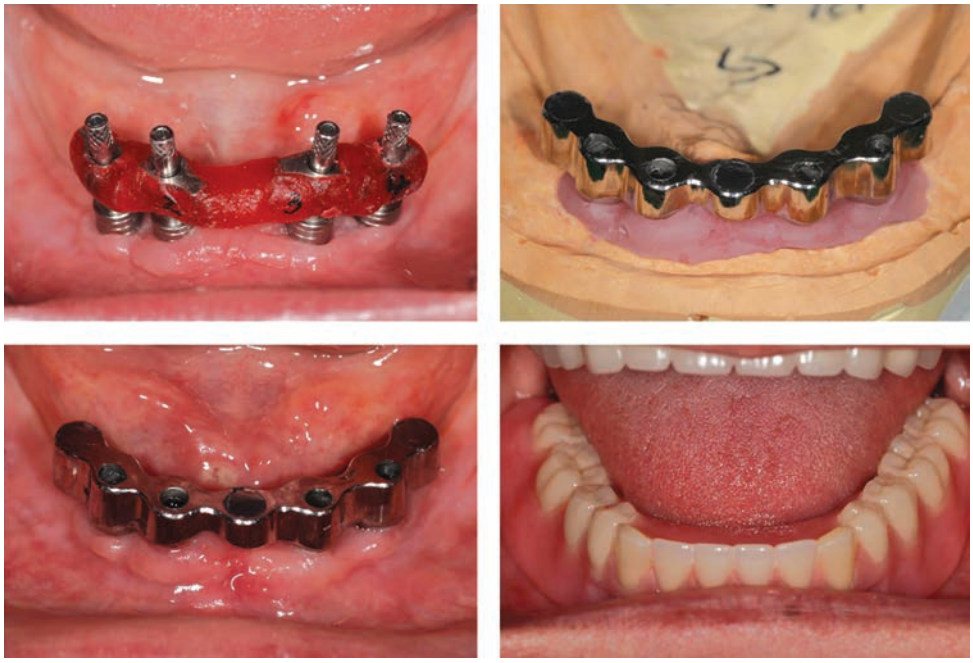


Fig. 4-66

(2) Abutment level impression

An abutment level impression is taking an impression after connecting an abutment to a fixture followed by connection of an impression coping or a plastic impression cap for corresponding this abutment **(Fig. 4-67)**, or taking a direct impression like in a conventional prosthetic therapy. **(Fig. 4-68)**

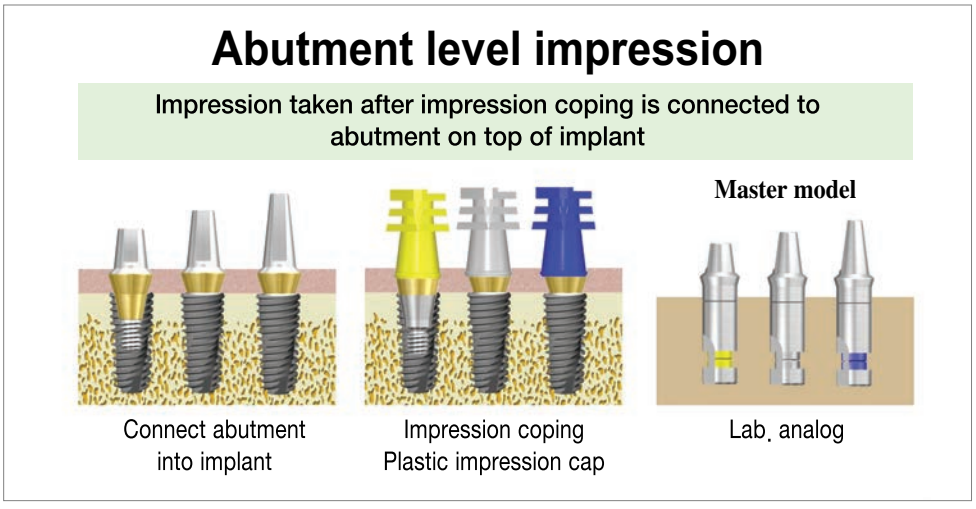


Fig. 4-67

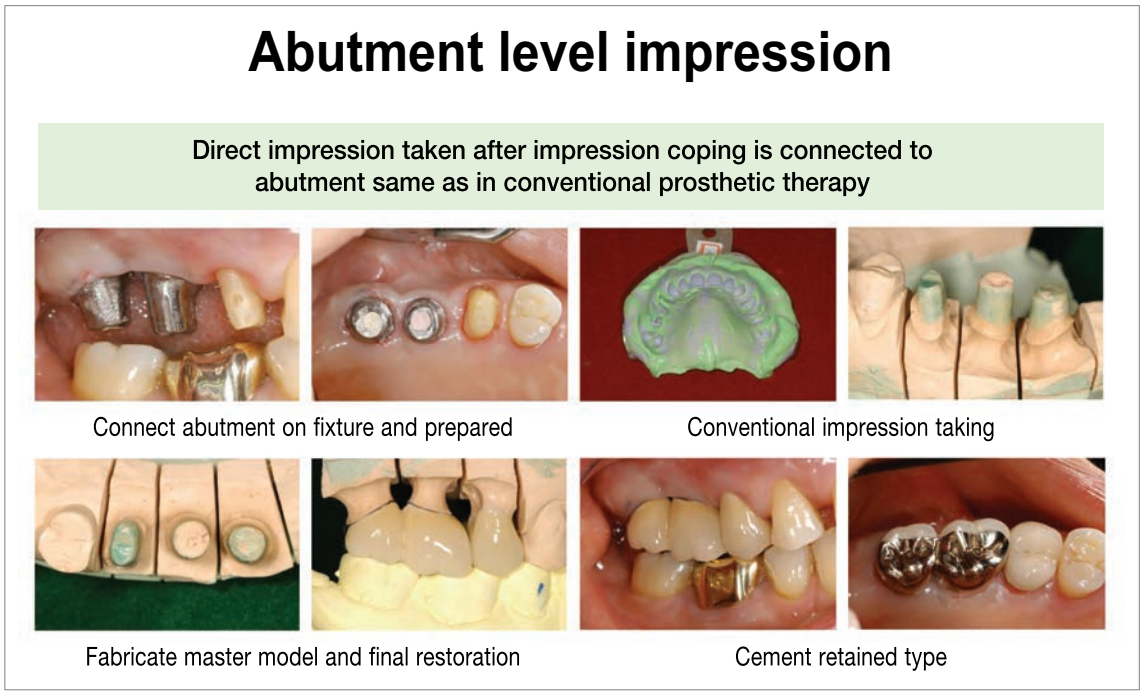


Fig. 4-68

The difference with a fixture level impression is: **First,** after an impression taking, the abutment which is connected to the fixture with 20~30Ncm is not removed ever since. **Second,** a protection cap should be inserted in its place to protect the abutment and prevent a gingival over-growth around the abutment until the delivery of a final prosthesis**. (Fig. 4-69) Third,** a lab. analog that was used in an abutment level impression is different from that of a fixture level impression. That is to say, a lab. analog in a fixture level impression has same shape as a fixture, whereas a lab analog in an abutment level impression has abutment shape that was connected to a fixture in the mouth. **(Fig. 4-70)** Consequently, if you are going to fabricate a master model after an abutment level impression using a plastic impression coping, same shape as an abutment in the mouth is duplicated into the master model.

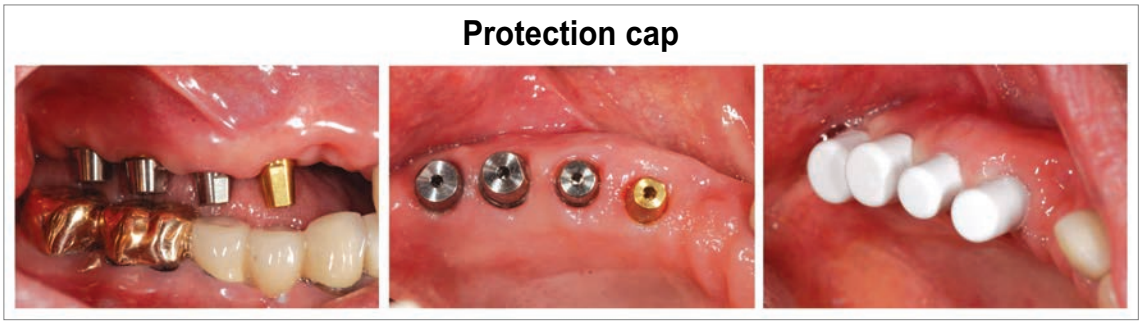


Fig. 4-69

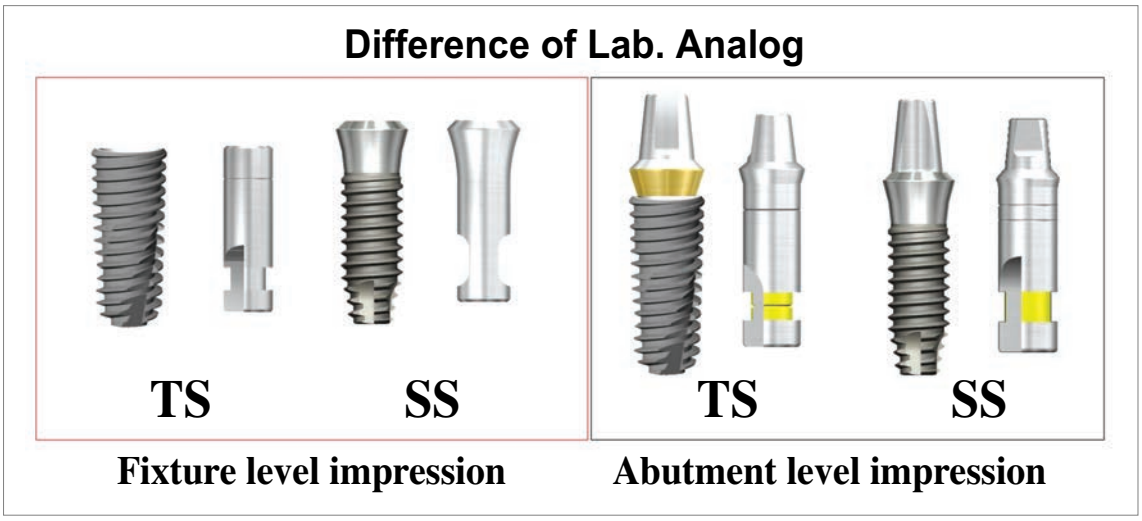


Fig. 4-70

An abutment level impression is selected for only a cement retained type restoration. Hence, a vertical space should be sufficient considering the abutment height for the retention of a prosthesis and the material for an occlusal surface of the prosthesis, and the path of implants should be as parallel as possible. **(Fig. 4-71)** An abutment level impression is divided into three methods: An original abutment level impression using a plastic impression coping, a similar impression method to a conventional prosthetic procedure with or without a gingival retraction and a simple method using retraction cap.

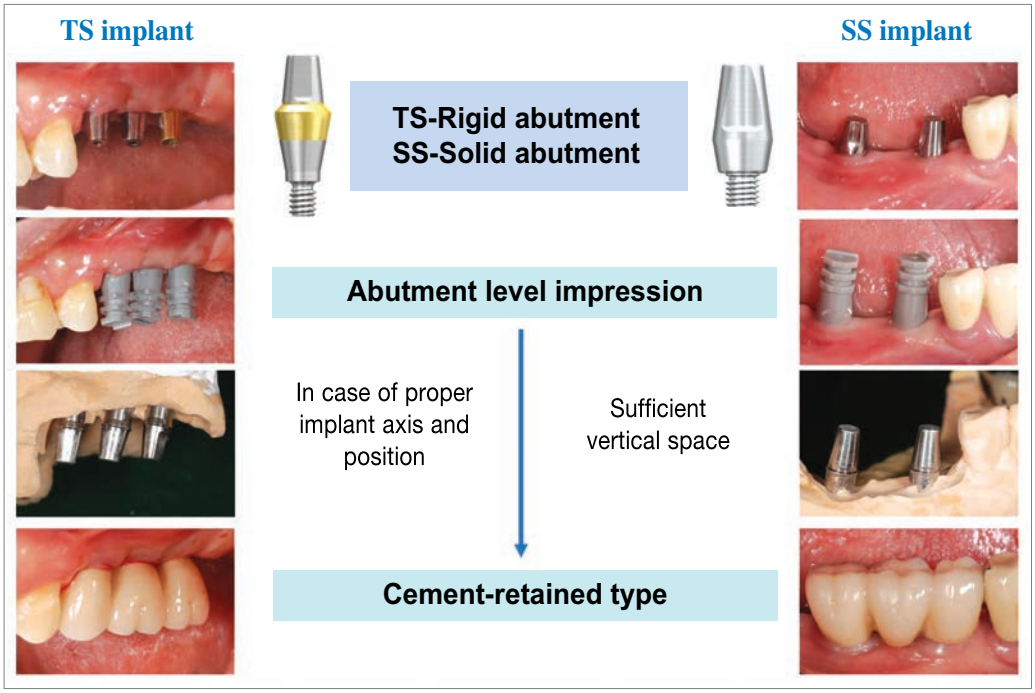


Fig. 4-71. A cement retained restoration through an abutment level impression

① Method using a plastic impression coping (TS implant system)

Briefly, an abutment level impression in TS implant system can be summarized as in the followings (an illustration in **Fig. 4-72** and figures in **Fig. 4-73~76**).

1) First, a suitable Rigid abutment is selected and connected to a fixture with 30Ncm tightening force (20Ncm in mini Rigid abutment for D3.5mm fixture) and this Rigid abutment is not removed afterward. **(Fig. 4-72-㉮, 4-73-①)**

2) And then a plastic impression coping(cap) corresponding to its Rigid abutment is inserted into a Rigid abutment with a snap-on technique. **(Fig. 4-72-㉯, ㉰, 4-73-②)**.

3) The plastic impression cap is picked-up into the impression body after taking an impression using a stock tray and silicone rubber impression material. **(Fig. 4-73-③)**

4) A lab. analog corresponding to Rigid abutment is selected (Fig. 4-72-㉱, 4-74-④) , and is inserted into the plastic impression cap in the impression body. **(Fig. 4-74-⑤)**

5) After taking an impression, a protection cap should be inserted in its place to protect Rigid abutment and prevent a gingival over-growth around this abutment. **(Fig. 4-72-㉲, 4-74-⑥)**

6) A master model is fabricated after sending the impression body **(Fig. 4-74-⑦)** and followed by multiple laboratory and clinical procedures, a cement retained final restoration is fabricated. **(Fig. 4-76-⑮)**

7) For the convenience of a laboratory work, a plastic cylinder for wax-up can be used **(Fig. 4-75-⑧)**. After casting, the "lip" part of a plastic cylinder at the bottom portion should be removed with Reamer® instrument **(Fig. 4-75-⑨~⑫)**. In a laboratory room, to skip such inconvenient procedure, a cement retained restoration is fabricated by direct wax-up as in a conventional prosthetic procedure instead of using a plastic cylinder. **(Fig. 4-71-⑭,⑮)**

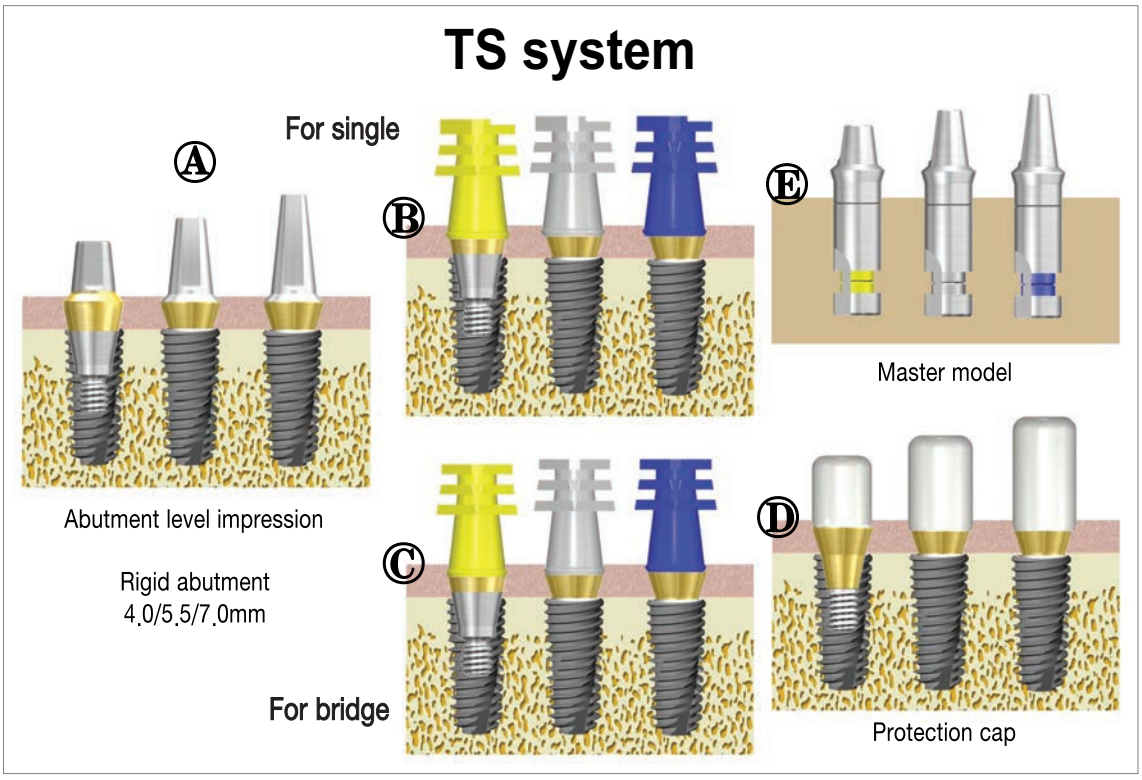


Fig. 4-72. Illustration of an abutment level impression procedure using Rigid abutment in TS implant system.

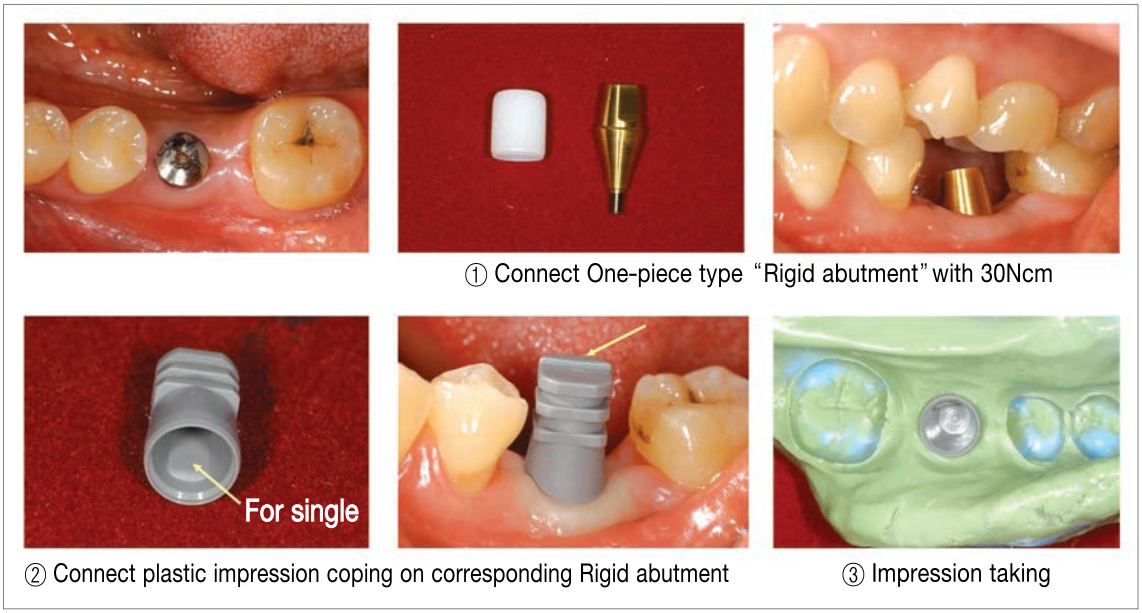


Fig. 4-73

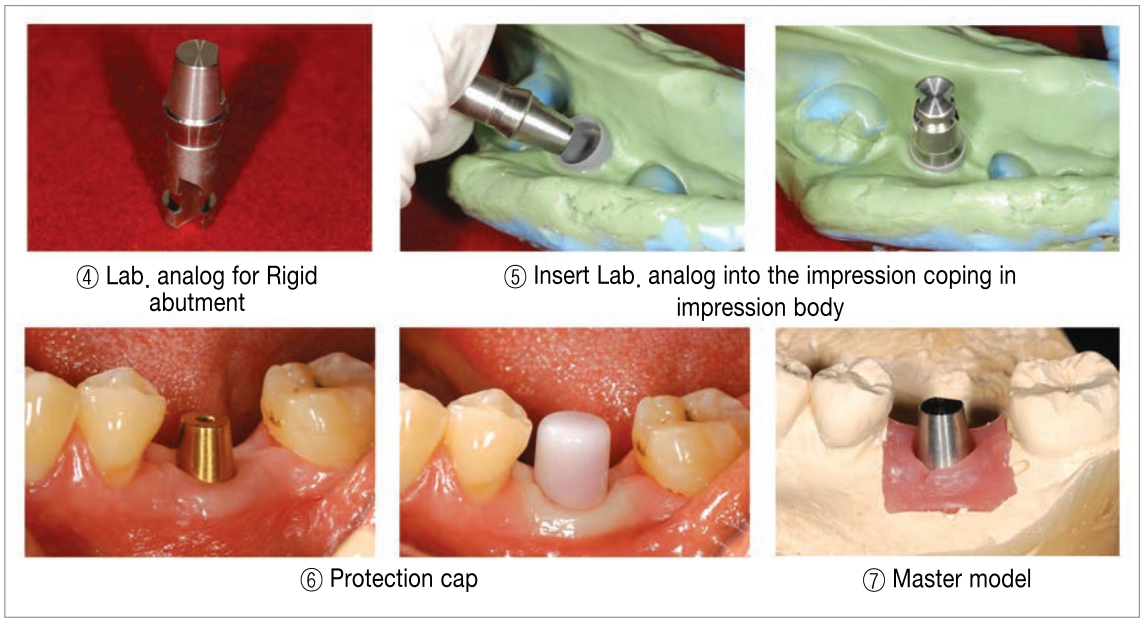


Fig. 4-74

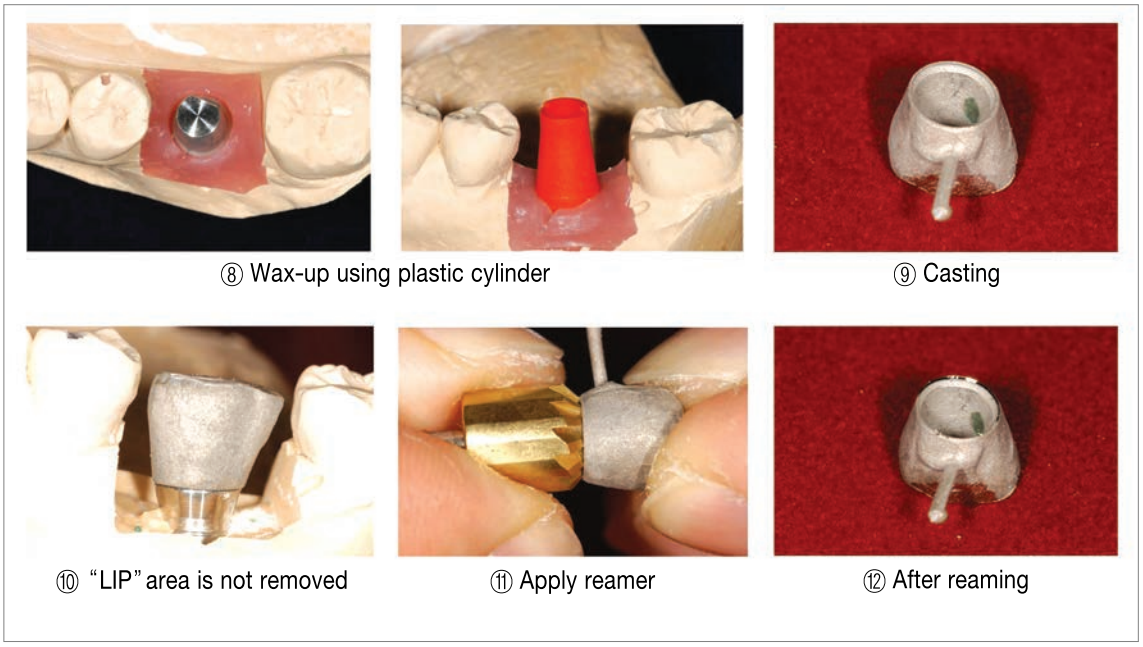


Fig. 4-75

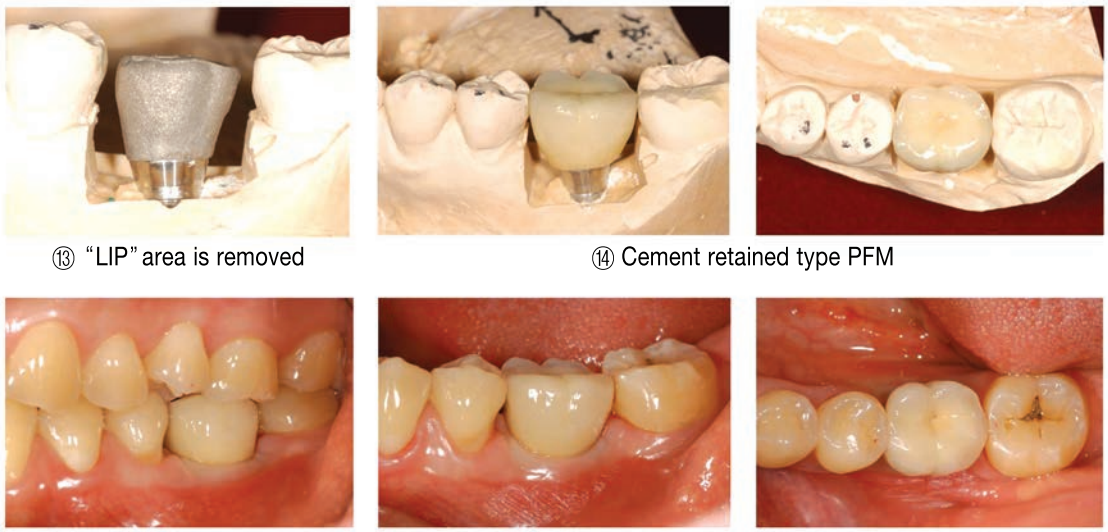
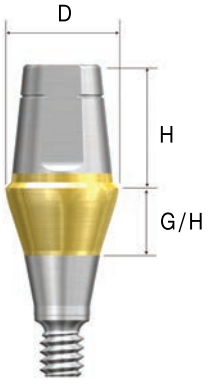


Fig. 4-76

From now on, I would like to describe in detail about clinical considerations related to an abutment level impression using the Rigid abutment in TS implant system. TS implant is a submerged type or a bone level implant. Therefore, we should select the most appropriate Rigid abutment considering the depth of implant, the gingival height around implant and the emergence profile of a final prosthesis.

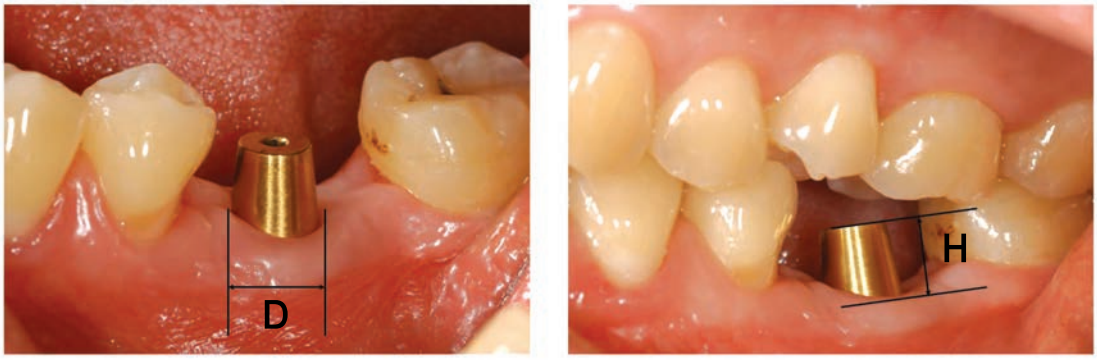


Connection	Mini	Regular
Diameter(D)	ø 4.0, ø 4.5	ø 4.0, ø 4.5, ø 5.0, ø 6.0, ø 7.0
Height(H)	4, 5.5, 7	4, 5.5, 7
G/H	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Note	-	ø 7.0 has H : 5.5 only

Fig. 4-77. Specification of Rigid abutment

Here, the worst part of an abutment level impression is that we should consider the dimension of Rigid abutment **(Table 4-48, 49).** As shown in **Fig. 4-77**, we should select the most suitable Rigid abutment according to various clinical situations such as abutment height (H), abutment collar diameter (D), and abutment collar height or gingival height (G/H) **(Fig. 4-77)** An abutment height so called H is related to the vertical space and the occlusal material of a final restoration like a gold crown or a full porcelain crown. Also, three kinds of abutment height are available in Rigid abutment: 4.0, 5.5 and 7.0mm. **(Fig. 4-78)** Clinically, it is important that the height of Rigid abutment shouldn't be adjusted or modified less than 4.0mm for the retention of a final prosthesis, especially in a single implant restoration.

Select abutment with proper collar height and collar diameter



D ➔ Emergence profile

H ➔ Vertical space / Occlusal materials of final prosthesis

G/H ➔ Position of Gingival margin (Supra-, Equi-, Sub-gingival margin)

Fig. 4-78

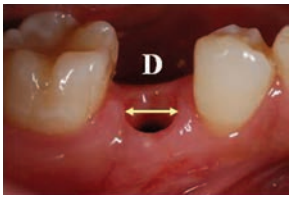
An abutment collar diameter so called D is related to the emergence profile of a final prosthesis and equipped D4.0, 4.5, 6.0, 7.0mm. D7.0mm is available only with the abutment height of 5.5mm. **(Table 4-48)** Generally, the guidelines of selecting an abutment collar diameter are: personally considering the average diameter of a natural tooth at CEJ or cervical area, D5.0mm collar diameter is proper on a premolar region and D6.0mm on a molar region. **(Fig. 4-79)** Of course, according to the position of implants, a smaller or bigger one can be selected depending on the distance between implants or the mesio-distal distance between adjacent teeth.

Table 4-48

■ Specifications-Rigid abutment

		Mini		Regular				
H	G/H	Φ4.0	Φ4.5	Φ4.0	Φ4.5	Φ5.0	Φ6.0	Φ7.0
4.0	1	GSRA4410	GSRA4411	GSRAS4410	GSRAS4411	GSRA5410	GSRA6410	-
	2	GSRA4420	GSRA4421	GSRAS4420	GSRAS4421	GSRA5420	GSRA6420	-
	3	GSRA4430	GSRA4431	GSRAS4430	GSRAS4431	GSRA5430	GSRA6430	-
	4	GSRA4440	GSRA4441	GSRAS4440	GSRAS4441	GSRA5440	GSRA6440	-
	5	GSRA4450	GSRA4451	GSRAS4450	GSRAS4451	GSRA5450	GSRA6450	-
5.5	1	GSRA4610	GSRA4611	GSRAS4610	GSRAS4611	GSRA5610	GSRA6610	GSRA7610
	2	GSRA4620	GSRA4621	GSRAS4620	GSRAS4621	GSRA5620	GSRA6620	GSRA7620
	3	GSRA4630	GSRA4631	GSRAS4630	GSRAS4631	GSRA5630	GSRA6630	GSRA7630
	4	GSRA4640	GSRA4641	GSRAS4640	GSRAS4641	GSRA5640	GSRA6640	GSRA7640
	5	GSRA4650	GSRA4651	GSRAS4650	GSRAS4651	GSRA5650	GSRA6650	GSRA7650
7.0	1	GSRA4710	GSRA4711	GSRAS4710	GSRAS4711	GSRA5710	GSRA6710	-
	2	GSRA4720	GSRA4721	GSRAS4720	GSRAS4721	GSRA5720	GSRA6720	-
	3	GSRA4730	GSRA4731	GSRAS4730	GSRAS4731	GSRA5730	GSRA6730	-
	4	GSRA4740	GSRA4741	GSRAS4740	GSRAS4741	GSRA5740	GSRA6740	-
	5	GSRA4750	GSRA4751	GSRAS4750	GSRAS4751	GSRA5750	GSRA6750	-

Table 4-49



D ➔ Emergence profile

Tooth	MD at crown	MD at CEJ	MD at bone crest	BL at CEJ	Recommended implant
I1	8.6	6.4	5.5	6.4	4.0, 5.0
I2	6.5	4.7	4.3	4.7	3.3, 3.75
C	7.6	5.6	4.6	7.6	4.0
P1	7.1	4.8	4.2	8.2	4.0
P2	6.6	4.7	4.1	8.1	4.0
M1	10.4	7.9	7.0	10.7	4.5~6.0
M2	9.8	7.6	7.0	10.7	4.5~6.0

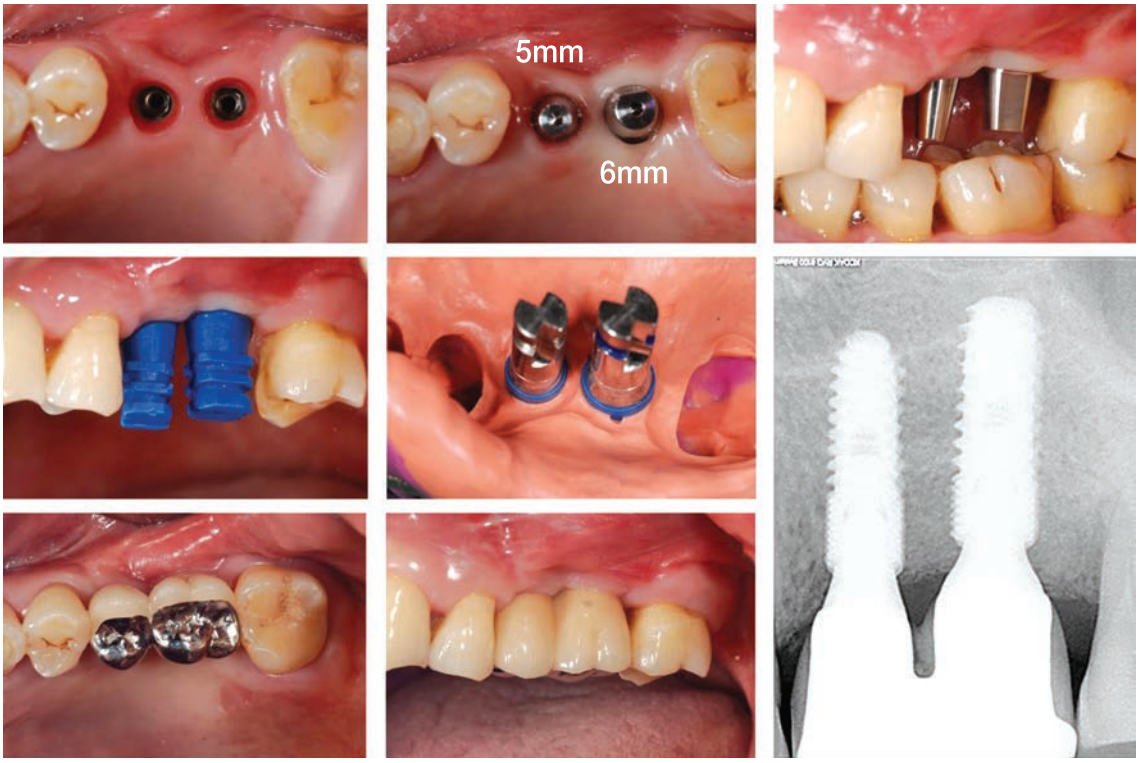


Fig. 4-79

A gingival height so called G/H is related to the position of a gingival margin. And five kinds of gingival height are available: 1, 2, 3, 4 and 5mm. It depends on an equi-gingival margin, a supra-gingival margin, or a sub-gingival margin of a final prosthesis. In a fixture level impression, a gingival margin can be located at same depth from the interproximal papilla or the highest portion by means of the milling process. As a result, it may be effective to reduce or prevent the risk of excessive cement in a gingival sulcus. However, in an abutment level impression, because the location of a gingival margin is primarily based on a buccal or labial portion for an esthetic reason and Rigid abutment has just non-anatomic flat or round form, there can be a relatively deep gingival margin, especially at the interproximal area of an adjacent tooth. **(Fig. 4-80)**

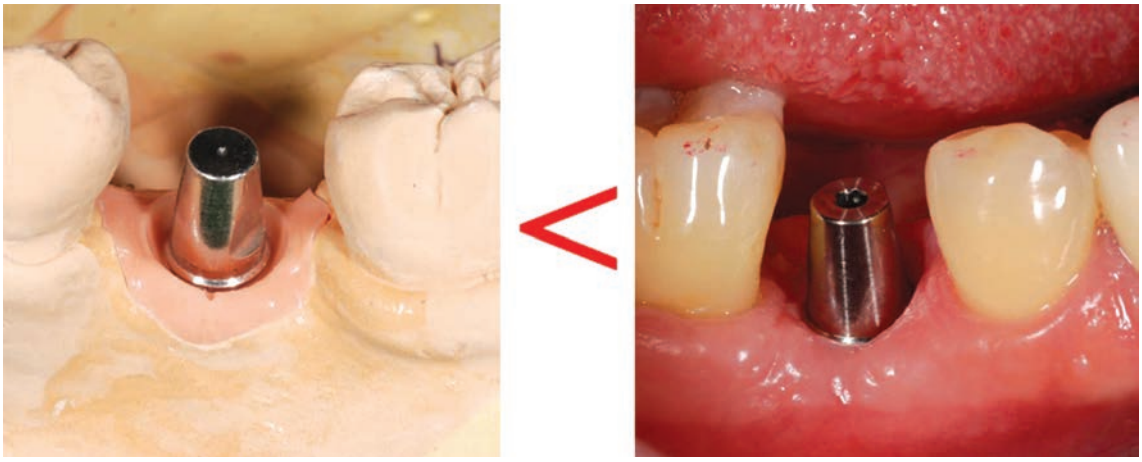


Fig. 4-80. Generally, the interproximal papilla at a cervical area of an adjacent tooth is highly positioned.

This is a major cause in increasing the risk of excessive cement in a gingival sulcus, which is the disadvantage of a cement retained type restoration. **(Fig. 4-81)** To avoid the risk of cement remnant, a screw retained type restoration can be considered. However, the risk of cement remnant in a cement retained type restoration, which comes from the difference of a gingival height and the position of a gingival margin, can be reduced by fabricating the prosthesis that has a supra-gingival margin or by adjusting the color portion of an abutment like Transfer abutment to be located at the same depth along the height of gingiva after a fixture level impression. **(Fig. 4-82)**

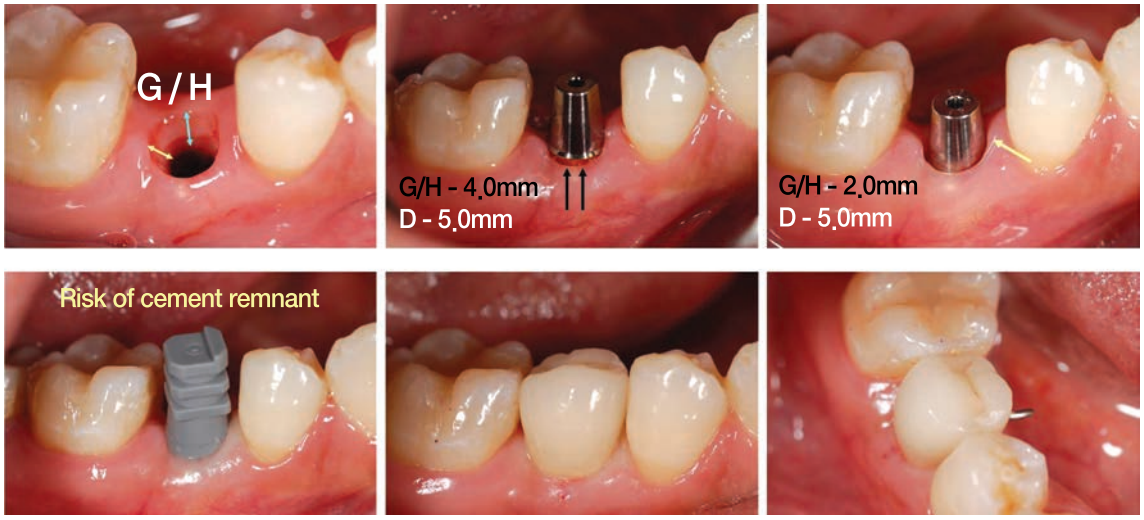


Fig. 4-81

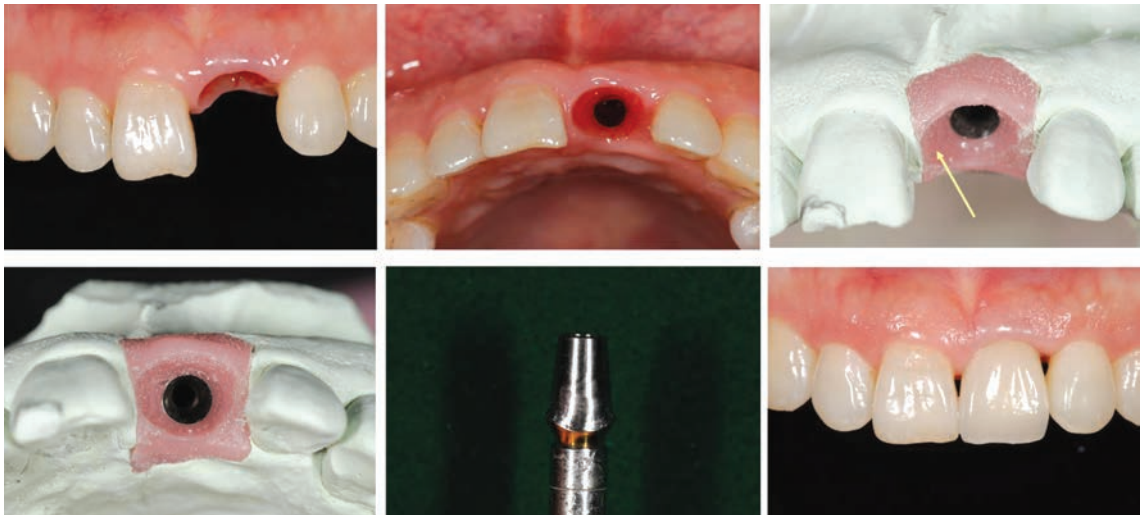


Fig. 4-82

A plastic impression cap for Rigid abutment are divided into a single exclusive **(Fig. 4-72-㉯)**, and a bridge exclusive. **(Fig. 4-72-㉰)** As shown in a **Fig. 4-73-**②, the plastic impression cap has an anti-rotational surface inside it to resist the rotation of a final prosthesis. It is designed correspondingly to that of a rigid abutment. And such a design enables you to transfer the anti-rotational surface of a rigid abutment into a lab. analog on the master model. Also, the plastic impression cap has a prominent portion right above the anti-rotational surface to verify the exact position when inserting an impression cap into a rigid abutment by means of a snap-on mechanism. Consequently, a single exclusive plastic impression cap should be used in a single implant restoration because this anti-rotational surface should be recorded accurately into the master model to prevent the rotation of a final restoration. On the other hand, a plastic impression cap for bridge or splinted prosthesis has no anti-rotational surface inside it. So, this is recommended for a multiple implant restoration .**(Fig. 4-83)** However, using a plastic impression cap for bridge **(Fig. 4-83-**③,④**)** results in mismatching the position of anti-rotational surface in Rigid abutment at mouth and master model. It is certain that you can see the anti-rotational surface of a lab. analog was located at different position in the master model. **(Fig. 4-83-**⑩,⑪**)** Hence, it is inconvenient to use the Rigid plastic coping (or cylinder) for bridge during a wax-up stage in a laboratory side **(Fig. 4-83-**⑫~⑭**)** or to perform a block-out for removing that anti-rotational surface of a lab. analog. Furthermore, a dental laboratory technician must consider such point when fabricating a bite block with pattern resin for a bite registration. Therefore, the author likes to use a single exclusive plastic impression cap even in case of multiple implant cases to avoid these kinds of inconveniences. **(Fig. 4-84~86)**

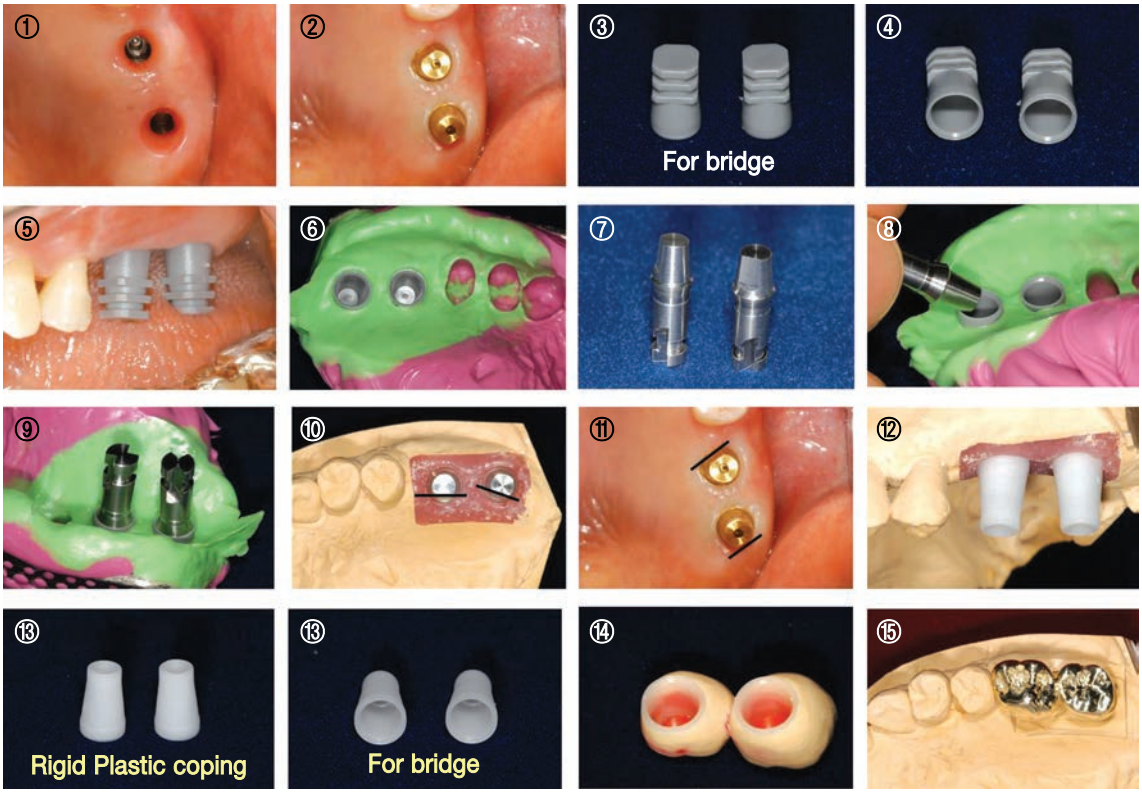


Fig. 4-83. In general, a plastic impression cap for bridge is recommended in multiple or splinted implant restoration.

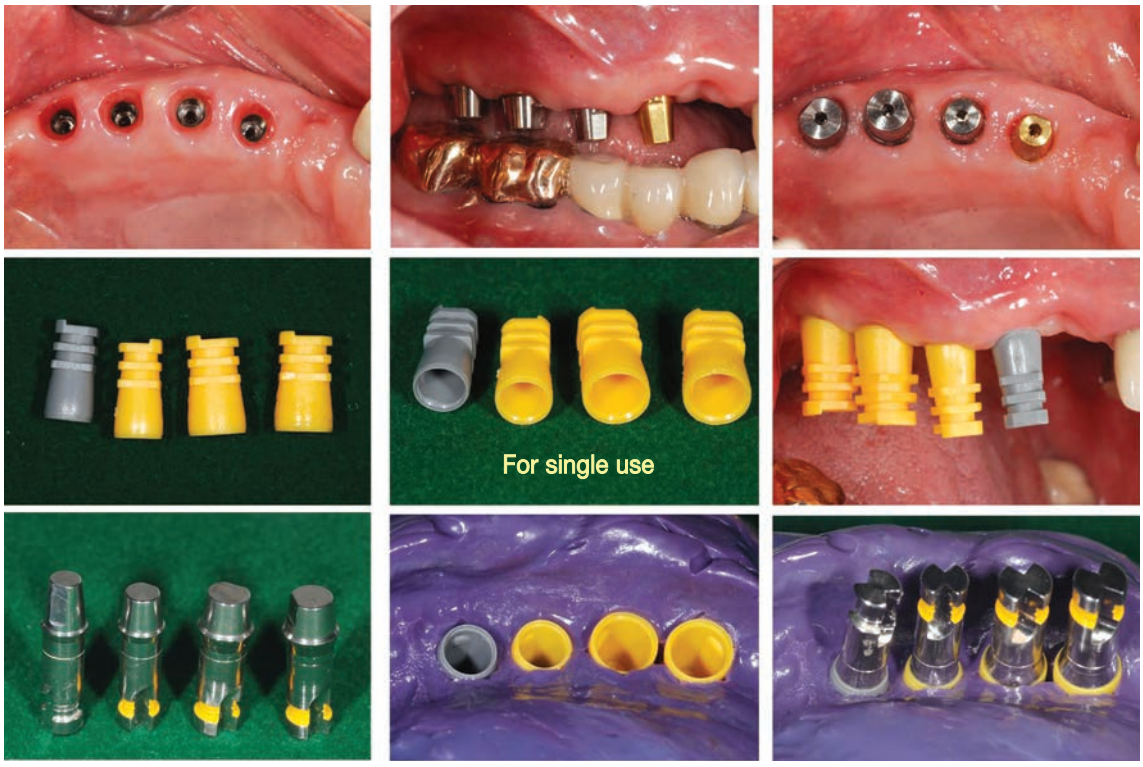


Fig. 4-84. Single exclusive plastic impression caps were used even in multiple implant restoration.

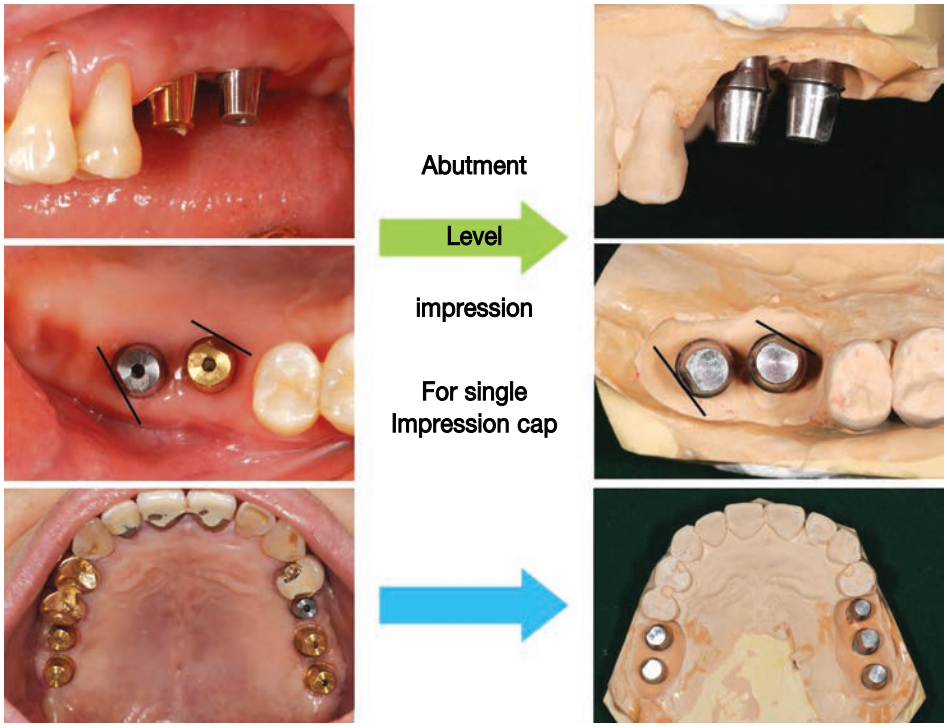


Fig. 4-85. The position of anti-rotational surface can be transferred by means of a single exclusive plastic impression cap.

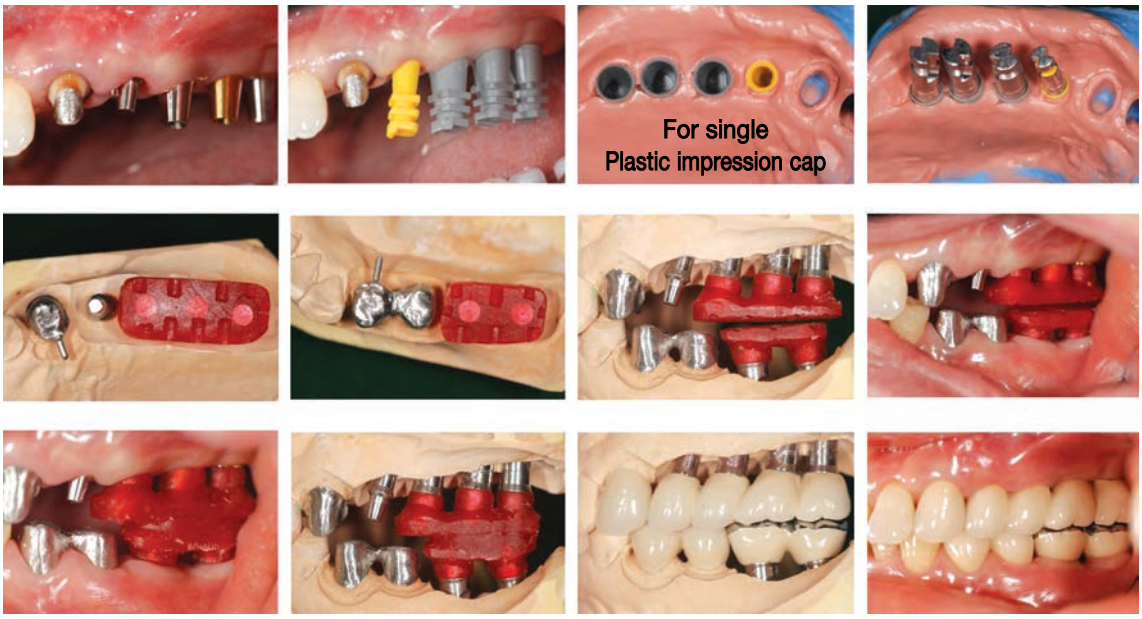


Fig. 4-86. If a single exclusive plastic impression cap would be selected even in case of multiple implant restoration, a cement retained type restoration can be fabricated by a conventional or routine method without using a Rigid plastic coping(or cylinder) for bridge and there is no trouble in fabricating a bite block using pattern resin.

Although an abutment level impression using a Rigid abutment enables us to take a relatively accurate impression, there are several possible impression errors related to a plastic impression cap. As shown in a **Fig. 4-87**, The impression material can be engaged or flowed between plastic impression cap and Rigid abutment when taking an impression without proper positioning of the plastic impression cap. **(Fig. 4-87)**

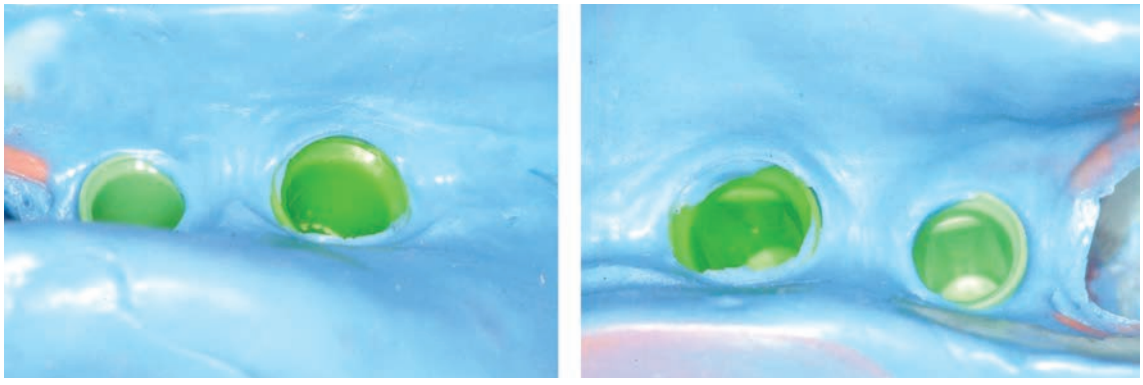


Fig. 4-87. This picture shows a plastic impression cap for different implant system. We can see the Impression material was engaged or flowed between plastic impression cap and Rigid abutment during the impression taking.

There are several reasons in this type of error. **First** is the gingival interference during the connection of a plastic impression cap when surrounding gingival is firm or too thick **(Fig. 4-88-ⓐ)**, especially in a mandibular retromolar pad area or a maxillary posterior area. **Second,** when the implant is placed deeply and there is an alveolar bone overgrowth above the fixture, the plastic impression cap cannot be positioned in its place because it is possible that seating the impression cap can be interfered or interrupted. **(Fig. 4-88-ⓑ) Third,** the plastic impression cap is disposable. Recycling of this may result in loosening of the "lip" part and dislodgement of impression cap from the Rigid abutment during the impression taking. **(Fig. 4-88-ⓒ)** Especially, in patient with an abnormal bony outgrowth like a torus or exostosis which causes painful touch with an impression tray, in this type of clinical situation, maybe you apply an excessive jiggling motion to avoid patient's discomfort during the positioning of tray with impression material. As a result, the plastic impression cap can easily dislodge. To reduce such impression error, don't use a plastic impression cap with loosened lip part and evaluate whether the gingival or alveolar bone interfere seating of a plastic impression cap. In addition that, limit the jiggling motion and position the tray in the mouth with a vertical movement.

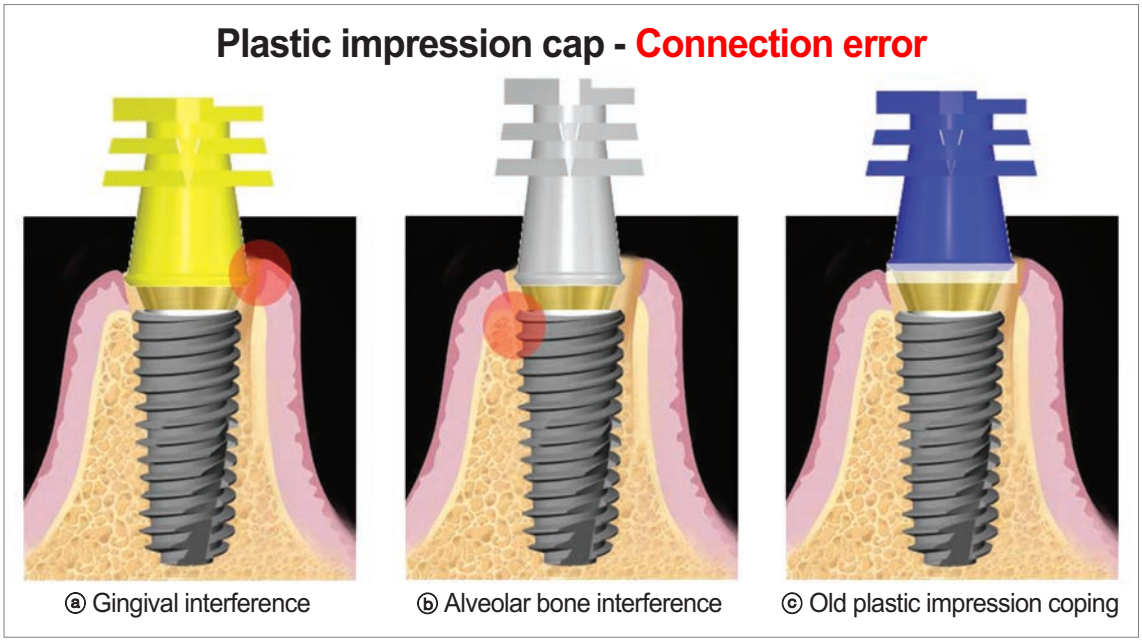


Fig. 4-88. Clinical factors related to the positioning interference of a plastic impression cap.

Last consideration is related to maintenance-management problems when using the Rigid abutment. Various maintenance problems after the delivery of a final prosthesis are one of the biggest factors which can embarrass dentists in implant therapy. The Rigid abutment is one-piece type of an abutment and an abutment screw. In a single implant restoration, it is difficult to solve the problem when a patient complains the food impaction due to a contact loosening and the mobility of prosthesis due to a screw loosening. For example, how can we solve the problem when we cannot retrieve the prosthesis using an ejector because of a retentive force of "supertructure" or a screw loosening itself? In other words, we cannot apply an ejecting force properly because the crown is moving due to a screw loosening. In case of two-piece type Transfer abutment, we can retrieve it by opening a screw access hole on the occlusal surface and convert to SCRP structure.

However, it is impossible in Rigid abutment because it cannot be changed or converted to SCRP. Perhaps the prosthesis must be cut to solve this problem. It becomes a bigger problem when the number of implant patient increases. Even when a cement retained type prosthesis is retrieved, the position of Rigid abutment will be changed after retightening the Rigid abutment because of the "settle down" phenomenon. **(Fig. 4-89)** As a result, an existing prosthesis can't be seated and it is necessary to remove the anti-rotational surface inside the prosthesis for seating.

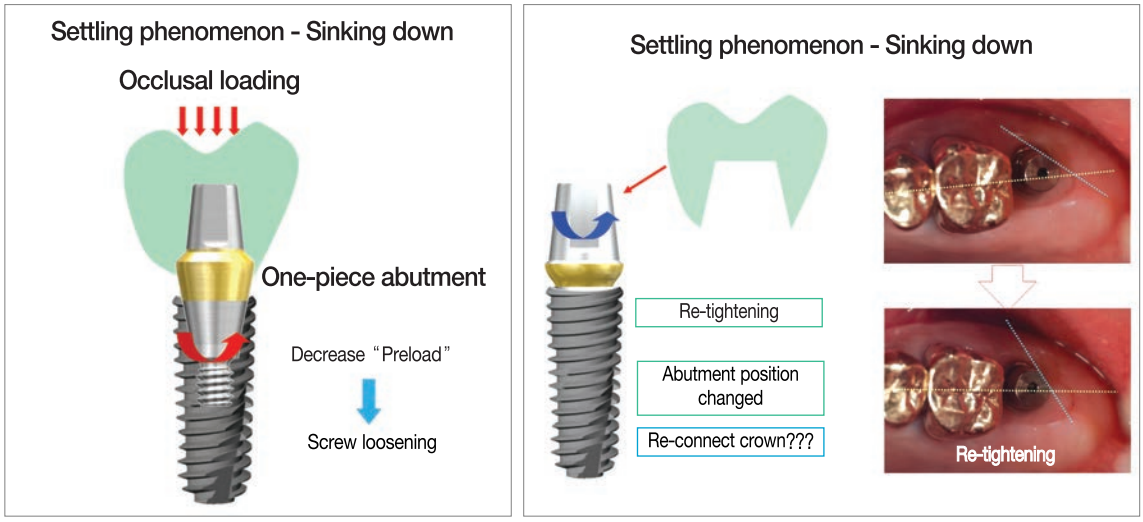


Fig. 4-89. A settling down phenomenon between a Rigid abutment and a fixture by patient's bite force elicits loss of preload and this reads to a screw loosening. Even when we retrieve the prosthesis, an existing prosthesis cannot be seated after screw retightening because the position of anti-rotational surface is changed.

Hence, we should consider the followings when using a Rigid abutment. **First,** as shown in a **Fig. 4-90**, various etiologies of a screw loosening due to a settling down phenomenon should be taken into account. Here, patient's bite force and a fixture diameter are the most important etiologies. As you well know, the internal connection part of a regular sized TS implant is same regardless of a fixture diameter. Consequently the narrower the fixture diameter is, the thinner the fixture wall is. Namely, in case of a single molar restoration, if a patient has a strong bite force and a 4.0mm diameter TS implant is placed, a "sinking down" phenomenon can happen between a Rigid abutment and a fixture because of the enlargement of a fixture wall by a wedging effect. That is to say, the Rigid abutment could be sank down when an occlusal force is loaded. This leads to the decrease of preload and the screw loosening. Therefore, it is better to avoid placing D4.0mm TS fixture in a molar region. You'd better choose more than D5.0mm TS implant.

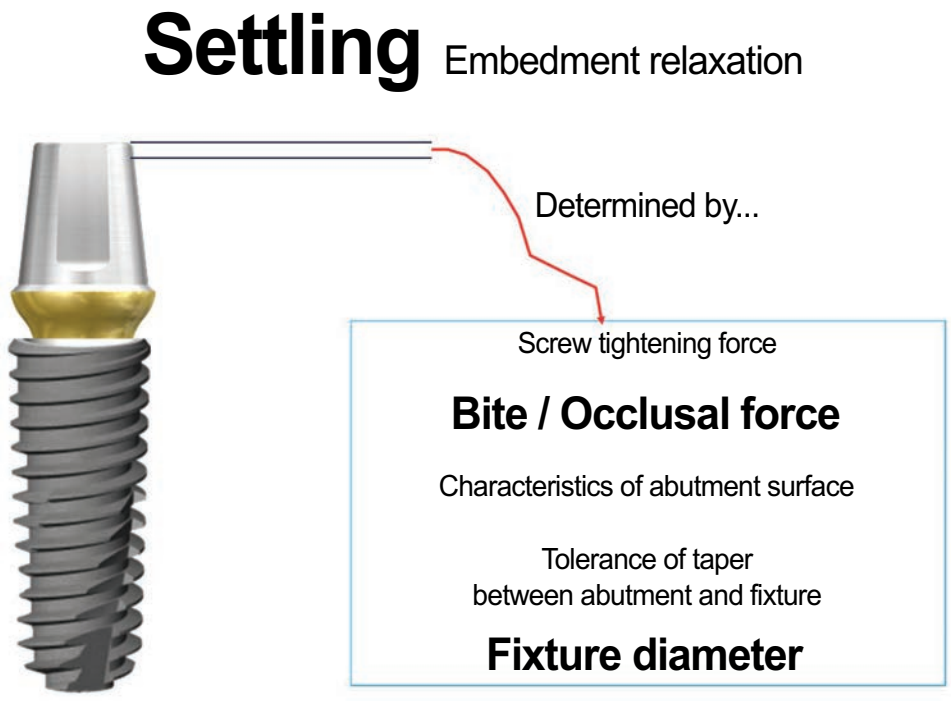


Fig. 4-90. Factors related to a settling down phenomenon

Second, we should consider factors which interfere with full seating of a Rigid abutment when we are going to connect a Rigid abutment to a fixture. The internal portion of a fixture should be cleaned thoroughly. If not so, a tightening torque of 30Ncm may not be applied properly because of the interference of surrounding gingiva or alveolar bone over the fixture as explained in a plastic impression cap.

Among the etiologies of a screw loosening, "further tightening of screw and failures of retightening" is related to this. In other words, the incidence of a screw loosening can increase because the inappropriate torque is applied between a fixture and an abutment. Here, the inappropriate torque means that we get the resting torque when subtracting a friction loss from the tightening torque of 30Ncm. To prevent this phenomenon, clinically, it is recommended that instead of making a final restoration after applying 30Ncm tightening torque to a Rigid abutment, a provisional restoration is delivered at first, and then retighten this Rigid abutment after 1 month of loading (Manufacturer's recommendation) with a provisional restoration and fabricate a final prosthesis.**(Fig. 4-91, 92)**

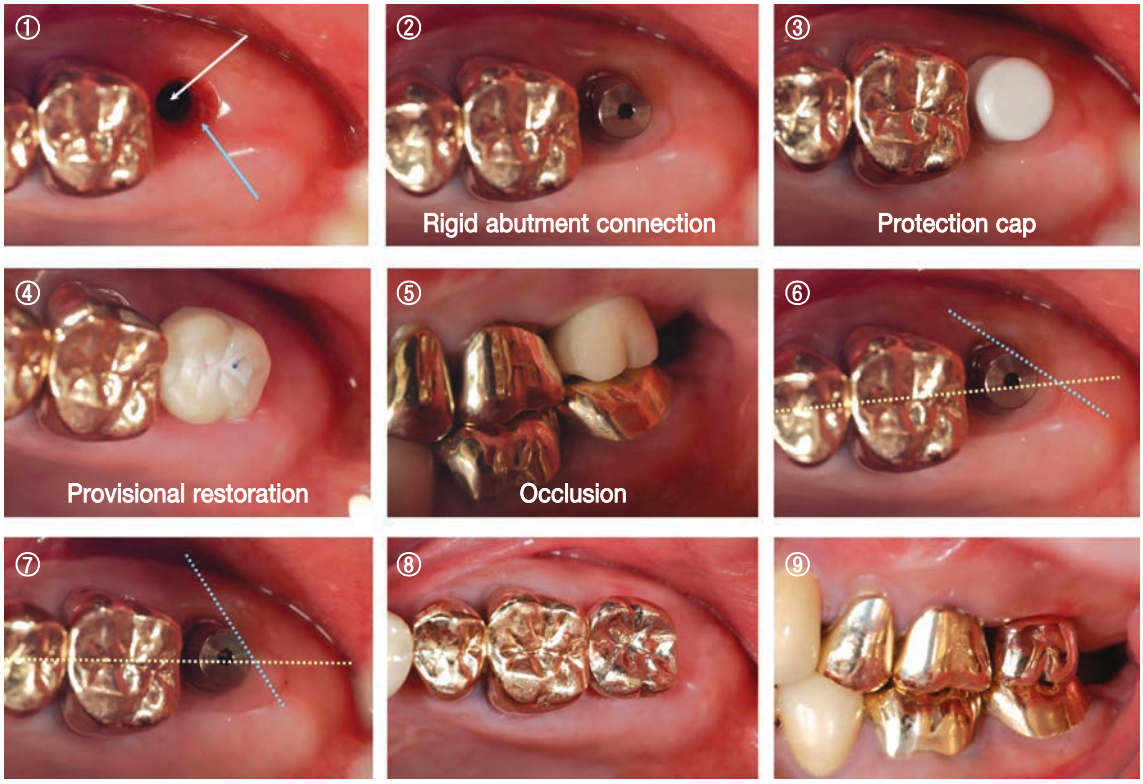


Fig. 4-91. Clinical protocol to prevent a screw loosening due to a settling down phenomenon in Rigid abutment.

Fig. 4-92. It is better to fabricate a final prosthesis after 1 month of loading with a provisional restoration

Some dentists like to use Transfer abutment instead of Rigid abutment even if an abutment level impression is going to be planned. This kind of clinical application enables us to convert a cement-retained type restoration into a SCRP (Screw- and Cement-Retained Prosthesis). In case of a screw loosening, we can reposition an existing crown after re-tightening the screw without a positional change of abutment. In other words, after a Transfer abutment is connected to a fixture, an abutment level impression can be taken using a plastic impression cap as same as in Rigid abutment. This method makes maintenance problems to be solved easily. **(Fig. 4-93)**

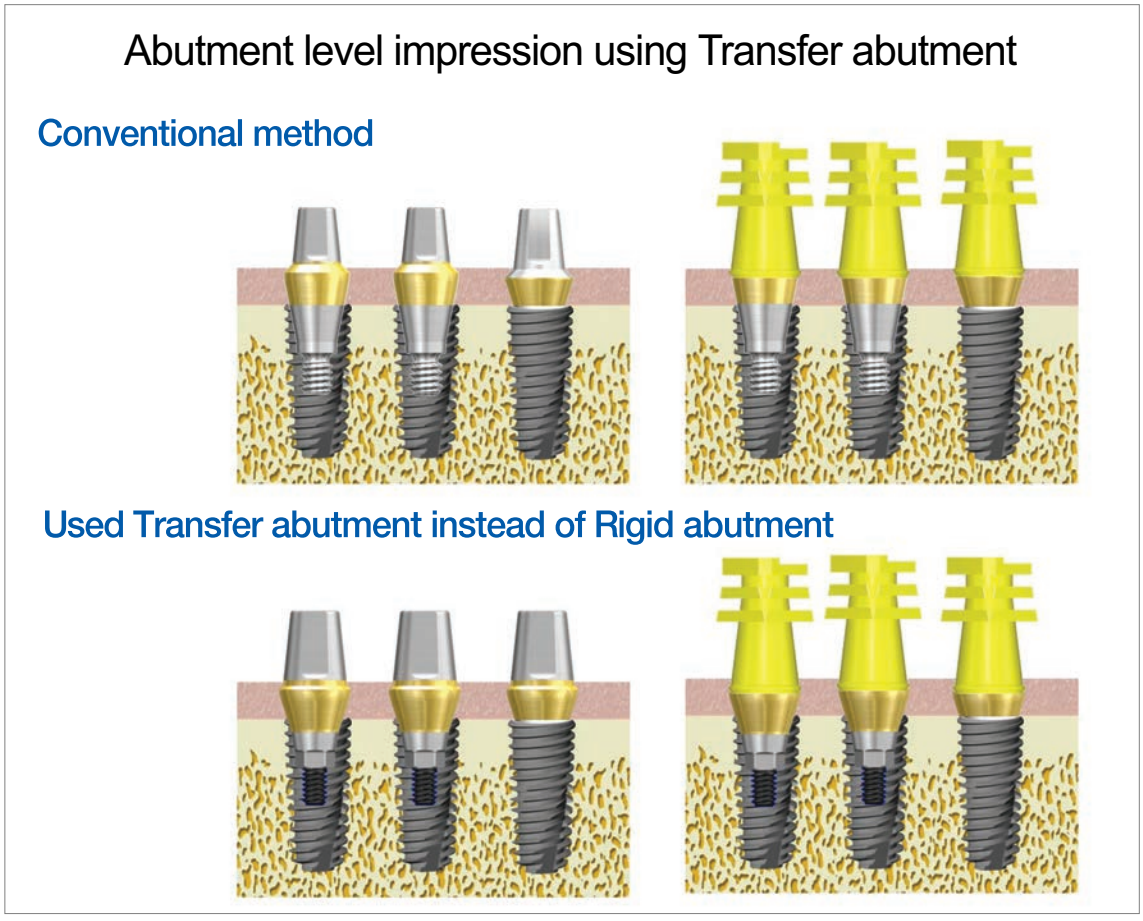


Fig. 4-93

② Method using a plastic impression coping (SS implant system)

An abutment level impression in SS implant system is easier than in TS implant system. As I mentioned before, TS implant system is a submerged type and a bone level implant, so we should consider abutment height (H), abutment collar diameter (D) and gingival height (G/H) during the abutment selection stage. But SS implant system is a non-submerged type and a gingival level implant. For that reason, we only have to consider abutment height depending on the dimension of SS implant when selecting solid or excellent solid abutment. **(Fig. 4-94)**

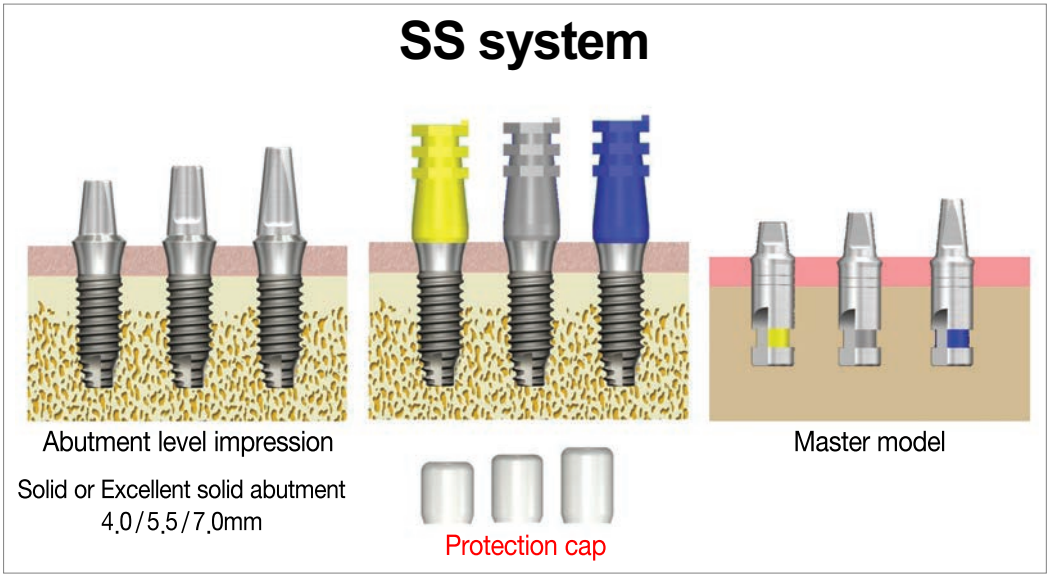


Fig. 4-94. Illustration of an abutment level impression method in SS implant system

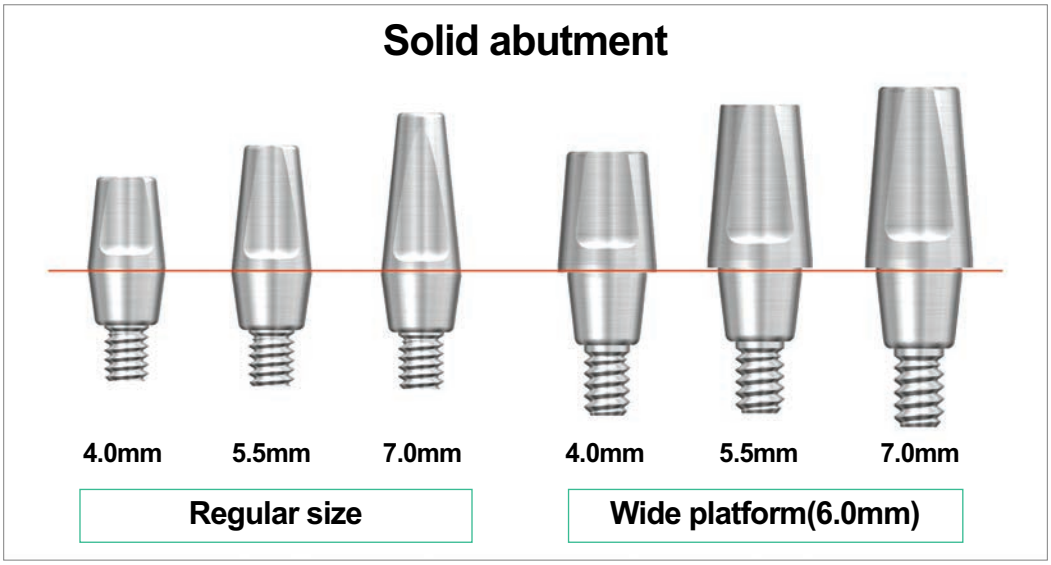


Fig. 4-95. Specification of Solid abutment

Two types of solid abutment are available, one for D4.8mm regular platform, and the other for D6.0mm wide platform. Each has 4.5, 5.5, 7.0mm of abutment height. **(Fig. 4-95)** Solid abutment is connected to a fixture using exclusive screw driver and torque wrench with 30Ncm. **(Fig. 4-96)**

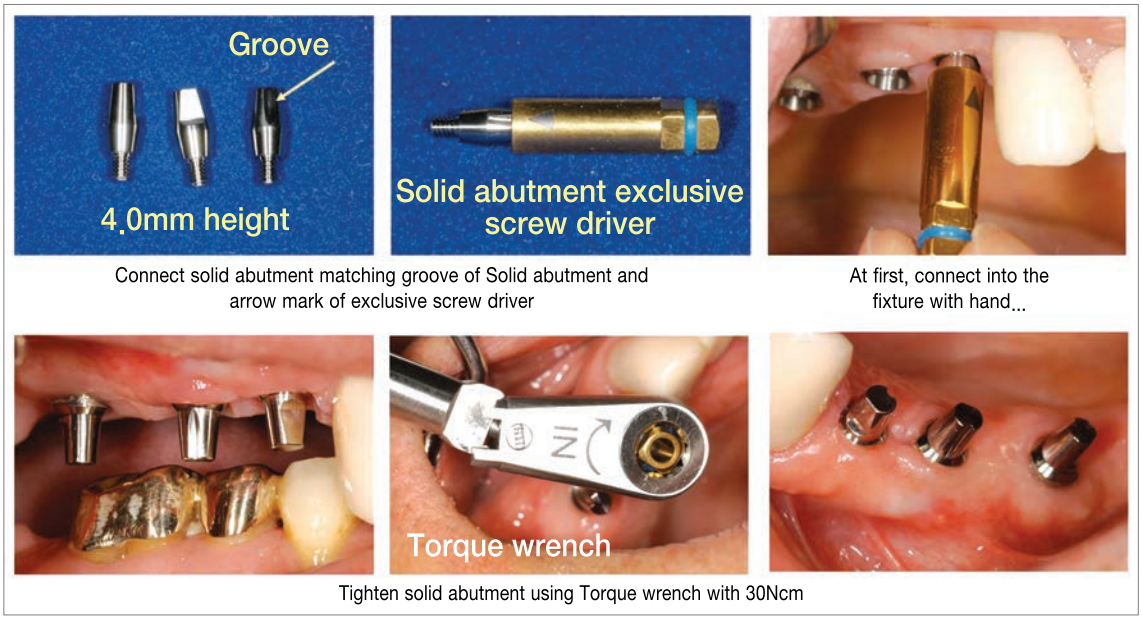


Fig. 4-96. Method of connecting solid abutment to a fixture

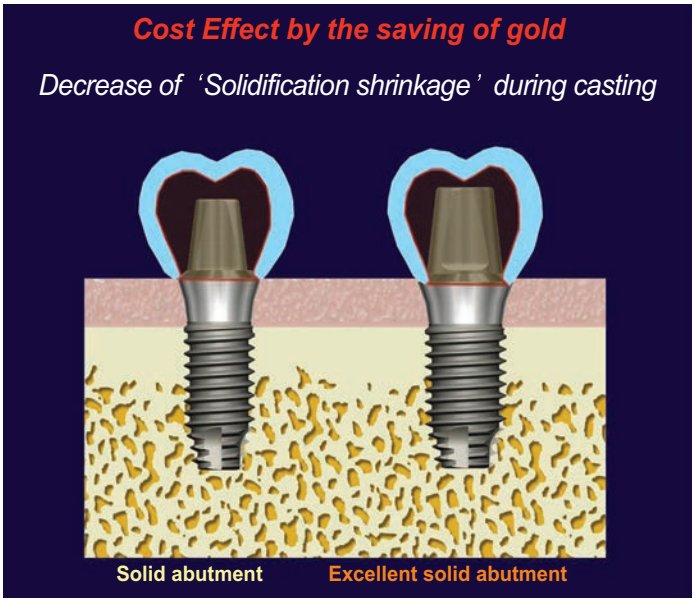


Fig. 4-97

Excellent solid abutment increased its volume by 40% than solid abutment, so it enhances the retentive force of a final prosthesis and a productive cost decreases when a final prosthesis is going to be made of gold. Also, even if we are going to choose a PFM (porcelain fused to metal) crown instead of a gold crown considering a productive cost or an esthetic result, it is advantageous in reducing a casting error which comes from a "solidification shrinkage" during a bench cooling. Furthermore, the portion of excellent solid abutment is more remained than solid abutment after modification. **(Fig. 4-97)** Same as solid abutment, two types of excellent solid abutment are available, one for D4.8mm regular platform and the other for D6.0mm wide platform. Each has 4.5, 5.5, 7.0mm of abutment height. Excellent solid abutment is connected to a fixture using an exclusive screw driver and a torque wrench with 30Ncm. **(Fig. 4-96)** But, 1.2 hex driver is used in case of solid abutment and excellent solid abutment of D6.0mm wide platform. The steps following an impression taking and laboratory procedures are same as those of Rigid abutment. **(Fig. 4-98)** Plastic impression caps are available according to abutment height: yellow for 4.0mm, gray for 5.5mm and blue for 7.0mm.**(Fig. 4-99)**

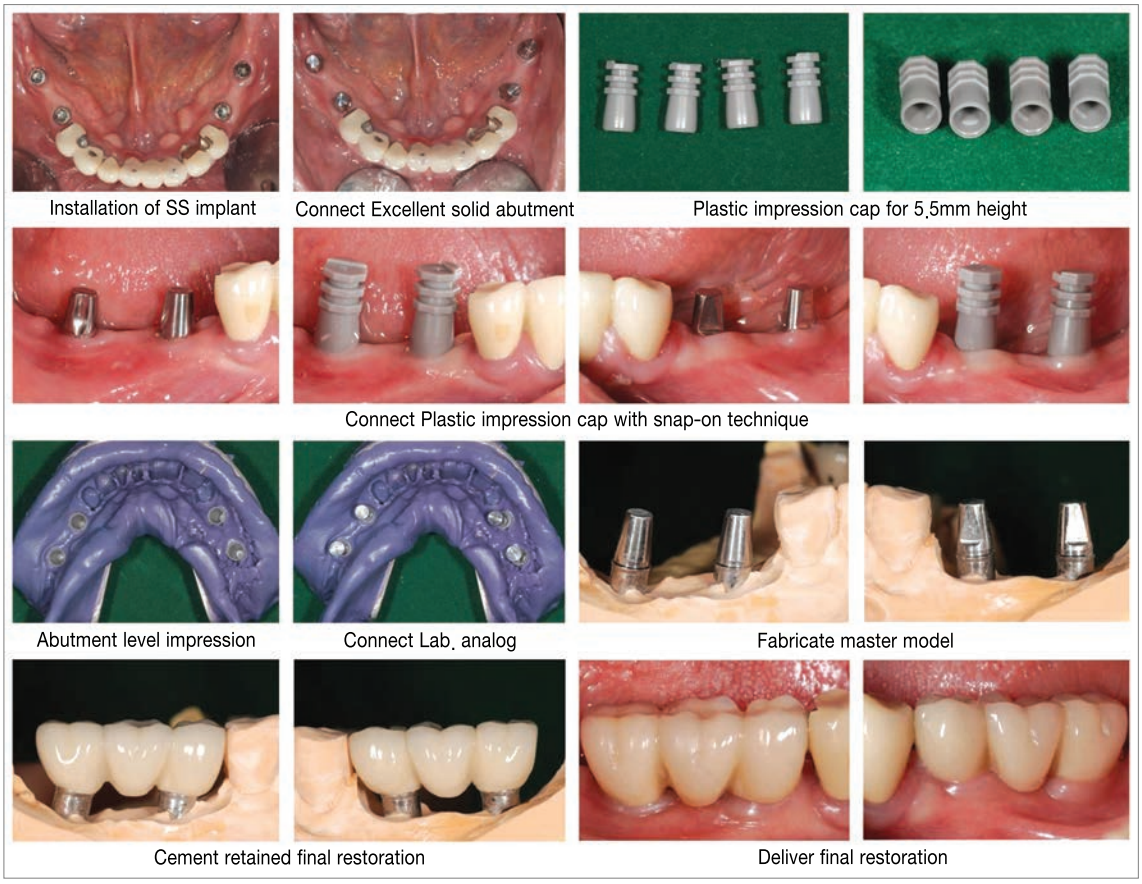


Fig. 4-98. A cement retained type restoration using excellent solid abutment in SS implant system

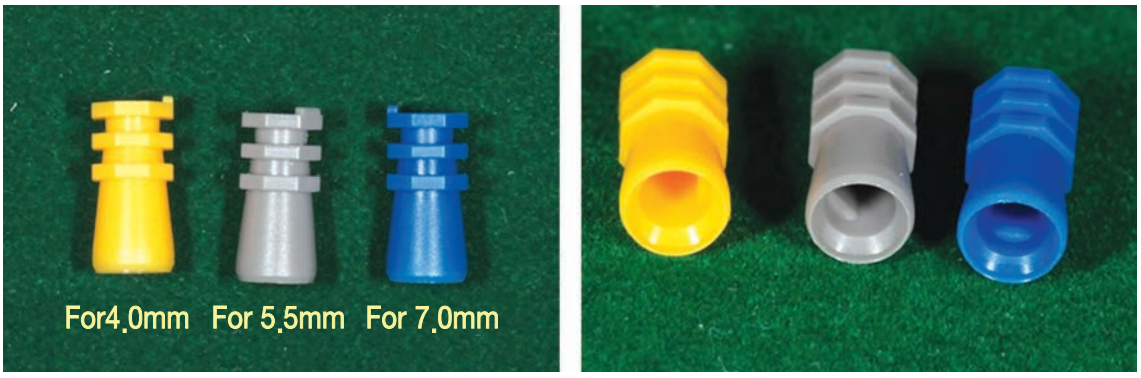


Fig. 4-99. Plastic impression caps are color-corded according to abutment height

It is a little inconvenient for a clinician to select an appropriate abutment at chair-side in an abutment level impression using a Rigid abutment or a Solid abutment. In addition to that, it is more difficult to select a suitable abutment in cases of multiple or full mouth implant restoration, especially when we are going to restore upper and lower jaw immediately. That is because an opposing dentition doesn't exist. At this time, there are many factors that should be considered such as occlusal plane, inter-occlusal clearance, abutment height, abutment collar height, abutment collar diameter, gingival height and path of implants and so on. Therefore, experiences of dentist are important to a certain degree in an abutment selection stage **(Fig. 4-100)** However, once we become familiar with this procedure, it has many advantages clinically and fortunately minor errors in an abutment selection stage can be solved by a "reverse technique" which will be explained in the next chapter.

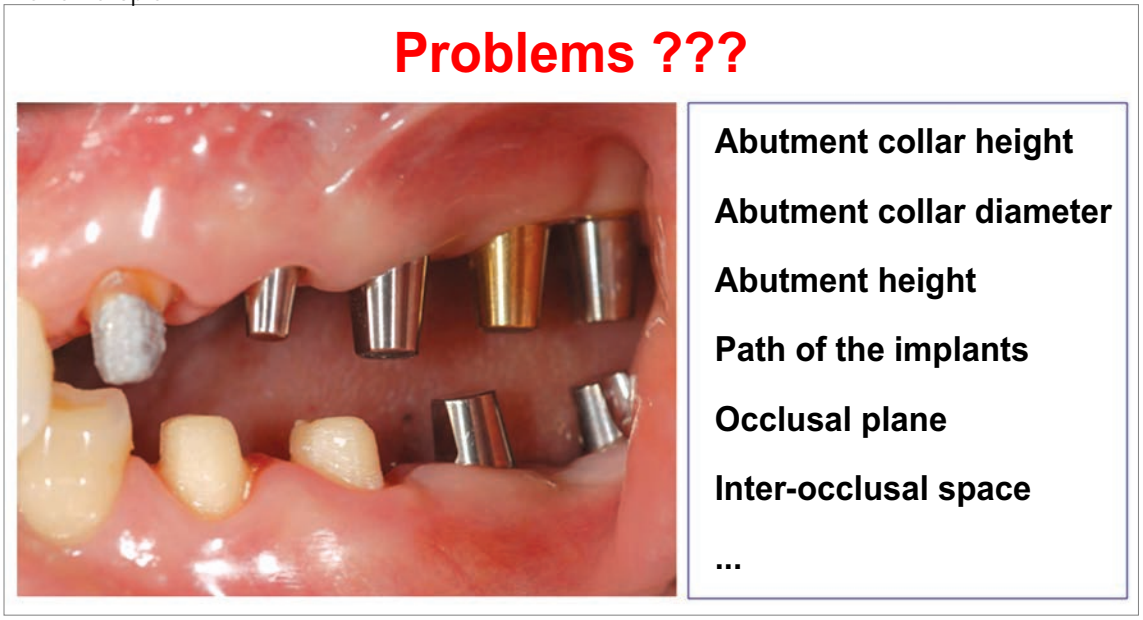


Fig. 4-100

The advantages of an abutment level impression are as in the followings. **First,** after selecting and connecting an abutment to a fixture, there is no need to remove this abutment during the following clinical procedures and the following prosthetic procedures will be same as conventional procedures. Namely, clinical and laboratory procedures are simple and easy. In a fixture level impression, it is inconvenient to repeat the connection and

disconnection of an abutment during clinical and laboratory procedures. Especially in a full mouth case, it is a time consuming procedure. But if a proper Rigid abutment in TS implant system is once selected, the frequency that the abutment has to be connected or disconnected can decrease. **Second,** a MICP (Maximum Inter-Cuspal Position) or a bite can be registered easily by means of a protect cap®. **(Fig. 4-101) Third,** sometimes a provisional restoration can be simply fabricated using a protection cap®. **(Fig. 4-102)** Consequently, it requires some time for an abutment selection but total clinical time in an abutment level impression is shorter than in a fixture level impression, particularly in multiple implant cases. **Fourth,** a dental laboratory cost would be lower because of the elimination or omission of a milling process. This cannot be ignored as implant patients are increasing. And finally, because Rigid abutments are stocked in our clinic, we can take good care of them easily. This has a significant meaning in regards to our dental management.

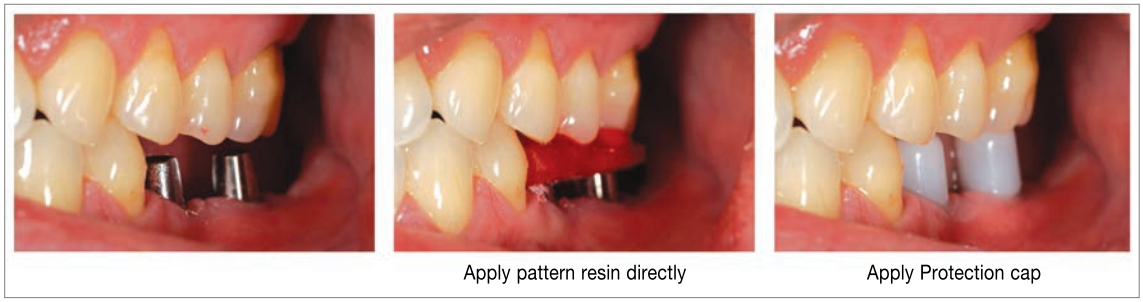


Fig. 4-101. Bite registration using protection cap

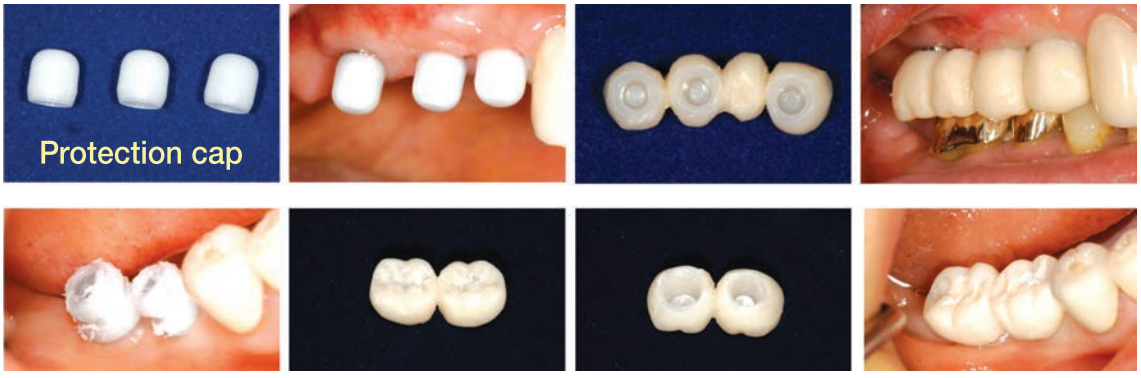


Fig. 4-102. Fabrication of provisional restoration using protection cap

③ Reverse technique

How can a clinician solve the problem if he/she received a call from a dental laboratory technician that it is impossible to fabricate a final prosthesis because of insufficient occlusal clearance after an abutment impression taking? Clinically the occlusal clearance looked enough but was insufficient during the lab-work. Then should the clinician recall the patient and take an impression again after changing abutment or grind an opposing tooth? It is troublesome. "Reverse technique" is a solution for this trouble. After an abutment level impression using a plastic impression cap, if needed, the height or the path of an abutment can be adjusted or modified in a lab. side. And a laboratory dental technician makes a final restoration as usual. And then a laboratory technician makes a "reduction cap or jig" that shows the amount of a lab. analog that was cut off in a lab. side. **(Fig. 4-103)** A reduction jig can be made of pattern resin or non-precious metal. In a clinic side, a clinician relocates a reduction jig to an abutment in its place and adjusts the exposed portion above it with a high speed bur to the same amount under abundant water supply. Finally, a final restoration is delivered.**(Fig. 4-104)**

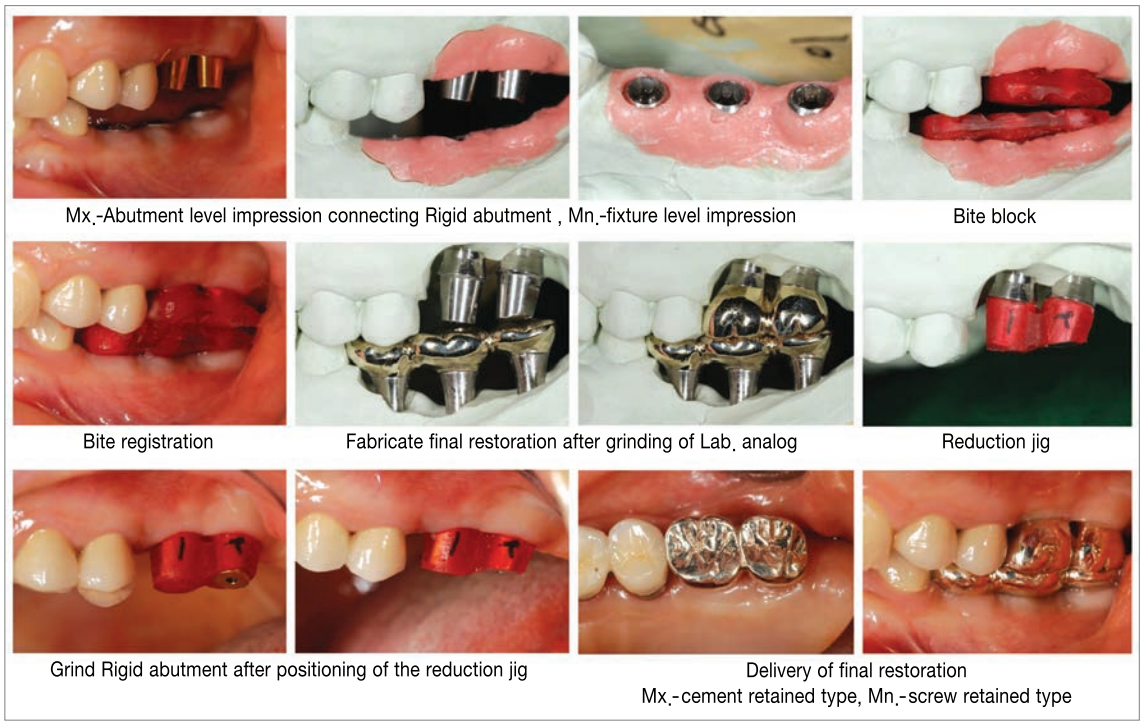


Fig. 4-103. Reverse technique to solve the insufficient occlusal clearance

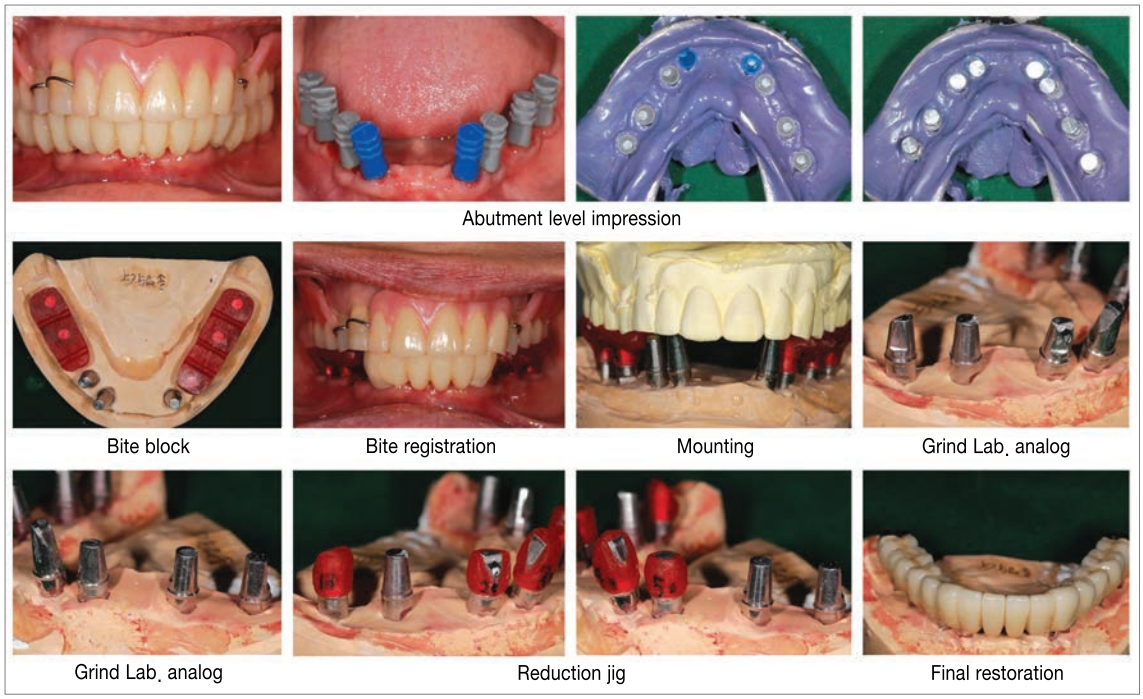


Fig. 4-104. Reverse technique to correct the path of implants

Fig. 4-104. Reverse technique to correct the path of implants

④ Method using a convertible abutment in TS implant system

TS convertible abutment is a kind of conical abutment which was used frequently in the past, and has decreased much in usage recently. However, if the path of TS implants is not parallel one another, it is not easy to take an impression or to fabricate a final restoration because TS implant has a relatively deep connection. Especially, when the path of implants is much slanted in case of a full mouth fixed type implant restoration or an implant bar overdenture, this abutment can be used to solve this kind of problem.**(Fig. 4-59)** In other words, it enables easy prosthetic design by converting an internal connection type into an external connection type.

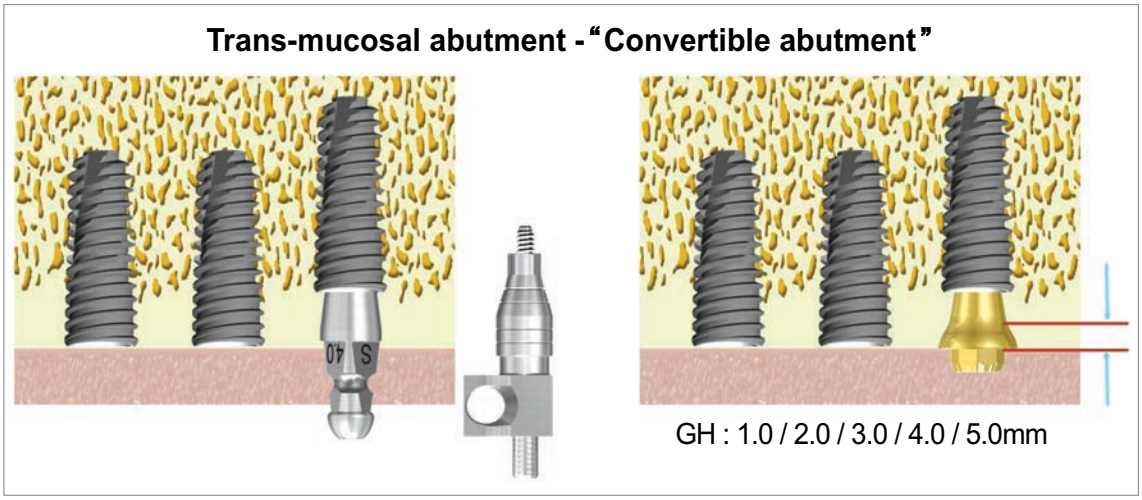


Fig. 4-105

Although I have not yet personally encountered such clinical situation, sometimes, I receive such a question: Although I have yet to personally encounter such situation, I sometimes receive such a question: "In maxilla, I placed TS implant too deep to get an initial stability. I heard that TS implant doesn't cause problems even when deeply placed, so I let it oseointegrated. But··· in prosthetic procedures, it is too deep, an adequate impression coping is not available. And I cannot take a conventional impression after connecting an abutment because a ready-made abutment with enough length is not available. What should I do?" Also, I have even experienced some dentist who made a phone call to me and asked that "I placed TS implant too deep on a maxillary posterior area, because I forgot to switch from a drilling motion of an engine into a torque motion. Oh, my god! Should I remove it? Or should I pull it out a little bit? I'm afraid of loosing the initial stability of a fixture. What shall I do for it?"

A convertible abutment can be applied in this situation. When TS implant is placed deeply, a transfer impression coping of 14.0mm or a pick-up impression coping of 15.0mm is still too short to use. To solve this problem, we can select an appropriate convertible abutment depending on the depth of implant. A convertible abutment has a gingival height of 1, 2, 3, 4, and 5mm. **(Fig. 4-105)** Following steps are same as those for US implant system. In other words, an abutment level impression is taken using a corresponding transfer impression coping or pick-up impression coping and a lab. analog. And a cement retained or a screw retained type restoration is fabricated using a corresponding ready-made abutment in a laboratory room. A case in **Fig. 4-106** is added to help the understanding of clinical and laboratory procedures of a convertible abutment although it is not for the control of implant depth.

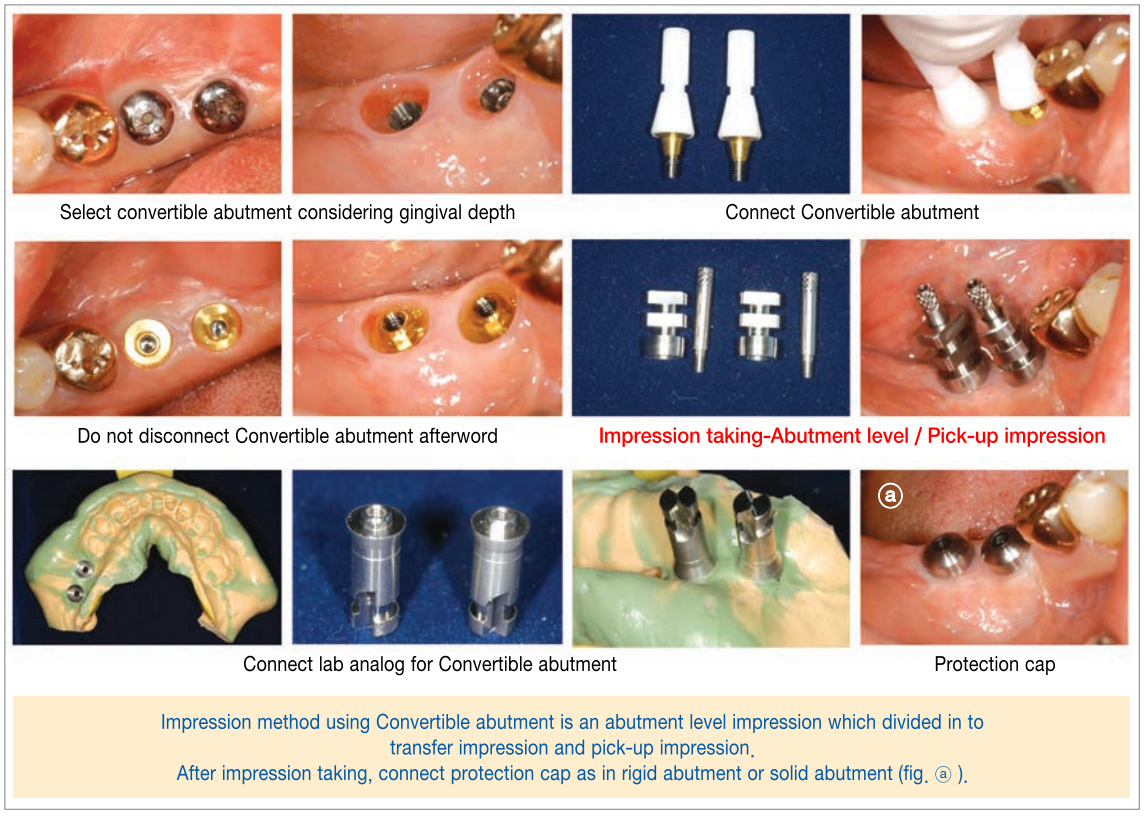


Fig. 4-106. Working process using convertible abutment

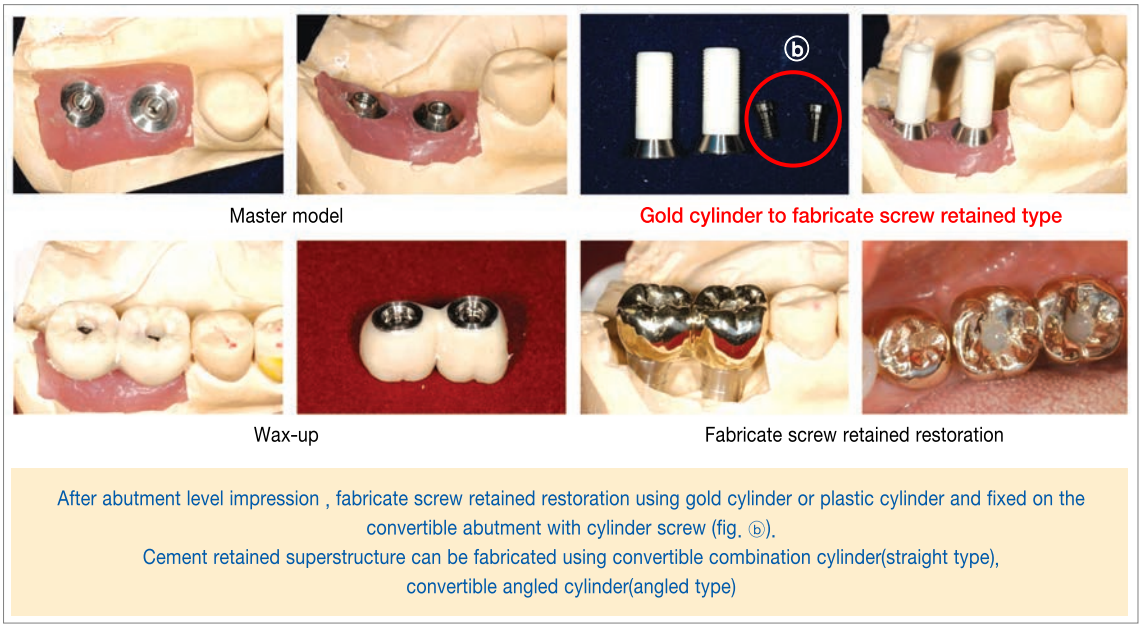


Fig. 4-106. Working process using convertible abutment

⑤ Conventional impression method

It is almost same as taking an impression in natural teeth. As you well know, in natural teeth, it is the most important to duplicate especially a gingival margin portion to a master model. That leads to a more precise prosthesis and a long-term success. This kind of a conventional method can be applied to an implant also. For example, in TS implant system, an appropriate ready-made abutment is connected a fixture with a recommended torque value considering gingival height, abutment collar diameter, abutment collar height, abutment height and so on. The ready-made abutment used in here can be a two-piece type (Transfer abutment) or one-piece type (Rigid abutment). And, if necessary, this abutment is adjusted taking into account the path of implants, the location of a gingival margin and the occlusal clearance. The occlusal clearance is related with the kind of material that is applied to the occlusal surface of a final restoration. Here, it is very important that the abutment height should not be less than 4.0mm for a good retentive fore. And the following procedure is same as in a general prosthetic procedure. **(see Fig. 4-68)** If a gingival margin is located at a supra-or an equi-gingiva in non-esthetic area like a molar region, we can simply take an impression without a gingival retraction**. (Fig. 4-107-㉮)** However, the margin area of ready-made abutment is not of anatomical shape but of just flat and round shape. Hence, it is not easy to locate the gingival margin at the same depth, so long as the height of gingiva around a ready-made abutment is not even. Especially, the gingival height of an interdental papilla is relatively higher than that of a buccal or lingual side, so a gingival retraction cord is mandatory in a deep gingival margin of ready-made abutment except in case with complete supra-gingival margin. **(see Fig. 4-80, 81)** In this situation, a gingival retraction is not easy because only circular fiber among the dento-gingival fiber group exists around the implant. And even after gingival retraction, taking an accurate impression is not easy because of the exudates around implant**. (Fig. 4-107-㉯, ㉰)** Sometimes a local anesthesia is necessary to remove the pain during the gingival retraction.**(Fig. 4-108)**

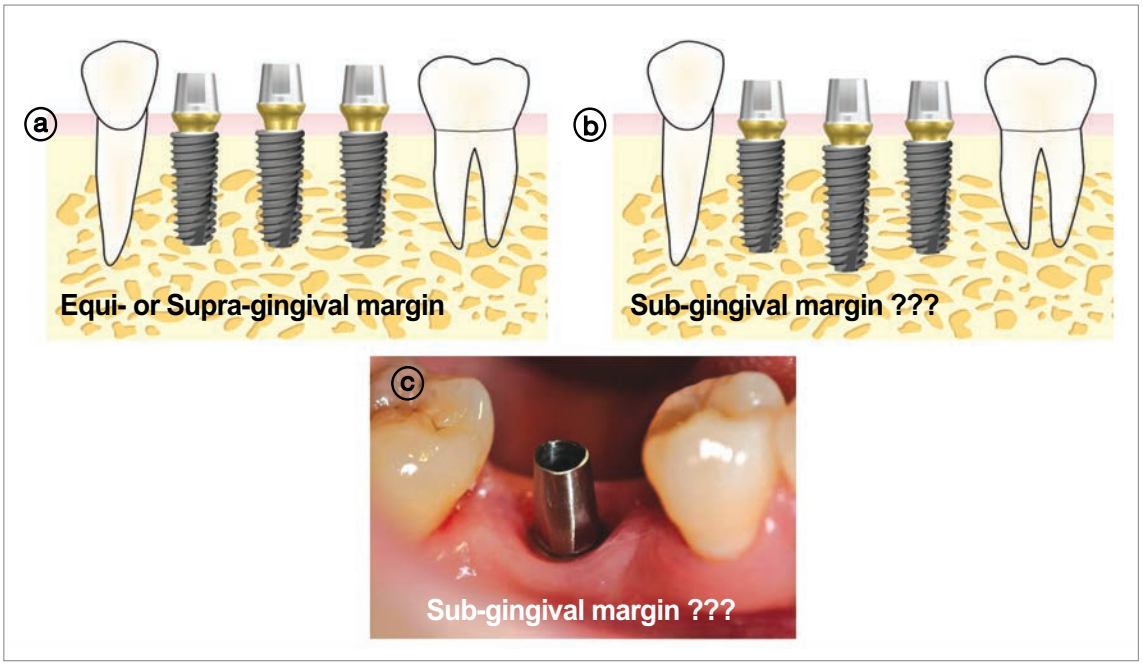


Fig. 4-107. In case of a sub-gingival margin, an inconvenient gingival retraction is necessary and that is not easy work.

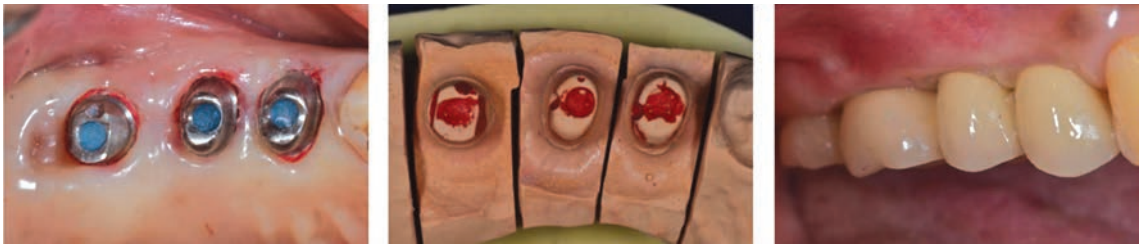


Fig. 4-108. A conventional impression was taken after applying gingival retraction cord under a local anesthesia.

Hence, a conventional impression is recommended in a posterior region where a supra-gingival margin is designed for a final prosthesis. If the quality of an impression is vague, please try a resin cap to get more accurate margin before fabricating a final prosthesis **(Fig. 4-109)** we can modify minor short margin intra-orally during the try-in of a resin cap and it is desirable to retake an impression when it looks too short or deformed.

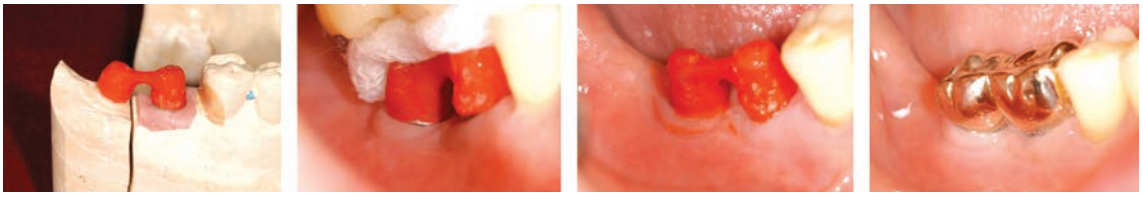


Fig. 4-109. After a conventional impression taking, it is possible to evaluate and modify the gingival margin area through the try-in of a resin cap.

We can apply a conventional impression method to a CAD-CAM titanium customized abutment which is increasing in usage recently. Generally, it is possible to make an ideal emergence profile by using a CAD-CAM titanium customized abutment, even when a gingival margin of a final prosthesis is designed at an equi-gingiva or slightly supra-gingival margin. Therefore, it is convenient to take a conventional impression without a gingival retraction. Some clinicians prefer to design and fabricate a CAD-CAM titanium customized abutment first after a fixture level impression and then fabricate a final prosthesis after taking a conventional impression. **(Fig. 4-110)**

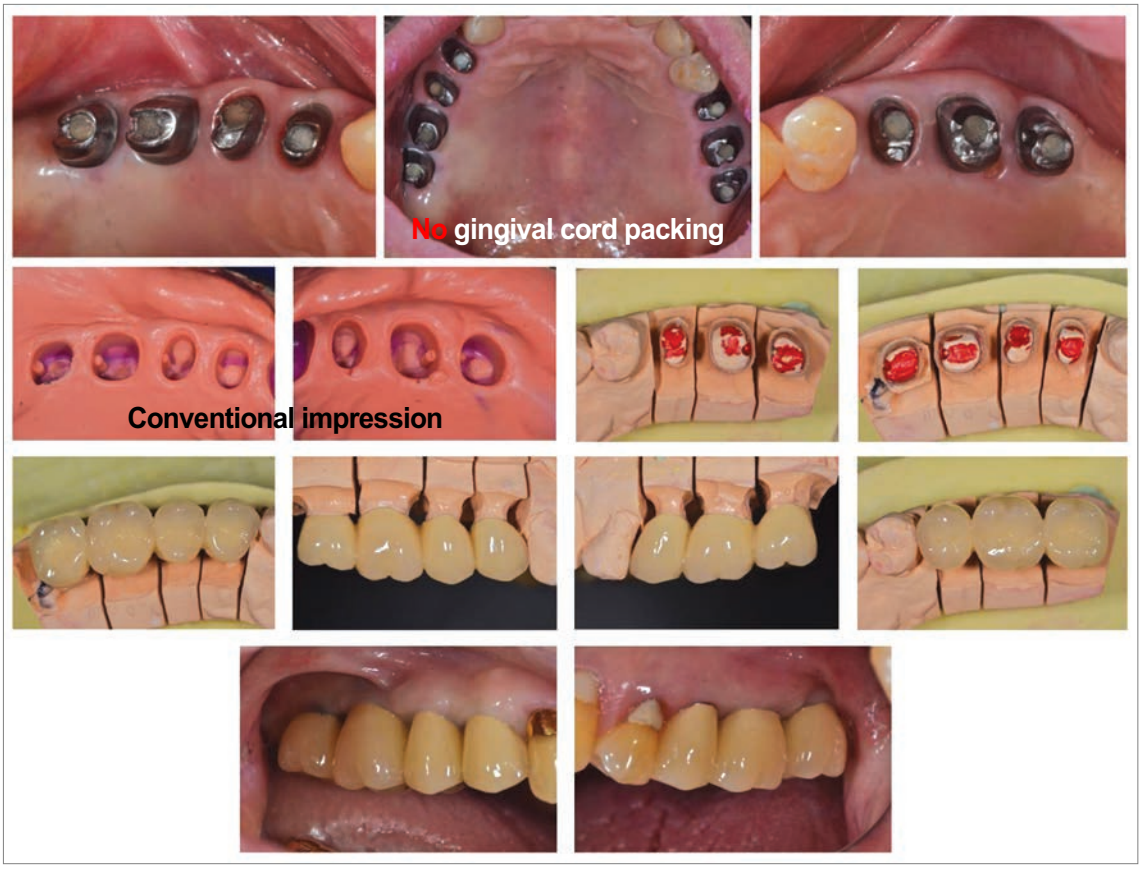


Fig. 4-110. A conventional impression was taken without a gingival retraction after a CAD-CAM titanium customized abutment was fabricated first. This is because it is very difficult to obtain the passive fitness of a final restoration when there is a little mistake in a fixture level impression. This is a major reason why a CAD-CAM titanium customized abutment is relatively bulky in size as compared with a ready-made abutment.

Author fabricates both a CAD-CAM titanium customized abutment and a final prosthesis at the same time after a fixture level impression and delivery the final prosthesis if satisfied. If there is an impression error or it requires some additional adjustment at the day of delivery, I take a conventional impression for a new final restoration, after a CAD-CAM titanium customized abutment is connected to a fixture with 30Ncm and adjusted the location of a gingival margin and the path a little bit. And then a bite registration is performed to determine a rigid posterior bite stop with a pattern resin after retightening with 30Ncm. Generally, it is difficult to get the passive fit of a final prosthesis even in with a minor impression error because the volume of a CAD-CAM titanium customized abutment is relatively big or bulky. Hence, a conventional impression method is useful in such a case.**(Fig. 4-111)**

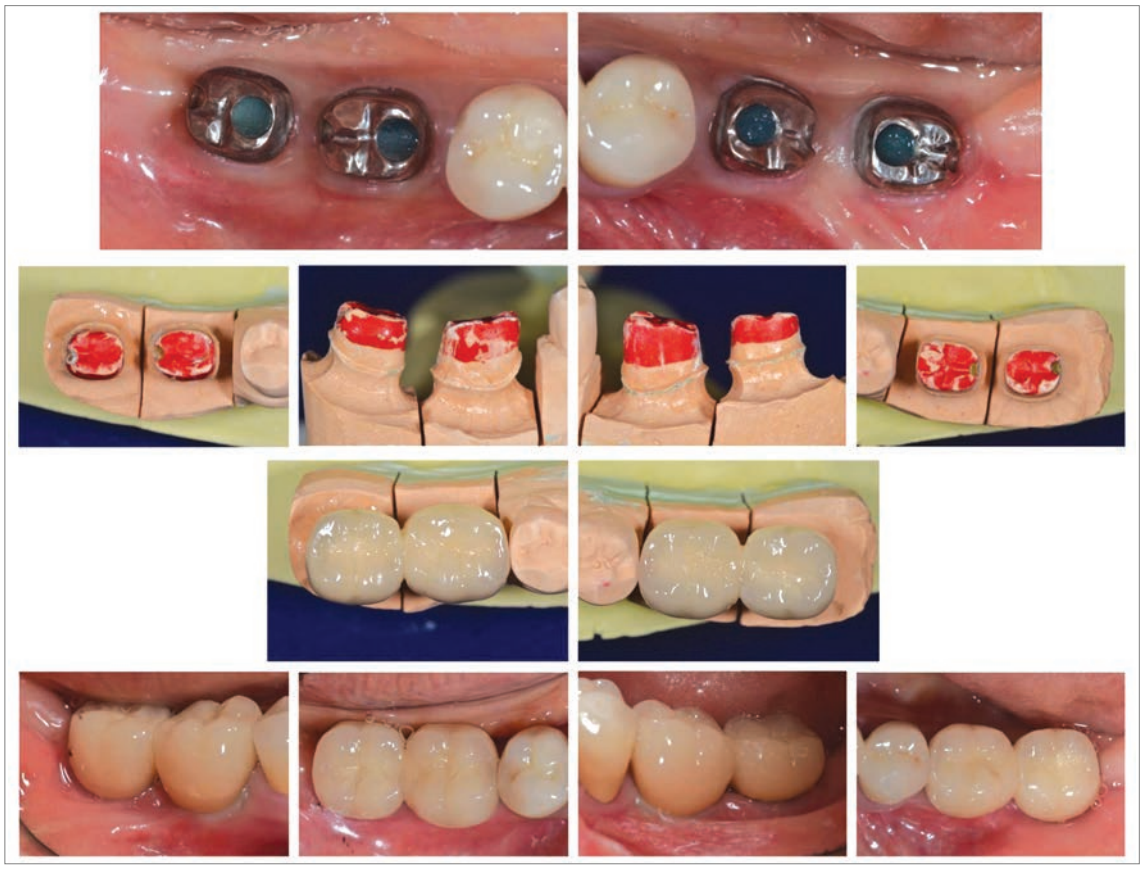


Fig. 4-111. During a try-in process, a fabricated CAD-CAM titanium customized abutment and a final prosthesis after a fixture level impression revealed an impression error. So a new final prosthesis was fabricated again after a conventional re-impression taking.

⑥ Method using a Retraction cap

A retraction cap is introduced to take a simple and effective impression without using a gingival retraction cord to expose a sub-gingival margin as explained in a conventional impression method. In the past, a protection cap®, that is used in Rigid or Solid abutment, has been tried personally for a conventional impression before OSSTEM company rolls out this retraction cap.**(Fig. 4-112)**

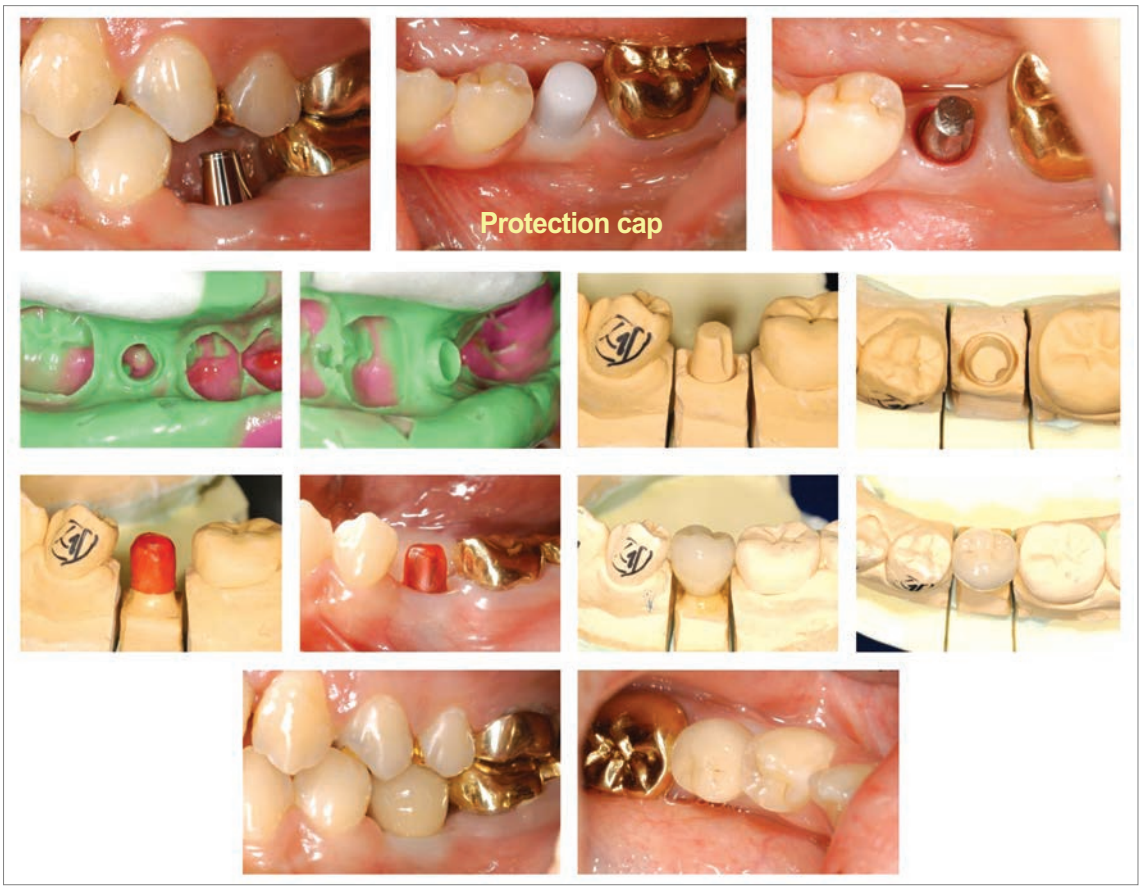


Fig. 4-112. A cement retained type prosthesis was fabricated after a conventional impression taking utilizing a protection cap.

However, a protection cap was used in limited cases depending on the gingival architecture or characteristics, the shape, and the depth of a gingival margin. A retraction cap supplemented its function. Because of its unique shape **(Fig. 4-113)**, sometime after this retraction cap is inserted in its place, we can obtain an impression body with an accurate gingival margin without a gingival bleeding as in a gingival retraction cord application. **(Fig. 4-114~117)**

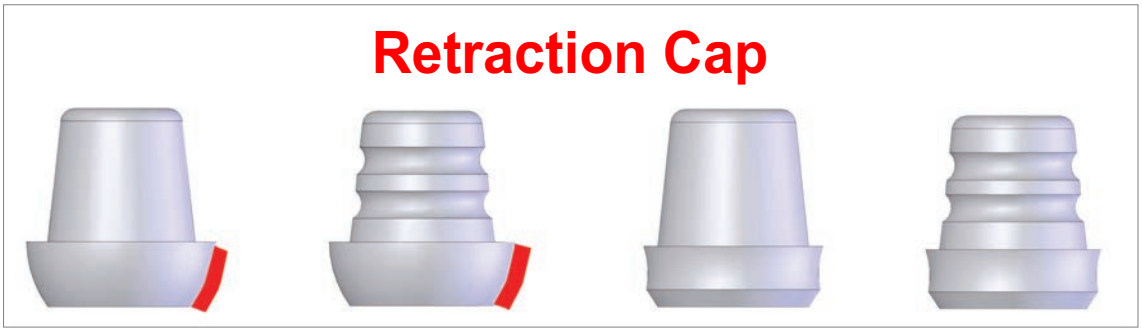


Fig. 4-113. Shape of a retraction cap

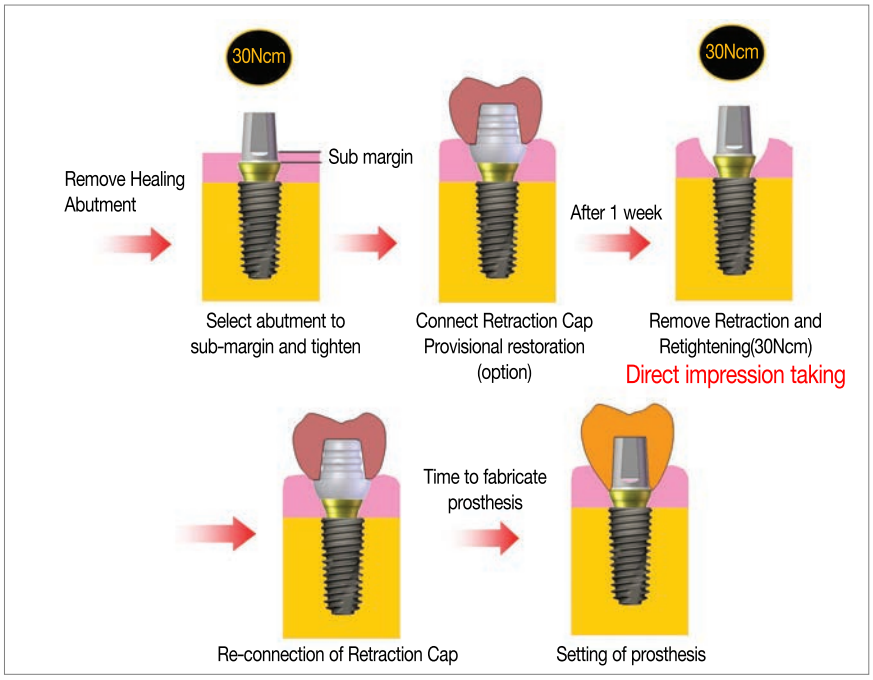


Fig. 4-114. Illustration of a conventional impression and a final prosthetic procedure using a retraction cap

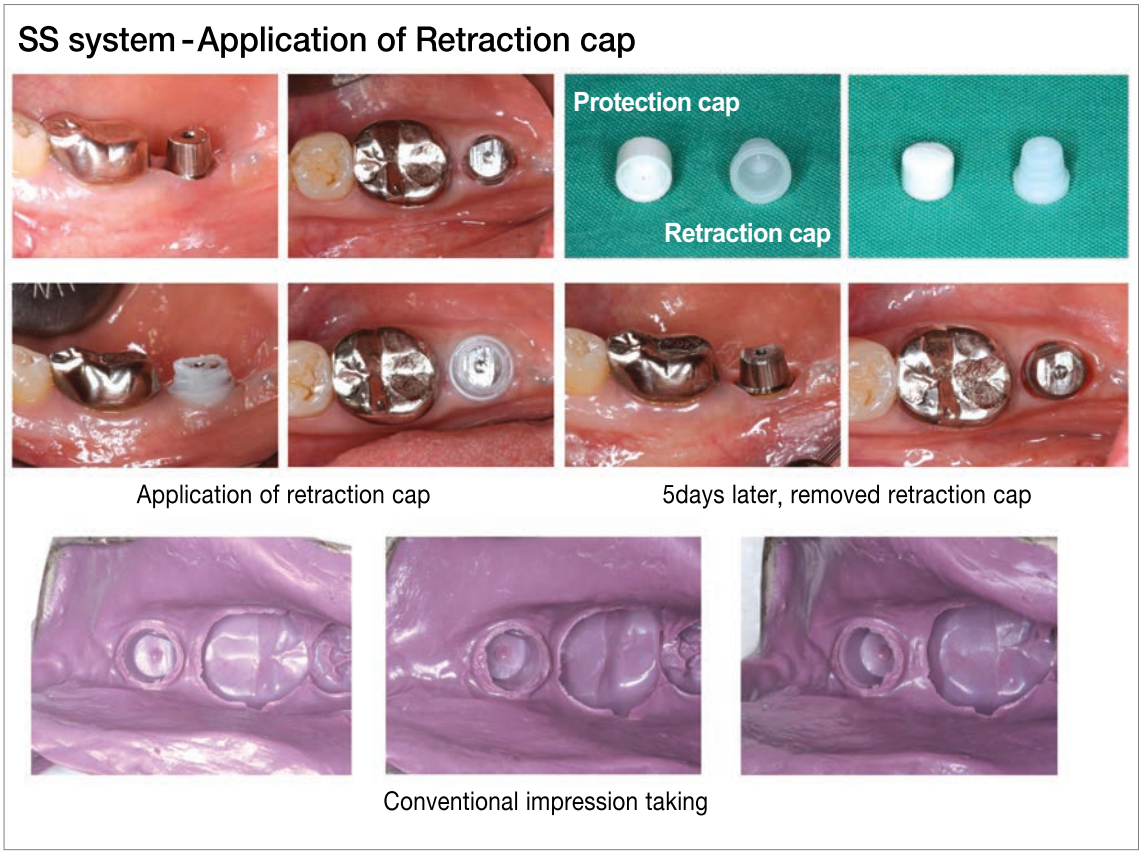


Fig. 4-115. Application of a retraction cap in SS implant system (Compare to a protection cap)

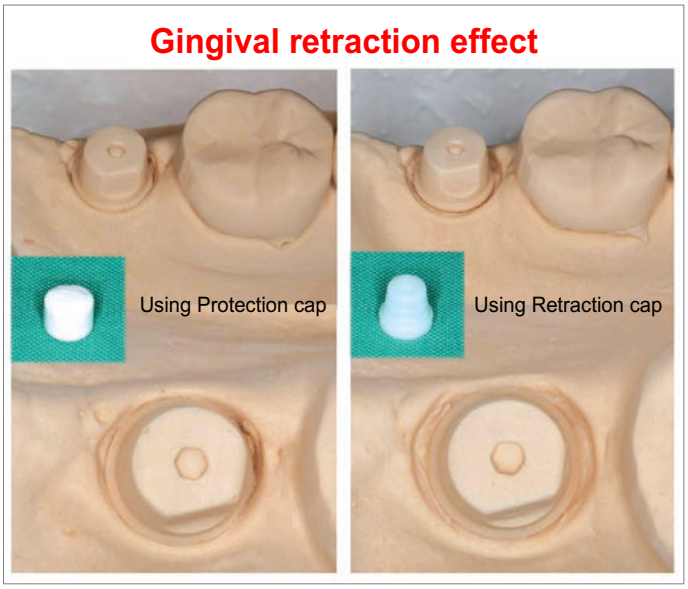


Fig. 4-116. We can verify the difference between a protection cap and a retraction cap in terms of the amount and effectiveness of a gingival retraction. A retraction cap is more effective.

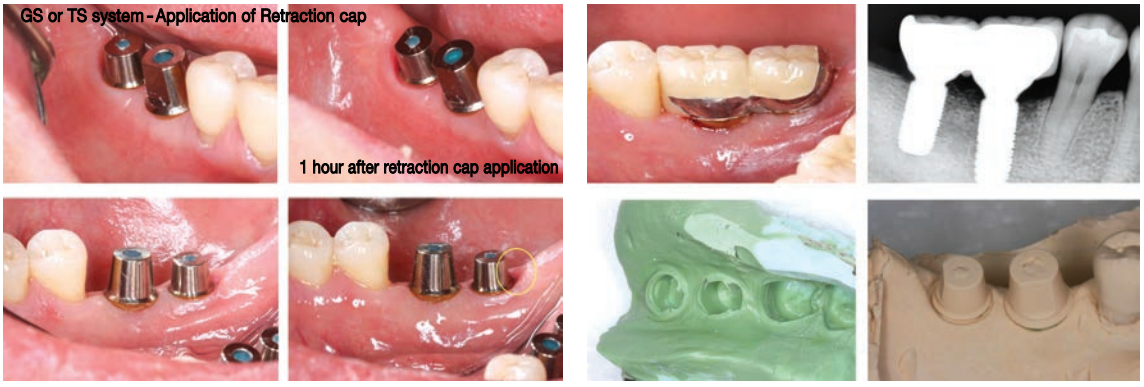


Fig. 4-117. Application of a retraction cap in TS implant system-In a shallow gingival margin or a limited deep margin case, a retraction cap can be applied for several hours and this is enough (second molar distal site in this case). But it may require several days in case of a deep gingival margin or a firm gingival architecture.

A retraction cap is applied to solid **(Fig. 4-118)** and excellent solid abutment **(Fig. 4-119)** in SS implant system. And Rigid or Transfer abutment (used as same concept of Rigid abutment) in TS implant system. **(Fig. 4-120)** A retraction cap can be applied in case of a modified ready-made abutment except in a gingival margin area considering the path of implants or the occlusal clearance. **(Fig. 4-121, 122)** And it is easy to make a provisional restoration using a retraction cap which reduces a screw loosening by retightening the abutment again after a certain period (recommend about 1 month) **(Fig. 4-91, 92)**

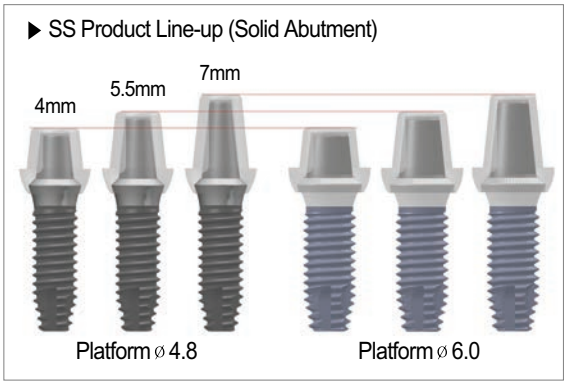


Fig. 4-118. A retraction cap for SS Solid abutment

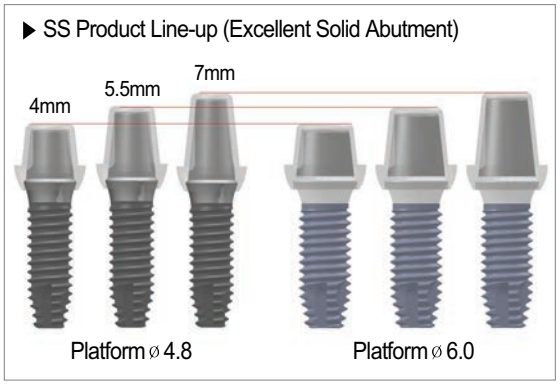
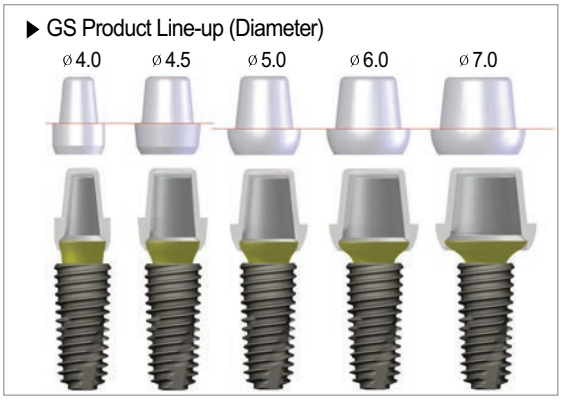


Fig. 4-119. A retraction cap for SS Excellent solid abutment



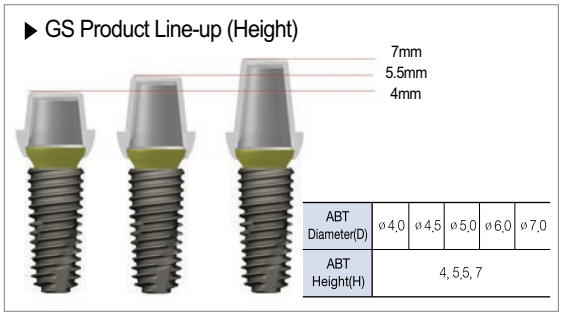
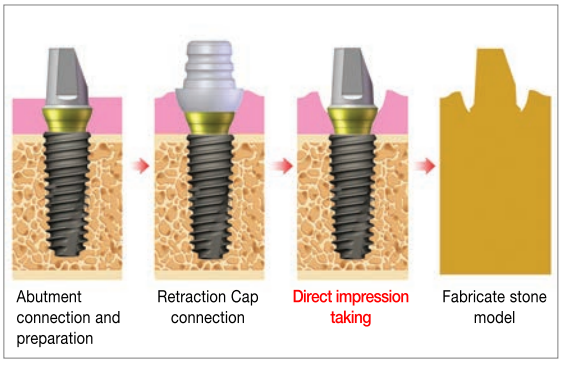


Fig. 4-120. A retraction cap for TS Rigid or Transfer abutment.



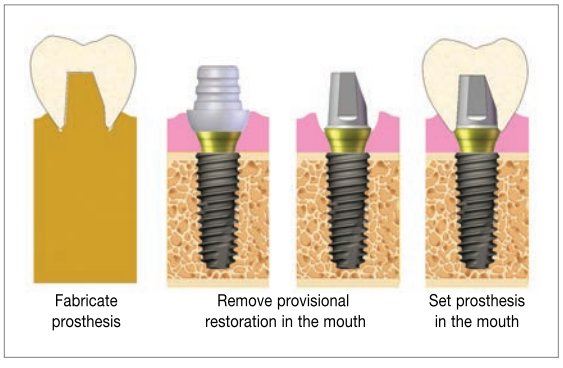


Fig. 4-121. Illustration of applying a retraction cap in case of the modification of an abutment

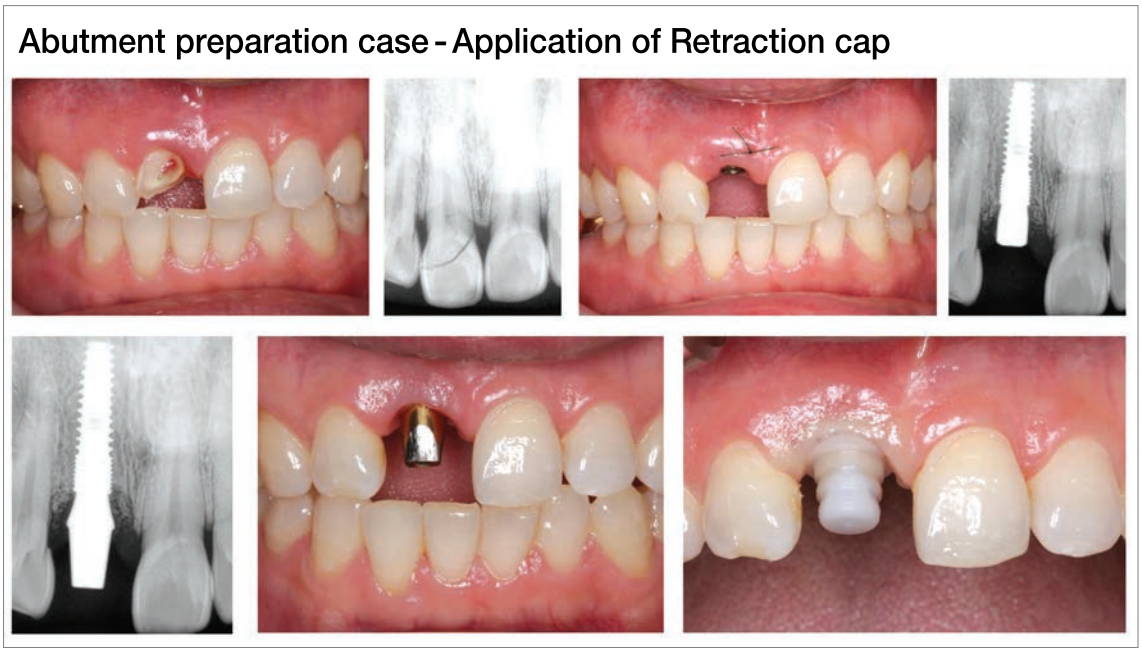


Fig. 4-122. This case shows the application of a retraction cap in case of the modification of an abutment

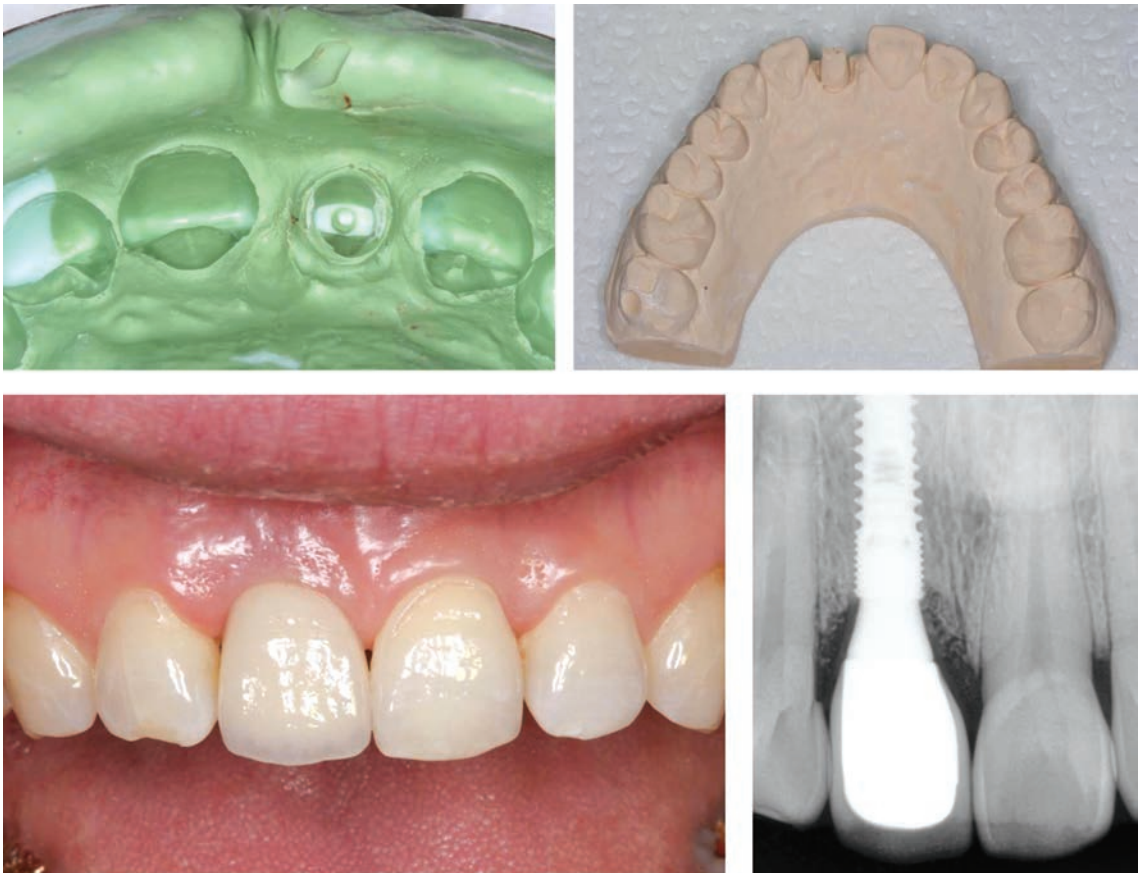


Fig. 4-122. This case shows the application of a retraction cap in case of the modification of an abutment

The clinical meaning of a retraction cap is that it allows getting an accurate margin relatively easily through a conventional direct impression taking and adds the convenience of delivery of the prosthesis with less gingival interference. Also, we can reduce the productive cost related to fabricating prosthesis and lab-work compare to current conditions.

⑦ In case of selecting an abutment level impression

Generally, an abutment level impression is selected in following cases

(1) When a cement-retained type restoration is possible because of a sufficient vertical space

(2) Posterior region with the proper position and path of implants

4) Summary-Impression taking in TS implant system

Methods of an impression taking and kinds of corresponding final prostheses are summarized at **Fig. 4-123, 124** and **Table. 4-50, 4-51,** and **4-52**. This is not absolute protocol but Author's personal clinical protocol. The author wants to give some guidelines. I hope to provide a more organized method of implant prosthesis treatment to those who read and master the aforementioned impression taking methods in this book with such a clinical guideline.

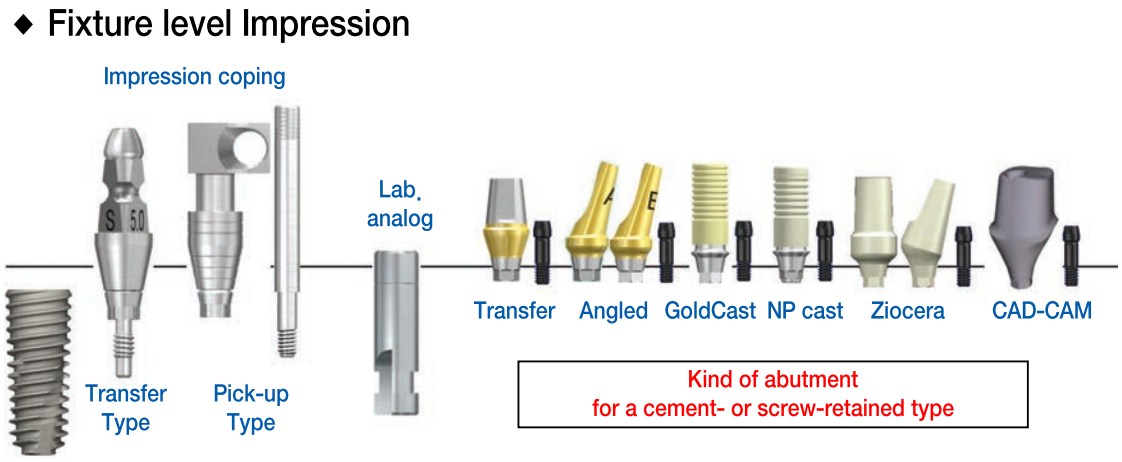


Fig. 4-123. A fixture level impression in TS implant system

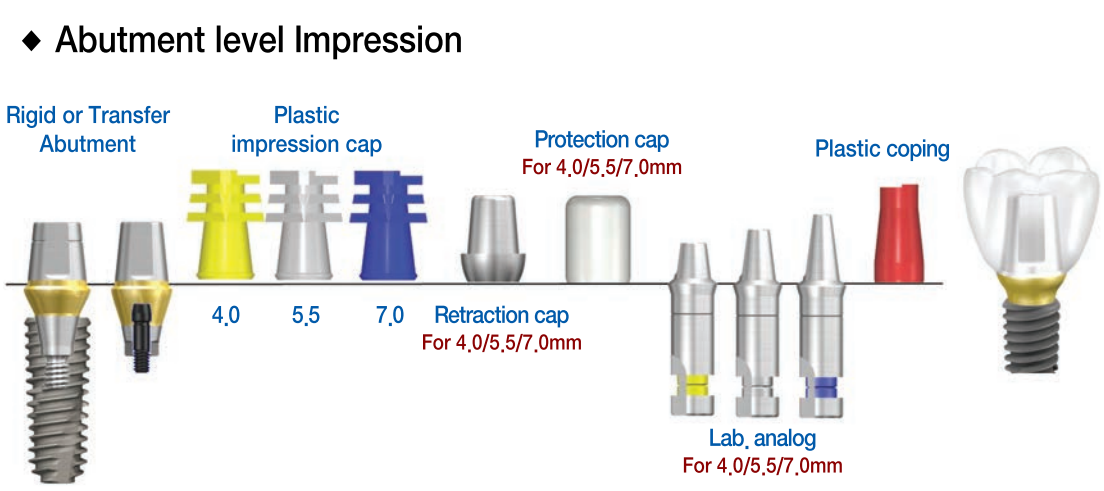


Fig. 4-124. An abutment level impression in TS implant system

Table 4-50. Autho's clinical protocol related to the impression taking method and the fabrication of a superstructure in anterior region

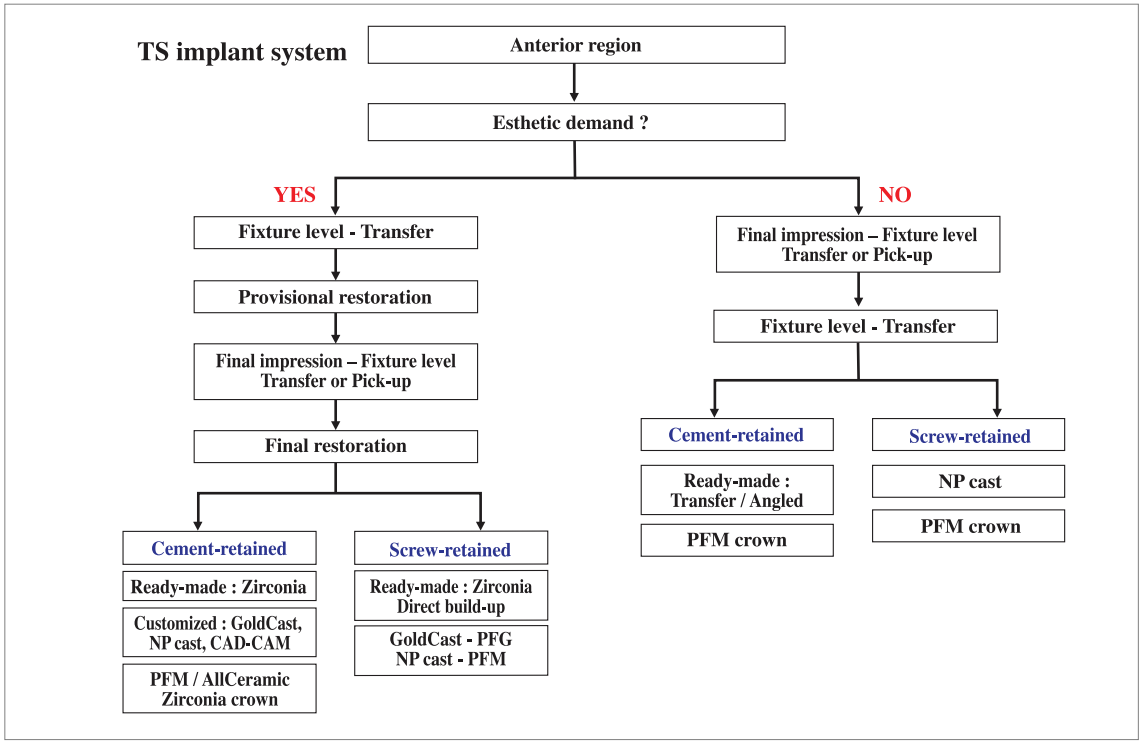


Table 4-51. Author's clinical protocol related to the impression taking method and the fabrication of a superstructure in posterior region (single case)

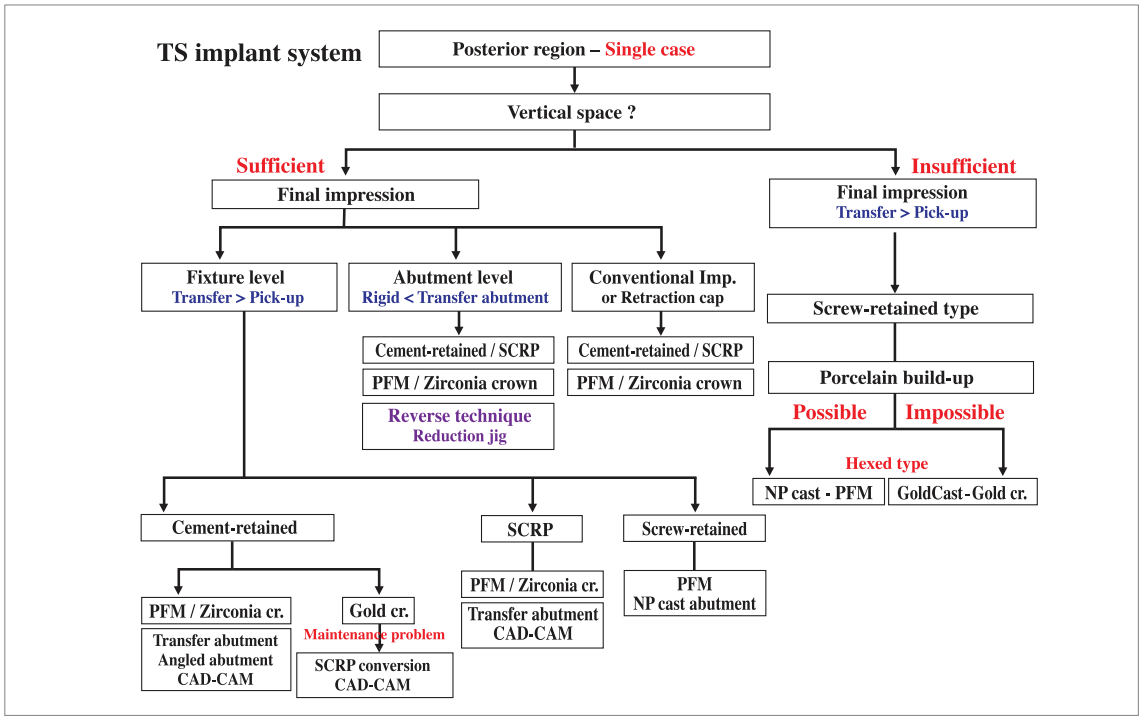
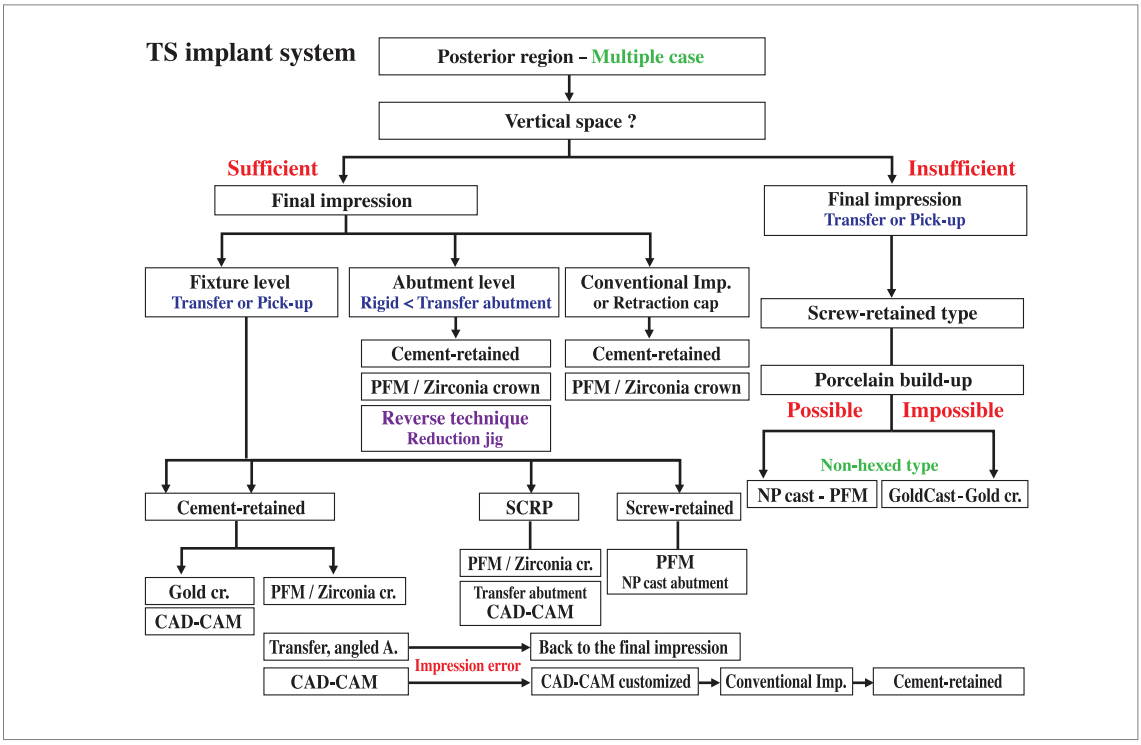


Table 4-52. Author's clinical protocol related to the impression taking method and the fabrication of a superstructure in posterior region (multiple case)



An impression taking procedure is very important in a conventional prosthetic procedure also. That more accurate impression taking is utmost important in an implant prosthetic procedure which requires precision procedures. It cannot be more emphasized. I experienced many difficult problems in prosthetic procedures that result from an impression error. When a certain mistake happens, please think about its etiology and make improvements, so that we can reduce stress which comes from an impression taking procedure. I hope you can make successful implant therapy through a good impression taking which is the first step in an implant prosthetic procedure.

3. Guidelines for occlusion of implant-supported restorations - By Dr. Park, Hwee-Woong

1) Occlusion, the never-ending challenge for dentists

There is almost no field of dentistry than "Occlusion" in which dentists are left with boundless feelings. Seemingly obscure, vague characteristics of occlusion, the wistfulness of forming improper occlusion for the patients, and the gap between ideal and clinical reality are enough to leave dentists frustrated.
Moreover, such clinical varieties of occlusion as discovering poor restoration in the mouth to have functioned properly for a long time, receiving complaints rather than satisfactory remarks from patients whose terrible dentures have been replaced with dentures made with utmost efforts following principle guidelines, or listening to patients describe incomprehensible descriptions of occlusal symptoms using the five senses desperate the dentists beyond their commons senses.

2) The history of occlusal concept in implant prosthodontics and current condition

The history of occlusion started from complete denture and became extended to the field of the natural dentition. Although many articles on occlusion exist, most of them are empirical, subjective and lack scientific evidence. Furthermore, introduction of dental implants changed the paradigm of restorative dentistry and added more confusion to the concept of occlusion.**(Fig. 4-125)**

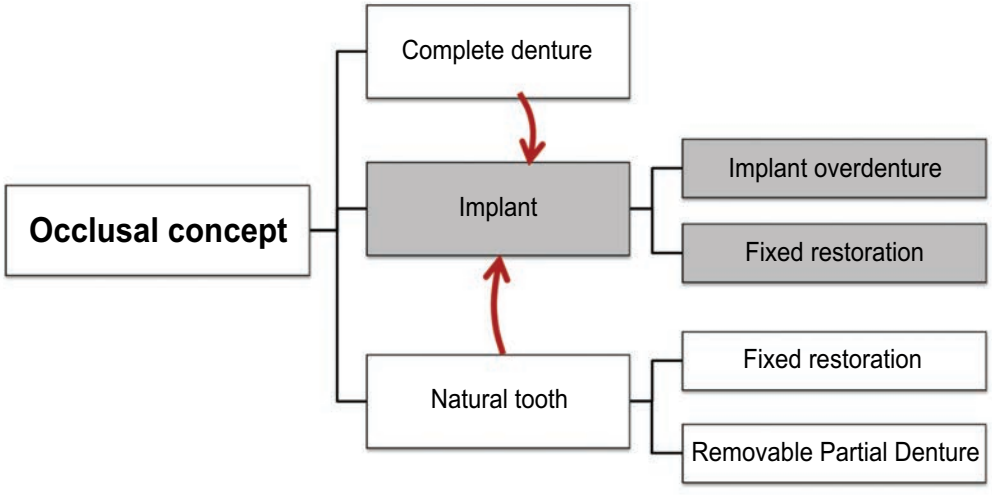


Fig. 4-125. Most of the concept of occlusion in implant dentistry is derived from that of complete denture and natural dentition. Consequenty, impant dentistry not only received benefits from acumulated expriences and theories of conventional proshodontics but also succeeded dilemmas in conventional prothodontics.
Exclusive concept of occlusion for implant prosthodontics has not been established until now.

Dental implants show superior results in treatment of fully or partially edentulous and even in esthetic cases. Clinical applications of dental implants are expanding continuously. But its occlusal concept is derived from that of complete denture and natural dentition. Traditional occlusal concept experienced much confusion and changes, so the occlusal concept of dental implant also inherited the same dilemmas. It will need much time to establish an exclusive concept of occlusion for dental implants.
But we should not be disappointed. In spite of the fact that the knowledge of occlusion is empirical, subjective, and lacks evidence until now, most of the restorative procedure performed by dentists are successful. So the main stream of basic knowledge remains valuable and clinically effective.
Consequently, it seems very valid to apply current concept of occlusion into implant prothodontics carefully. In this chapter, the author summarized the clinical guidelines to the occlusion of implant –supported restoration.**(Fig. 4-126)**

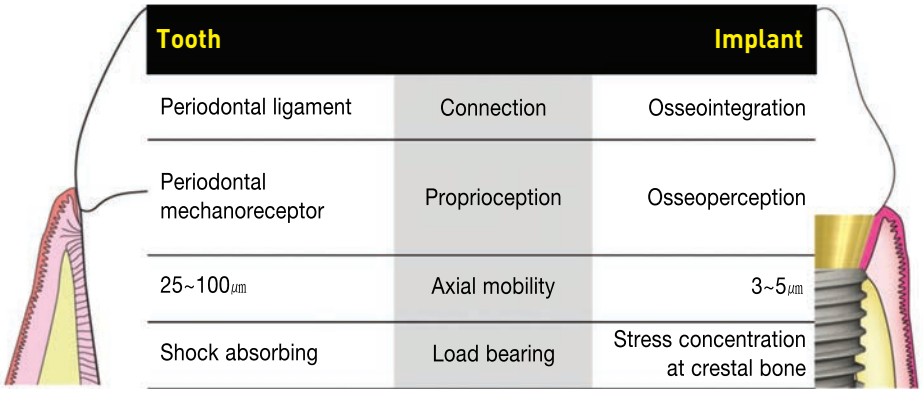


Fig. 4-126. Physiologic difference between implant and natural tooth comes from difference of connection structure with alveolar bone. Implant shows almost no mobility because peridontal ligament is absent and odontogenic proprioception and buffer action are decreased, so the reponse of implant to bite force is phsiologically quite different from that of natural tooth.

Clinicians come across the following questions about occlusion.

- Should the occlusal contact of dental implant be weaker than that of the natural dentition?

- Is it safe to make eccentric guidance in an implant-supported restoration?

- Should the single, multiple, full arch, and overdenture occlusion be same or different?

- What about long term changes of the occlusion of implant-supported restorations in a patient's mouth?

These questions basically come from the concern of the ability of implants to withstand the occlusal force. It is well known that dental implants are different from natural teeth in structure and physiologic ally, and can cause various problems when overloaded.
First of all, clinicians are concerned about osseointegration. Earlier studies of dental implant focused on osseointegration itself against occlusal load because maintenance of stable osseointegration was the most important interest. For this reason, acrylic resin artificial teeth were used for occusal material to reduce impact

of occlusal force, and elastic polymer was used between an implant and an abutment to mimic the function of the periodontal ligament. However these materials elicited many problems such as frequent fracture and abrasion due to their poor mechanical properties to resist occlusal force.

Some clinicians are concerned about overloading of osseointegration interface when metal or ceramic was used for material of occlusal surface. But it is well known that difference of occlusal surface material do not influences on the osseointegrtion. Now porcelain-fused-to-metal crown is commonly used as occlusal material for partially or fully edentulous patients. Recently, zirconia which has advantages in esthetics and biocompatibility is successfully applied on superstructure and occlusal surface. Furthermore, evolution of surface treatment technology allows strong osseointegration in shorter period and enhanced long term success, so we don't need to worry too much about the harmful influence of occlusal load on the osseointegration itself anymore.

Secondly, we are concerned about the fracture of implants. At early stages, fixtures with diameters of 4.0mm or less were used for single molar missing case and were frequently fractured. To prevent fracture, dentists applied occlusion type which has greatly reduced occlusal table and flat cusp even compromising masticatory efficiency. Recently, however, mechanical problems such as fixture fracture or deformation are not serious factors because property of titanium alloy has been improved and various wide diameter implants are available.

Third is related to prosthetic components and its connection interface. Among them, screw loosening and fracture are common problems. However, the function of a screw in a screw-retained implant prosthesis is different from that of current cement retained implant prosthesis. In a screw retained implant prosthesis, the screw was a structure for retrievability and, especially, the screw which fixes prosthesis on the abutment functioned as a safety device by loosening first to prevent harmful effect on implant during overloaded situations. On the contrary, main function of screw in cement retained prosthesis is connecting abutment on the fixture. Hence, basically it shouldn't be loosened after tightening by other factors except when operator intentionally unscrews. Consequently, screw loosening should be minimized during functioning in cement retained implant prosthesis. Fortunately, screw loosening is rare during functioning in prosthesis which has a stabilized structure due to several re-tightening with adequate tightening torque.

As reviewed before, implant is considered as something "to be protected" which has very weak structure. Therefore, dentist commonly use concept of implant protected occlusion in partially edentulous case, which means implant is protected by adjacent or contralateral natural teeth. Although implant is not stronger than sound natural tooth, it is not so weak to be protected by natural tooth. In some cases, depending on occlusion and condition of remaining tooth, an occlusion type which implant protects natural tooth should be applied.

These two kinds of occlusion concepts are case specific and very vague, but, should be established in implant occlusion. (*There is a confusion of terminology. Currently, usually we use "implant- protected occlusion" and "implant-protective occlusion" without distinction and mainly they mean "occlusion to protect implants". However, when we consider that 'canine protected occlusion' means a canine that protects posterior teeth at eccentric position in conventional prosthodontics, it is more reasonable that 'implant-protected occlusion' means implant protects tooth not protected by natural tooth. Nevertheless, there is no clear differentiation in terminology yet.)

3) Osseoperception

In functional aspect, the biggest difference between natural tooth and implant is the existence of periodontal membrane. Periodontal membrane in natural tooth buffers occlusal load and controls masticatory muscle function by feedback action of mechanical sensory receptor which exists in the periodontal membrane. Because implant has no periodontal membrane, input of stimulation into central never system will be decreased, and actually many researchers report that sensory threshold of implant prosthesis load is higher than that of natural tooth. In other words, patient may not detect any problem in overloaded implant. However, we can guess that osseointegrated dental implants have an unknown compensation mechanism of p in spite of lack of periodontal ligament, because osseointegrated implant merges to the stomatognatic system and successfully replaces function of tooth.
(Especially, single implant shows almost similar level of proprioception as natural tooth assisted by the sensory function of adjacent and opposing teeth) Recently, researchers have suggested the concept of osteoperception and have been reporting results of related researches. 'Osseoperception' means a phenomenon in which an implant detects mechanical stimulation (tactile sensitivity). It is thought that implant is merged to oral and maxillofacial system and functions well because of flexibility of central nerve system and compensating sensory organs which exist in muscle and TMJ, in spite of decreased proprioception in implant without periodontal ligament. Others suggest that nerve endings exist in the surrounding bone of osseointegrated dental implant and detects mechanical stimulation.**(Fig. 4-127)**

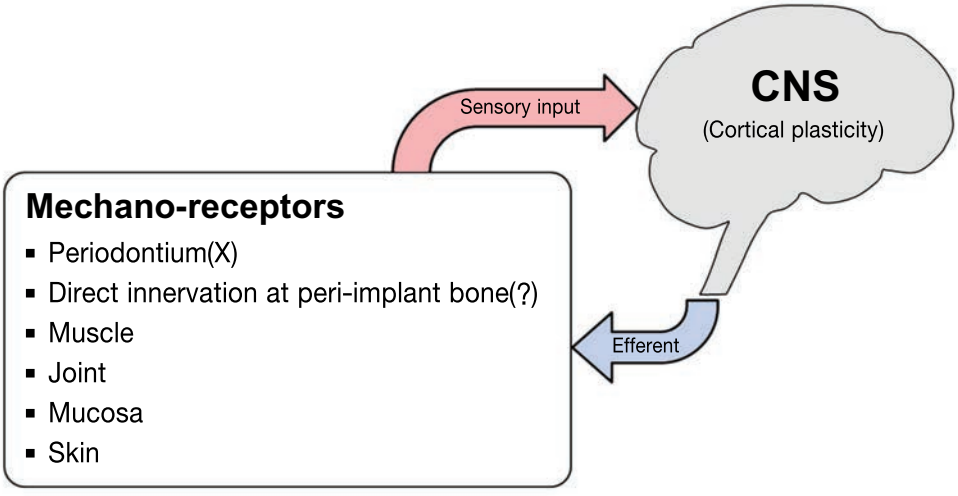


Fig. 4-127. Osseoperception means tactile sensitivity phenomenon of osseointegrated implant. Because extracted tooth loses sense of periodontal membrane, which is the most important odontogenic sense, mechanical stimulation conducted to central nerve will be much decreased. It is thought that a certain compensation mechanism exists because dental implants which has no structure like periodontal membrane in natural tooth still performs masticatory function successfully although it is a big handicap.

4) Occlusion equals force control

Defense mechanism of implant against occlusal overload may not be so sensitive because of relatively high sense threshold, lack of periodontal membrane, and pulp in implant. For a long time, many dentists have been aware of and studying such risk of overload.
Typically, Isidor's study reported that excessive non-axial force can destruct osseointegration completely. However, this study left room for doubt because conditions of overload were unrealistic and some implants well maintained their osseointegration. On the contrary, Heitz-Mayfield and, Ogiso's study reported that all implants under overloading well maintained osseointegration.
As above, studies on excessive occlusal load mainly handled problem of implant-bone interface. In reality, mechanical components caused more problems. Cell activities continuously remodel and repair implant-bone interface and the strain of a certain range can stimulate to strengthen ossointegration. However, connection of mechanical component can elicit problems when repeated load is accumulated by time passing, because it is a consumptive interface and cannot be repaired spontaneously. Activity of masticatory muscle makes all possible problems in implant-bone interface, mechanical components, and prosthesis. Consequently, Occlusion is an academic science which handles subjects of muscle energy distribution, control, and long term functioning to teeth

(1) Guidelines for occlusion of implant-supported restoration

Avoidance and protection of risk factor is one of the basic principle of occlusion in implant supported restoration, and many articles mention following risk factors commonly.

Occlusal risk factors

- Large cantilever
- Parafunctional habit
- Excessive premature contact (〉00-180 ㎛)
- Large occlusal table
- Steep cusp
- Poor bone density/quality
- Inadequate number of implants

It is known that dentists can prevent a large amount of implant failure by avoiding such risk factors in occlusion. Among various theories of occlusion the most important common three factors are vertical dimension of occlusion, solid posterior support for maintenance, and appropriate eccentric guidance.**(Fig. 4-128)**

Implant occlusion is divided into following three categories depending on implant or natural tooth which functions dominantly in occlusion. In other words, this is a discussion of whether natural tooth protects implant or implant protects natural tooth depending on the number of remaining tooth or implant.**(Fig. 4-129)**

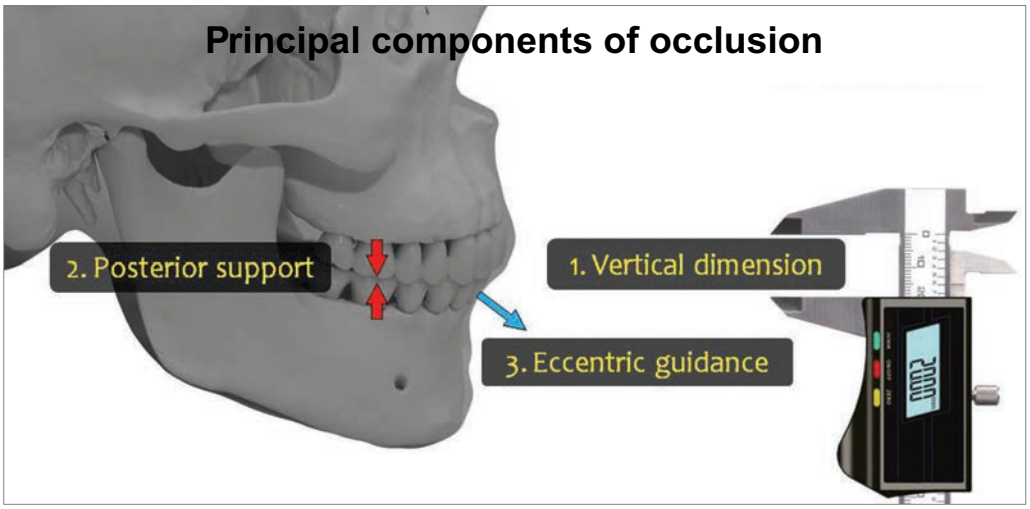


Fig. 4-128. There are three kinds of important common factors among various theories in occlusion. **First,** proper vertical dimension, **second,** solid posterior support for maintenance, **third,** choice of tooth in charge of eccentric guide.

First, when few implant prostheses exist among many sound natural teeth, do not change current occlusion and harmonize with natural teeth.
Second is a case when natural teeth and implants are mixed almost evenly. Sound natural teeth can share the occlusal force evenly with implants, however, implant can be charged with more occlusal load instead of periodontally weakened natural teeth.
Third is a case of implant prosthesis with few natural teeth. Establish completely new occlusion replacing current one and implant will be in charge of this function.

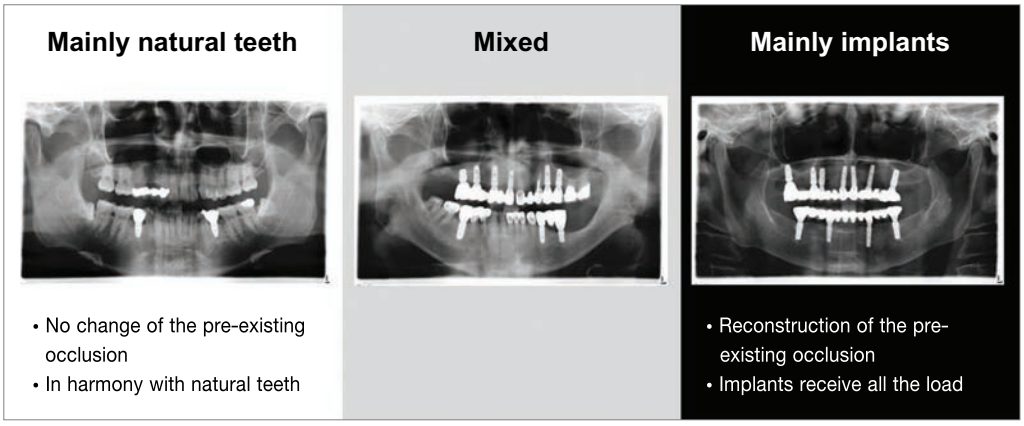


Fig. 4-129. Occlusion of implant restoration is classified as three types; natural teeth dominant, implant dominant, and mixture of implants and natural teeth.

(2) Mutually protected occlusion

"Mutually protected occlusion" is the most simple and intuitive concept of applying these factors at actual patient's mouth. It is a principle that posterior teeth protect anterior teeth at maximal intercuspal position (MI) and vice versa during protrusive / lateral movement. We can apply this concept to occlusions in which implants and natural teeth are mixed. However there is an exception for this concept because of weakness of implant to lateral force. In other words, it is concerned with protection of the small numbers of implant over previous dominant principle if implant can be overloaded. In this situation, implant restoration just keeps space and does not serve any masticatory function. Based on mutually protected occlusion, let's look at the details of occlusal scheme of occlusion in implant restoration.**(Fig. 4-130)**

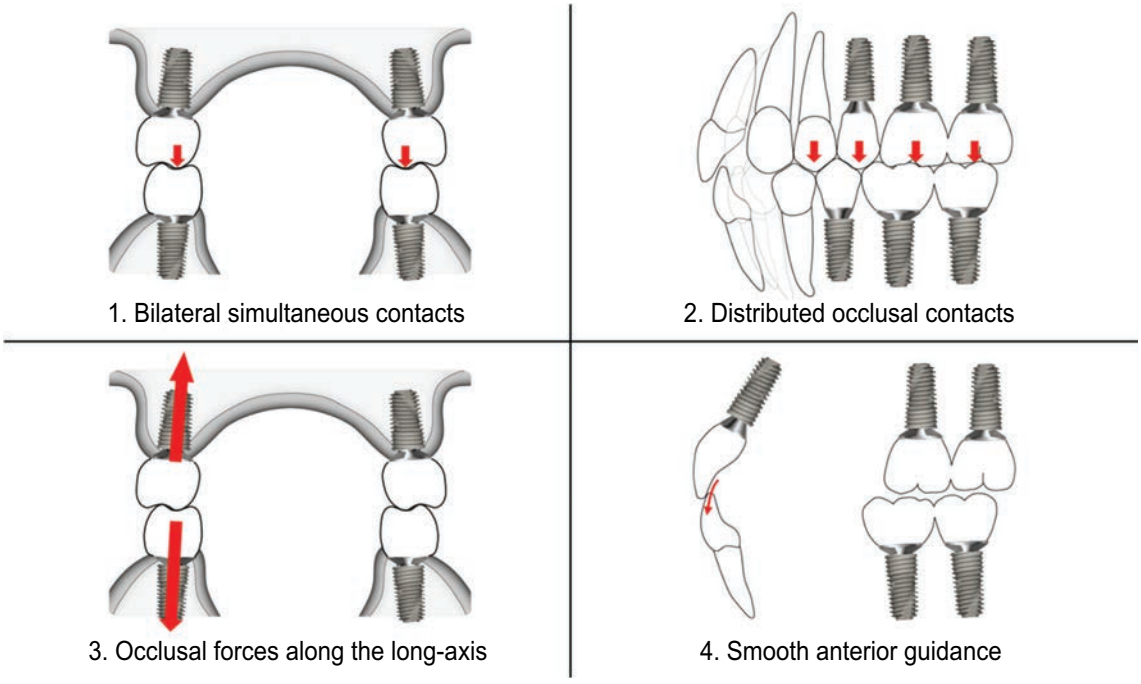


Fig. 4-130. 4 factors for occlusion in fixed implant restoration
1. Both posterior teeth should make contact simultaneously at maximal intercuspal position
2. Distribute occlusal force to each tooth evenly
3. Guide occlusal force to the implant long axis if possible.
4. Anterior guidance should separate posterior teeth with gentle and smooth course.

(3) Occlusal relationship of each tooth.

Above all, occusal surface of implant restoration must have a structure to prevent overload. It is safe to make round cusps, low cusp angles, flat occlusal tables, and wide fossae, thereby giving horizontal freedom to opposing teeth. These shapes guide the occlusal load axially and prevent interferences.**(Fig. 4-131)**

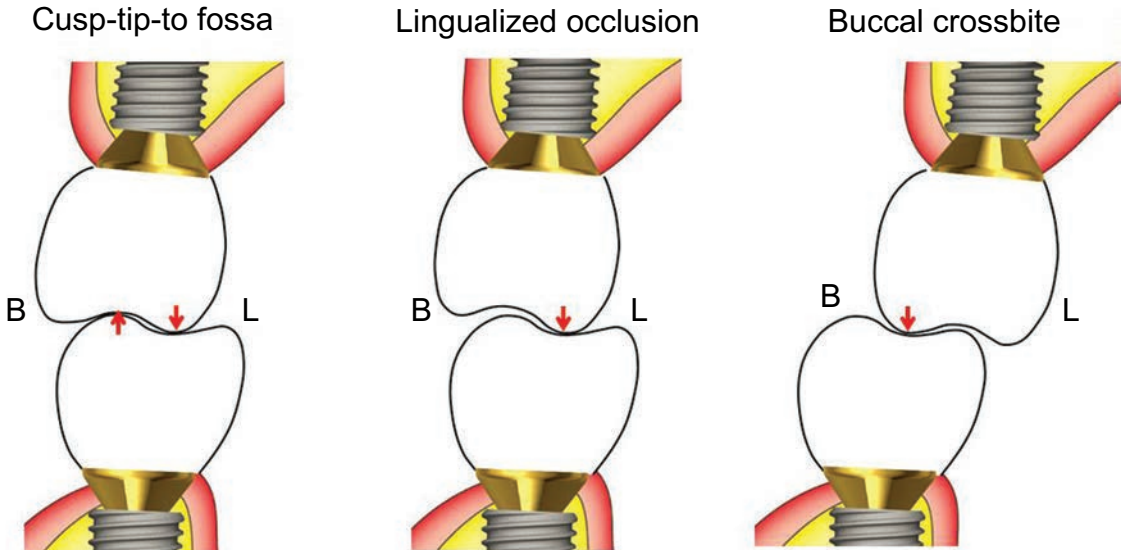


Fig. 4-131. Generally, cusp tip-to fossa relationship is favorable in implant supported fixed restoration and can form lingualized occlusion in maxillary posterior teeth.

In maxillary posterior region, because of buccal bone resorption, dentists may place implant at palatal position away from the center of tooth to replace. To restore buccal surface of maxillary prosthesis same as original shape of natural tooth, dental technician will position buccal cusp away from the center of implant, which is mechanically disadvantageous. Concept of lingualized occlusion can be a safe occlusion type to apply in this situation. The principle of lingualized occlusion in implant supported fixed restoration is basically same as that of full denture.**(Fig. 4-132)** It prevents working interference by occluding maxillary palatal cusp on the concave and wide mandibular fossa and forming maxillary buccal cusp low and flat. The only difference of lingualized occlusion in full denture is that it requires bilateral balanced occlusion while in implant requiring separation of non-working posterior teeth during anterior and lateral movement. We can apply shape of buccal cross bite instead of lingualized occlusion, but not only will it yield no advantages if it was not original natural tooth occlusion but also unpreferred by patients.

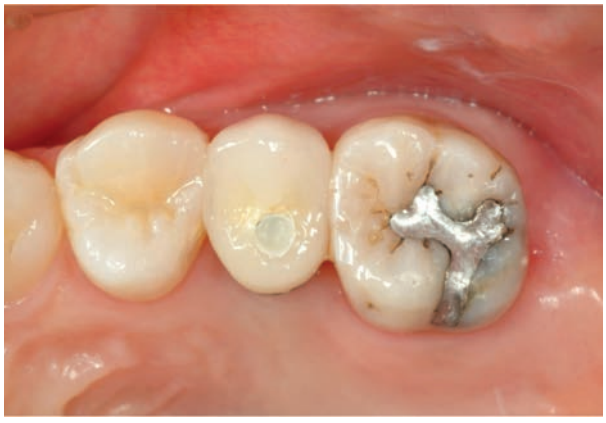


Fig. 4-132. This case requires lingualized occlusion. The implant in this premolar siteis placed too palatally. In this situation, mechanical problem such as screw loosening can easily occur when the slope of buccal cusp occlude to opposing tooth. So the occlusal contacts should be placed around the lingual cusp only.

(4) Is compensation of the PDL space necessary?

The vaguest problem in occlusion of natural tooth and adjacent implant restoration is how to control intensity of occlusal contact compared to adjacent teeth. Natural teeth can move vertically about several tens of micrometers on vertical occlusal load because of periodontal membrane, however, implant almost doesn't move vertically and can be overloaded. To prevent this, some clinicians recommend infra-occlusion of implant prosthesis than adjacent teeth. Such theory suggests that applying, about 30 micrometer space for discussion of implant restoration with opposing teeth in light occlusal load will elicit similar occusal intensity by sinking down tooth within the limit of periodontal ligament in heavy occlusal load.**(Fig. 4-133)**

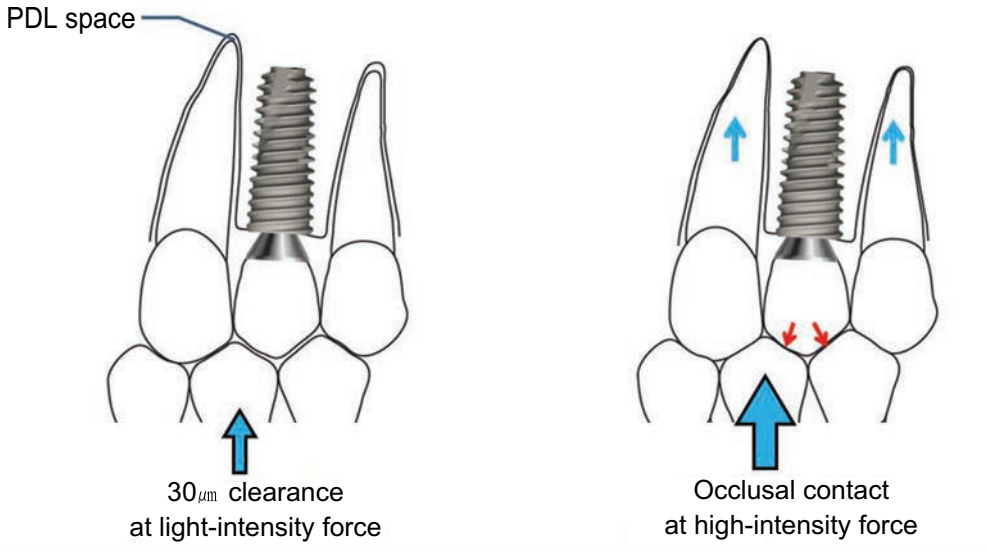


Fig. 4-133. The theory that the occlusal contacts of implant-supported restorations should be weaker than that of natural teeth at about 30 micrometer to compensate for thedifference of the vertical movement between implants and natural teeth.
On a heavy occlusal force, finally, occusal contact intensity will be similar to that of adjacent natural teeth.

However, it is difficult to control this movement for practical reason. The author remains skeptical about the clinical meaning of such infra-occlusion. Rather it looks more favorable to occlude with same intensity in implant and natural tooth prosthesis, and inhibit contact with opposing teeth during anterior or lateral guidance. The implants are vulnerable to lateral forces but very strong to bear axial forces. We can apply this concept especially in single molar implant.

(5) Control of crown size

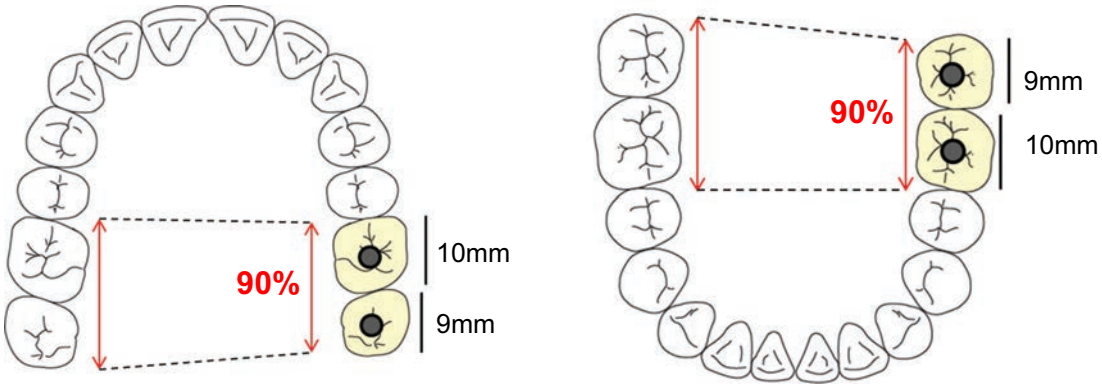


Fig. 4-134. It is adequate to make mesio-distal width of both molar prostheses in implant to be about 90% of that of natural teeth. Length of dental arch will be reduced about 2~3mm if we make first molar size to 10mm, and second molar to 9mm. Place implant at center of the restorative tooth that will be rehabilitated.

Bucco-lingual and mesio-distal size of both anterior and premolar in implant prosthesis should be the same as those of natural teeth to secure minimum distance of 2~3mm between implant as well as for esthetic purpose. On the contrary, it looks good to make mesio-distal width of molar prosthesis in posterior missing site, which includes last molar, to be about 90% of that of natural teeth. Interdental space tends to be too big unless medi-odistal width is slightly reduced because cervical diameter of implant prosthesis in molar is quite smaller than that of natural molar, and has a weak emergence profile. And, it is better to reduce occusal table of molar prosthesis because of risk of heavy bite force. Nevertheless, position of buccal surface in maxillary posterior region should be same as that of natural tooth to support buccal cheek and keep buccal overjet in relation to mandible.**(Fig. 4-134, 135)**

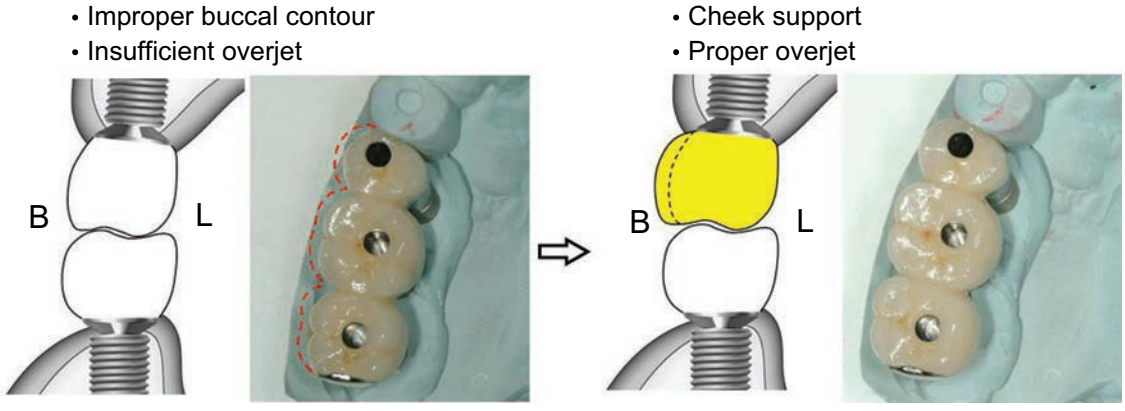


Fig. 4-135. Posterior prosthesis in left picture has too much reduced buccal surface which resuts in insufficient cheek support and keeps buccal overjet difficult. Porcealin was added on buccal surface until the red dotted line to mofify the prosthesis as in right picture.

We cannot reduce mesio-diatal width of implant prosthesis if natural teeth exist mesiodistally like the first molar missing site which is a tooth-bound space. In this case, to decrease overload, it is better to make bucco-lingual width of crown same or slightly smaller than that of natural tooth and reduce occlusal table width to 85~90% of natural teeth.**(Fig. 4-136)**

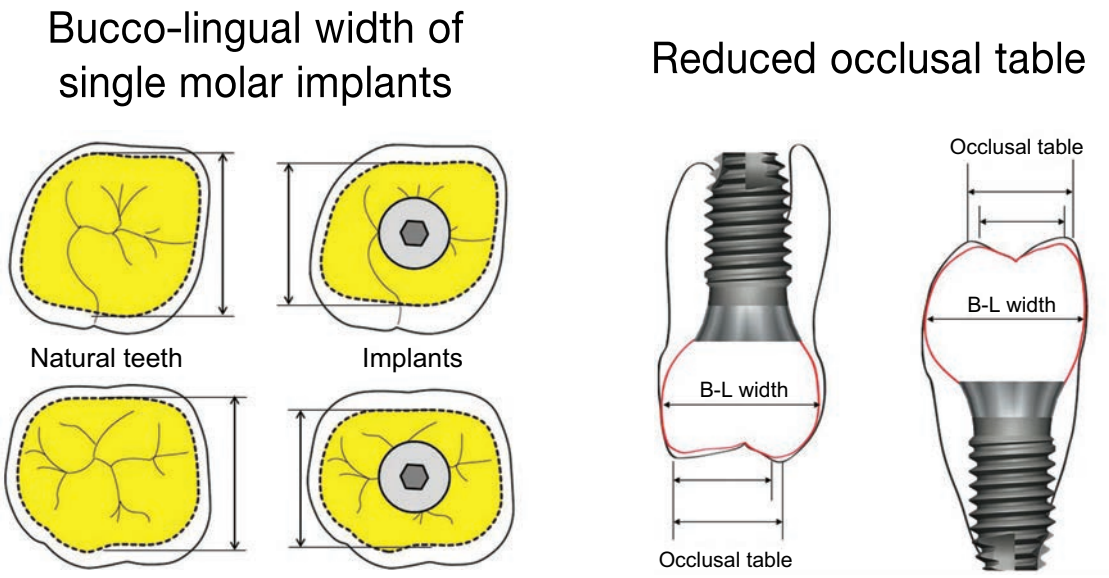


Fig. 4-136. A case of tooth-bound space (Kennedy Class III) in posterior region, especially in the first molar single implant, make bucco-lingual width of occlusal table 85~90% of natural tooth and decrease eccentric interference by reducing buccal cusp angle. At this moment, make maxillary buccal surface same as that of natural tooth.

Fatigue of dental implant material

In material engineering term, fatigue means a phenomenon of structural damage in a material which is exposed to cyclic loading. Repeated load, even when small, can results in micro cracks at defect site or where stress is concentrating, and if this crack reaches critical size, thefinal fracture will happen suddenly even at small force (catastrophic failure or spontaneous fracture).

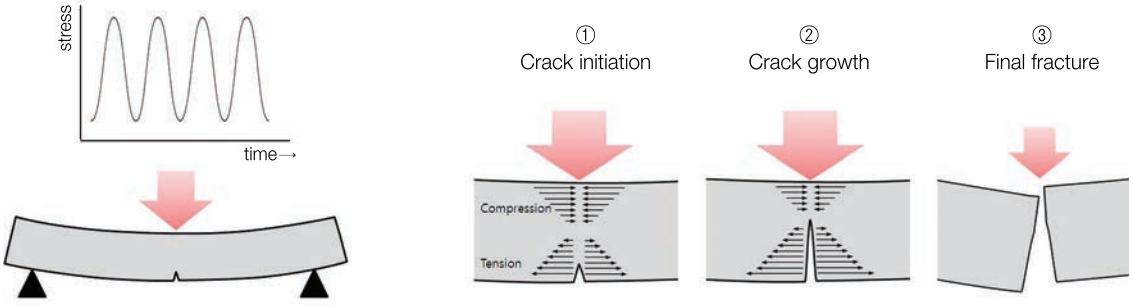


Fig. 4-137. Fatigue fracture progresses in three steps. A crack started at small defect site propagates by repeated load and elicits final fracture when it reaches a certain size.

We can see a unique structure named "fatigue striation" at cross section of material with fatigue fracture. It is known that etiology of big catastrophic accidents such as succeeding crash of de Havilland comet airplane in 1954, rollover of Norway oil prospecting ship in 1980, and crash of JAL 747 airplane in 1985, was fatigue fracture of main components.

We interpret many of implant components fracture and prosthesis failures to have come from fatigue. Average number of masticatory movement is 1 million per year, and cyclic load causes fatigue phenomenon of tooth and prosthesis. Accumulation of fatigue for a certain period can elicit final fracture. It is difficult to select satisfactory material for intraoral structure which is limited in size yet have increased strength and have conditions such as biocompatibility, corrosion resistance, and esthetics. To increase fatigue strength, use material with proper physical properties and design junction of the structure round not angled. Such are the responsibilities of the implant manufacturer. Practically, dentists can use qualified product with sufficient strength, distribute and prevent overload in prosthesis by forming adequate occlusion.

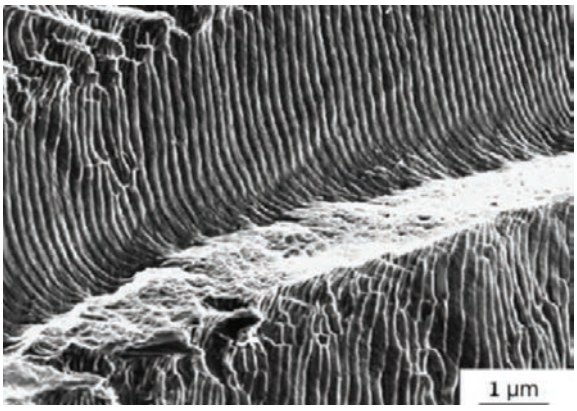


Fig. 4-138. Typical structure of fatigue striation in cross section of fatigue fracture. Every striation corresponds to each load repeated.

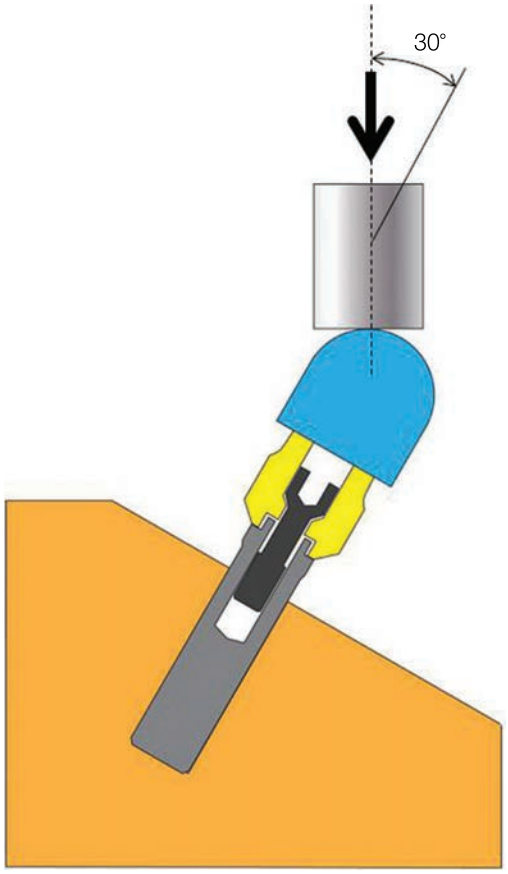


Fig. 4-139. Fatigue test for endosseous dental implants. International Organization for Standardization regulate fatigue test of implant at ISO 14801. It measures numbers of cyclic load and force which elicit fracture in implant which has been placed with 30 degree angulation. In fact, this test is a minimal requirement because intra oral condition is usually poorer.

5)Detailed occlusion patterns depending on number and positions of teeth to rehabilitate

(1) Occlusion of single molar implant restoration

Molar area receives heavy bite force, and occlusal interferences frequently occur excessively. Especially, in single molar implant restoration case, cyclic occlusal load tends to cause screw loosening, screw fracture, and fixture fracture more frequently. Hence molar region requires protective occlusion to avoid occlusal risk factors. **(Fig. 4-140, 141)**

Occlusion of single molar implant		
Maximal intercuspal position	Lateral movement	Protrusive movement
• Occlusal contact the opposing teeth with same intensity to that of adjacent teeth	• No contact • Disclusion by anterior teeth/premolars	• No contact • Disclusion by by anterior teeth

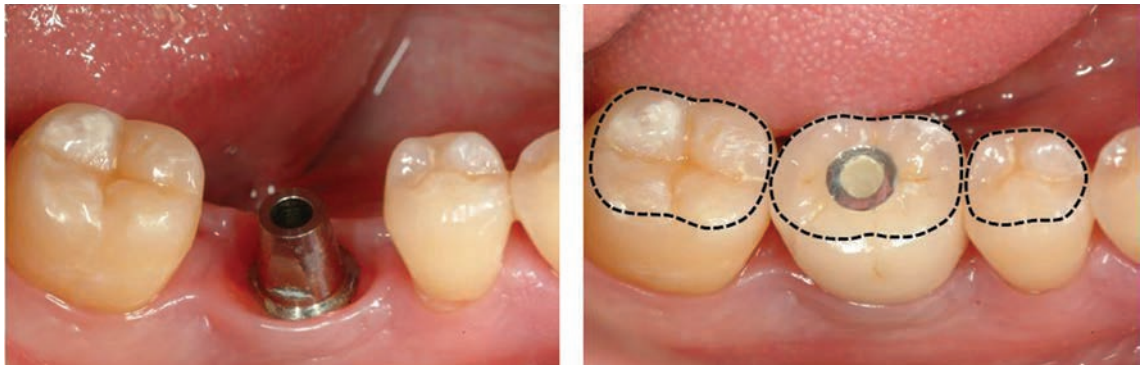
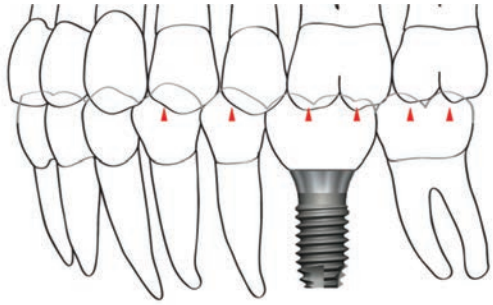


Fig. 4-140. Mandibular first molar implant crown. To avoid contact with opposing teeth, the cusp angles are reduced the occlusal table is flat. Tidth of occlusal table was reduced to 90 % of a natural tooth.



Maximal Intercuspation	• Occlusal contact similar to natural teeth
Lateral movement	• no contact(flat occlusal surface) • disclusion by natural teeth
Protrusive movement	• no contact(flat occlusal surface) • disclusion by natural teeth

Fig. 4-141. In maximal intercuspal position, the first molar should contact the opposing teeth with the same intensity to those of adjacent teeth and be discluded during the lateral and protrusive movement.

Single molar implant restoration should contact the opposing teeth with same intensity to those of adjacent teeth in maximal intercuspal position, and be opened during the other position. **Fig. 4-142** is a case of abutment fracture in mandibular first molar. We can see several risk factors such as lingually placed implant, high cusp, and regular diameter implant. Other possible factors are insufficient screw tightening or parafunctional habit of this patient.

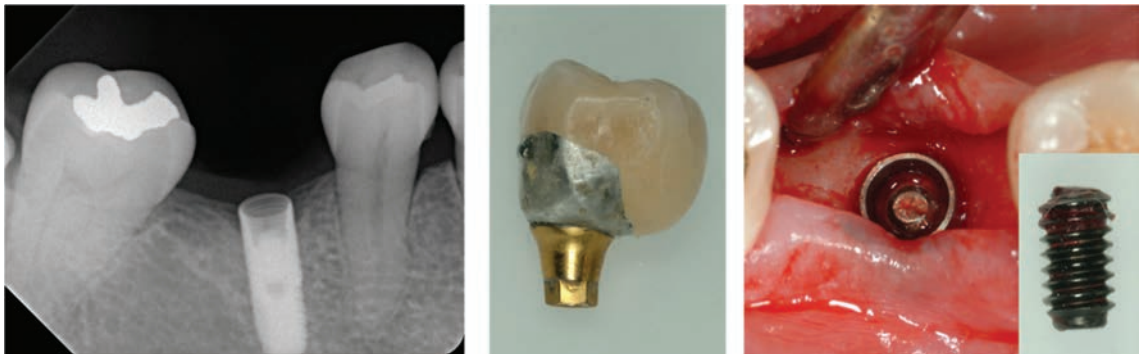


Fig. 4-142. The abutment screw is fracture in an implant placed 1 year ago. The patient was referred to the author. The screw was removed after flap reflection because the access was difficult due to the hyperplastic soft tissue. Lingual position of implant and shape of occlusal table shows high-risk factors of occlusion.

(2) Occlusion of anterior single implant restoration

It is mechanically disadvantageous to maxillary anterior teeth, which mostly receive lateral force in occlusal relation to mandible. Labial alveolar bone of maxillary anterior teeth is very thin and easily resorbed when it receives overload, resulting in gingival recession. Moreover, lateral force can be a major cause of screw loosening or fracture of components. Hence, in maxillary single implant restoration, it is safe not to make contact with opposing teeth neither in maximal intercuspal position, in protrusive movement, nor in lateral movement.**(Fig. 4-140, 141)**

Maximal intercuspal position (MI)	• no contact
Lateral movement	• no contact - lateral guidance by adjacent teeth
Protrusive movement	• no contact - anterior guidance by adjacent teeth

It is mechanically disadvantageous to maxillary anterior teeth, which mostly receive lateral force in occlusal relation to mandible. Labial alveolar bone of maxillary anterior teeth is very thin and easily resorbed when it receives overload, resulting in gingival recession. Moreover, lateral force can be a major cause of screw loosening or fracture of components. Hence, in maxillary single implant restoration, it is safe not to make contact with opposing teeth neither in maximal intercuspal position, in protrusive movement, nor in lateral movement. **(Fig. 4-143, 144)**

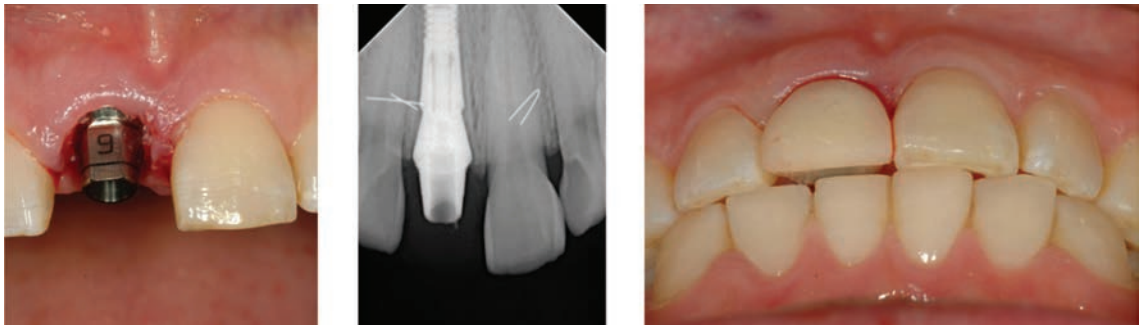


Fig. 4-143. Sufficient overjet is given in maxillary anterior tooth.
More freedom was given in this immediately placed and immediately restored implant with an immediate temporary crown.

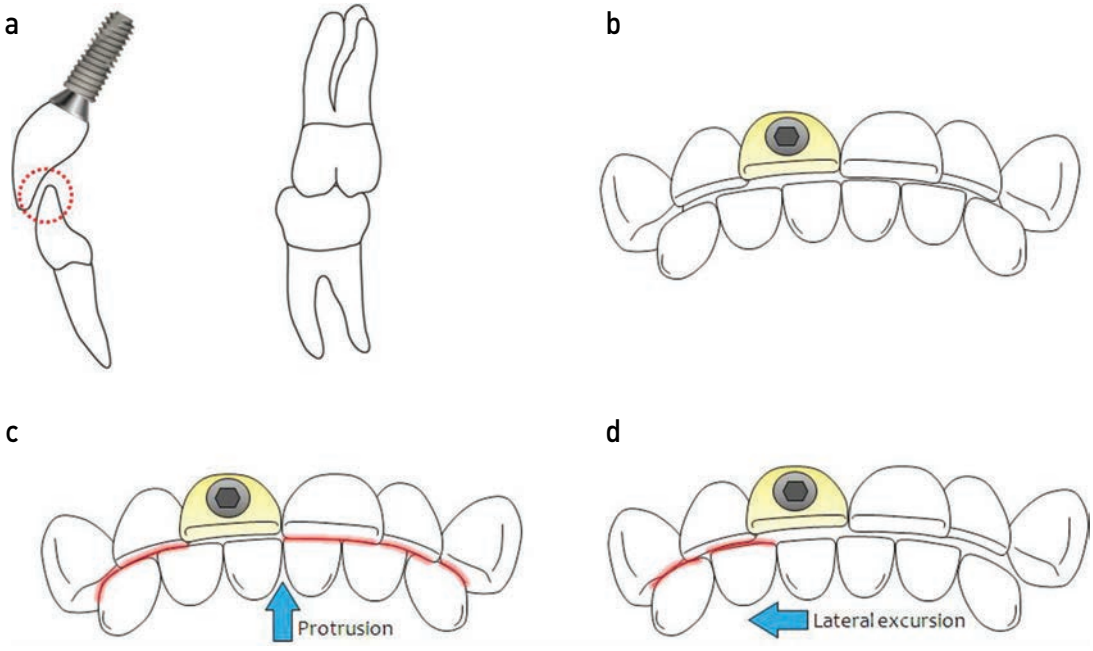


Fig. 4-144. Occlusal relationship in single maxiallry anterior implant. a, b. Give sufficient freedom horizontally in maximal intercuspal position. It requires strong vertical support in posterior region. c, d. during mandibular movement, anterior and lateral guidance should work at adjacent teeth, and implant crown shouldn't contact opposing teeth.

There is no trouble in avoiding contact with opposing teeth if natural teeth are periodontally healthy and have no mobility. However, it requires more freedom if natural teeth are mobile. A case which cannot satisfy such requirement is contraindication for single maxillary anterior implant. For example, implant is in risk of overload in following situations: When patient cannot maintain vertical occlusal clearance stably because of loss of posterior teeth or mobility in periodontally affected molars, when natural teeth cannot be involve in anterior and lateral guidance because of severe mobility.**(Fig. 4-145~148)**

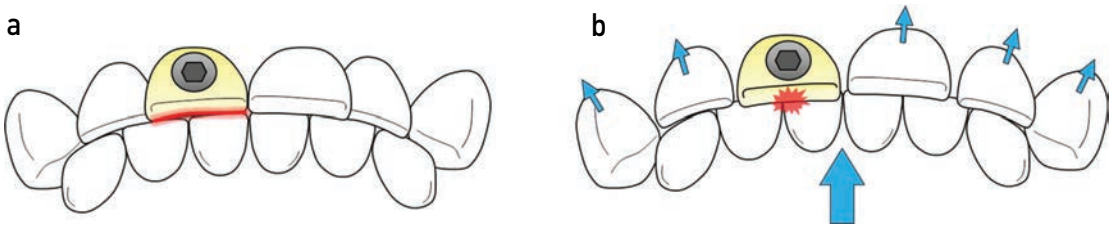


Fig. 4-145. a. Single maxillary anterior implant without sufficient freedom at lingual side is exposed to the risk of continuous lateral force. b. Implant will receive overload if posterior support is not strong or if adjacent natural teeth are mobile.

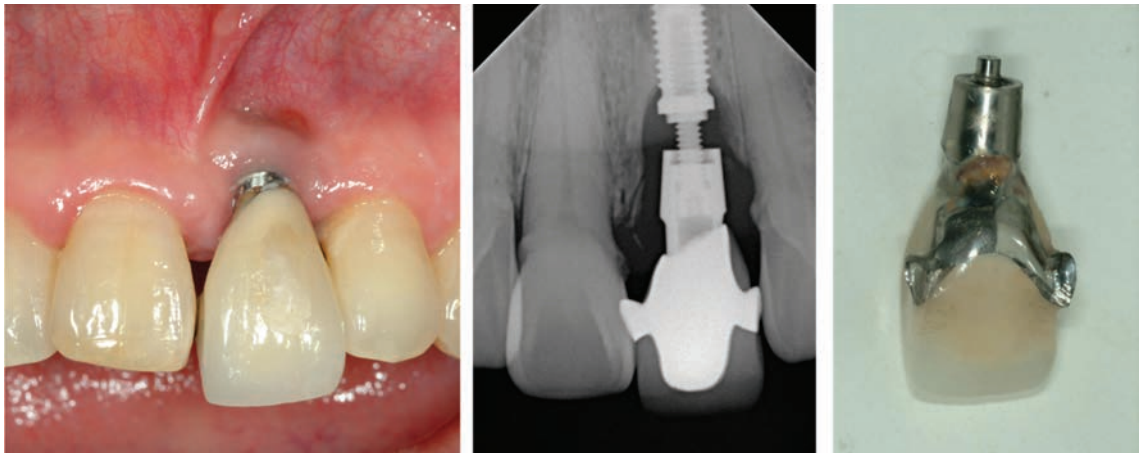


Fig. 4-146. Referred case which reveals screw loosening in single central incisor implant crown. Occulsal rests for anti-rotation positioned at both sides are ineffective.

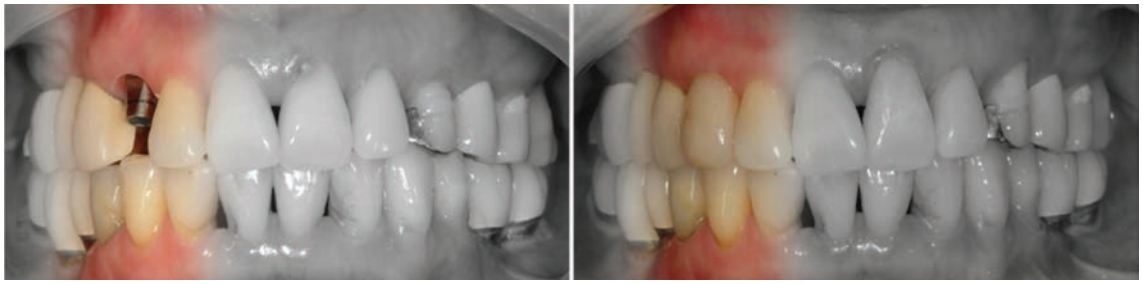


Fig. 4-147. In a canine missing case, neither conventional prosthetic procedure nor implant restoration procedure is easy. The canine of this patient was extracted and restored with an implant-supported crown. Canine is out of occlusal load, and adjacent lateral incisor and premolar are involve in lateral guidance. Although it is unsatisfactory that Canine is not involved in lateral guidance, there is no alternative options to prevent overload.

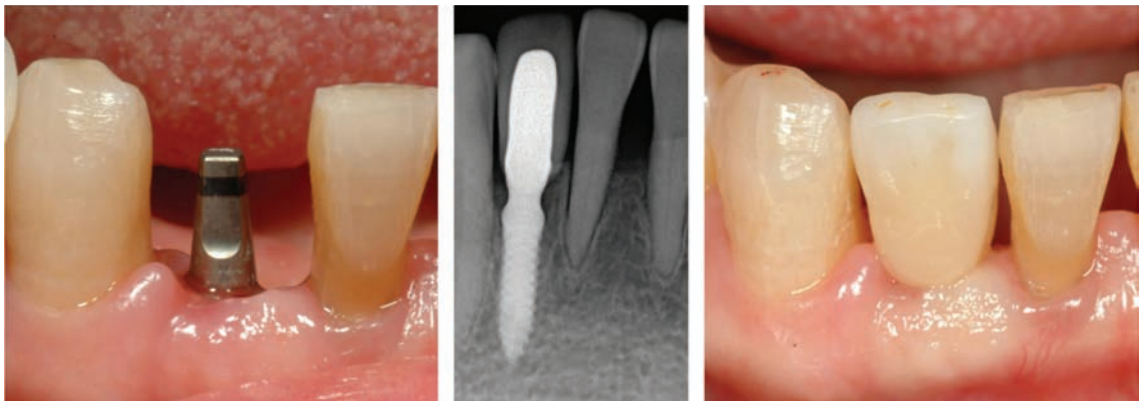


Fig. 4-148. Although direction of occlusal load is less unfavorable than maxillary anterior teeth, mandibular anterior teeth is not easy to involve in occusion. Mobility of adjacent teeth will amplify the risk.

Occlusion of posterior multiple implant restoration (Kennedy Class I, II, III)

Maximal Intercuspation	• Even bilateral contact of posterior teeth • Definite vertical support
Lateral movement	• Eccentric guide by natural teeth - canine guidance or group function • Eccentric guide by implants - group function by splinted implants
Protrusive movement	• no contact - disclusion by natural teeth

Fig. 4-149. Kennedy classification used in partial denture restoration can be applied to implant prosthesis. Examples of Kennedy Class I, II, III from left side.

One of the most important functions in posterior multiple implant restoration is rehabilitation of original function of posterior teeth, a.k.a. vertical stop. As in mutually protected occlusion, implant restoration should contact opposing teeth to let posterior teeth protect anterior teeth at maximal intercuspal position. Intentional infra-occlusion to avoid overloading in posterior implant, or failure of fabrication of firm vertical stop because of errors in clinical and laboratory procedure, results in loss of main function of posterior region.**(Fig. 4-149~151)**

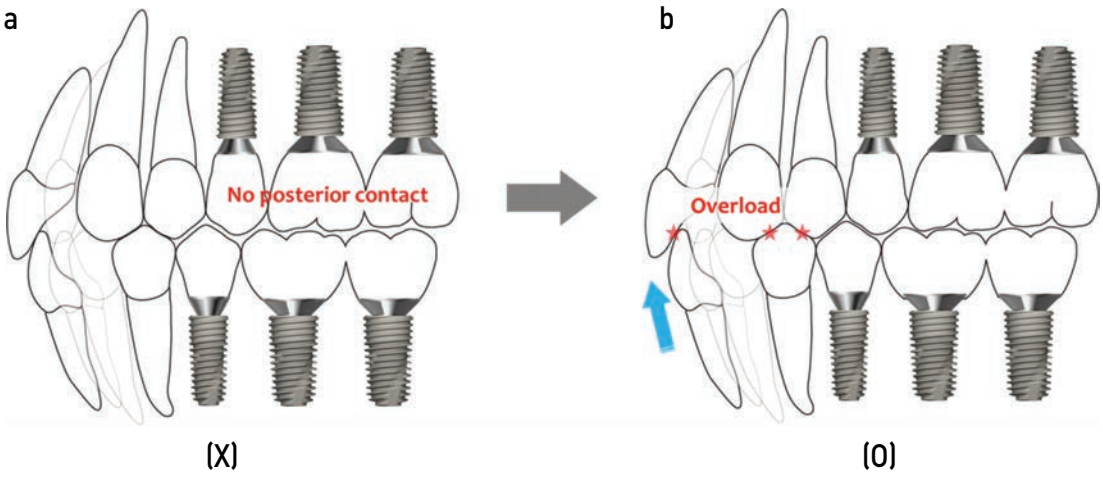


Fig. 4-150. Intentional infra-occlusion to avoid overloading in posterior multiple implant restoration may elicit overloading in anterior teeth. In this situation, implant is not to be protected by but to protect natural teeth.

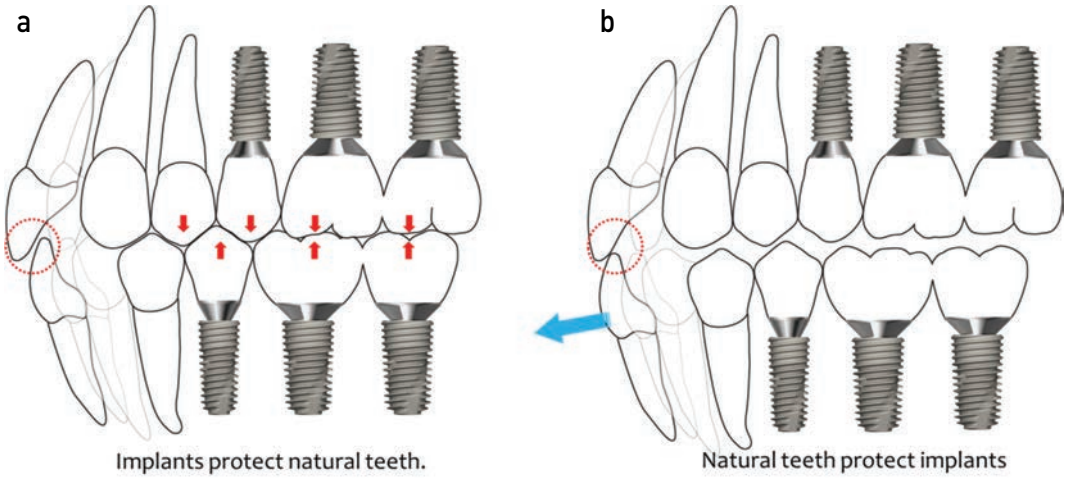


Fig. 4-151. Illusttations of mutually protected occlusion of posterior multiple implant restorations. a. posterior implants should be actively involved in occlusion and keep vertical support at maximal intercuspal position. Anterior teeth will be exposed to risk of overloading during mastication if there is no definite vertical stop in posterior region. b. Posterior region should be discluded by anterior guidance of anterior region during protrusive movement.

Clinicians can consider two kinds of lateral guidance in cases of posterior multiple implant restoration. First, in a case with sound canine and premolar, canine guidance of natural teeth or group function will disclude the posterior teeth. Second, implant-supported restoration can help the guide group function when natural teeth are not sound or premolar, even replacing a canine with implant restoration.**(Fig. 4-152, 153)**

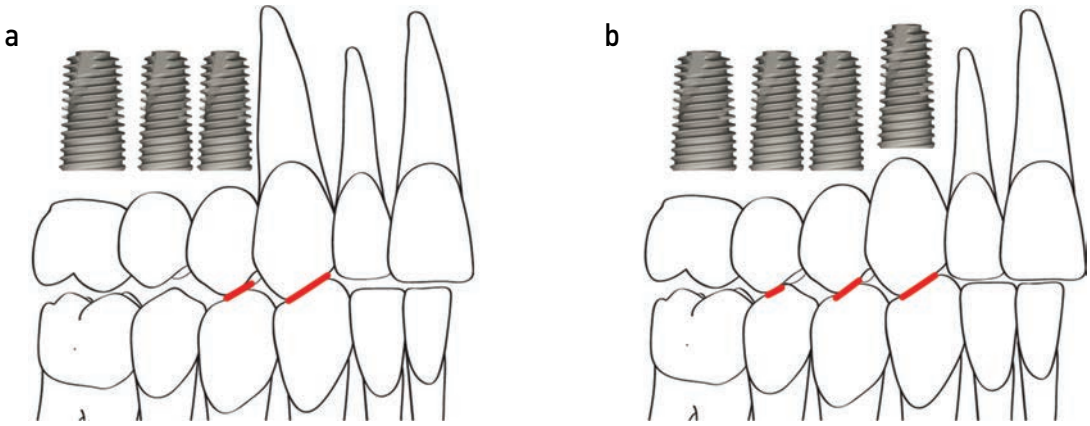


Fig. 4-152. a. In sound canine case, during lateral movement, use canine guidance and group function by splinted premolar in implant restoration can assist. b. If canine is weak or restored with implant, use lateral guidance assisted by group function in canine and premolar.

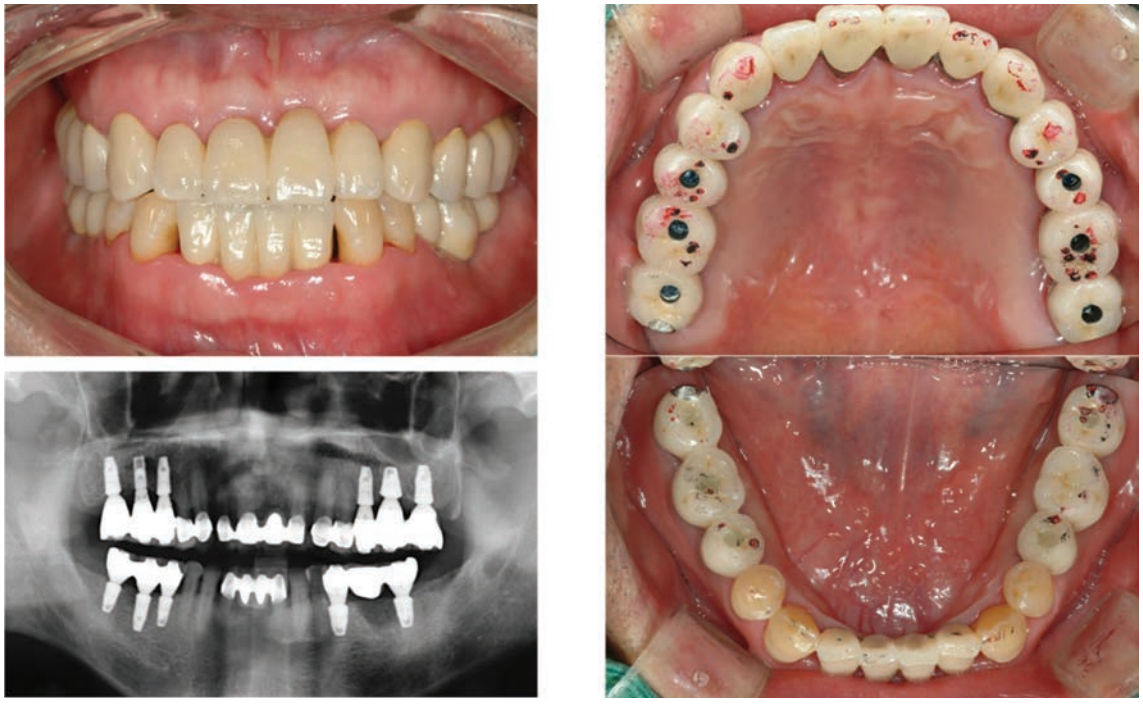


Fig. 4-153. Implant-supported restorations in maxillary and mandibular partial edentulous case (Kennedy Classification I). In maximal intercuspal position, occusal contacts are expressed with black occusal paper in maxilla. Natural teeth are in charge of lateral and anterior guidance and are expressed with red occlusal paper. It is similar to class III malocclusion and 2nd molar does not occlude with mandible

(4)Occlusion of anterior multiple implant restoration (Kennedy Class IV)

Anterior multiple implant restoration is classified into three depending on the number of missing teeth. First. In case of missing limited 2~3 teeth, adjacent natural teeth can perform anterior and lateral guidance, and if necessary, implant restoration can assist slightly.
Second, in case of restoration which involves canines, we cannot avoid eccentric contact of implant prosthesis. In this situation, splint all implant prosthesis rigidly and make slope of anterior and lateral guidance gradually to form shallow guide. Third, in missing case including premolars, implant should be in charge of all the functions of existing natural teeth. If number of implant is sufficient, it is possible to make the prosthesis with segment type, but if insufficient, it is safe to make cross-arch splinting. Just as in second type, anterior and lateral guide should be shallow.(Fig. 4-154)

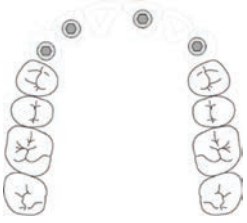
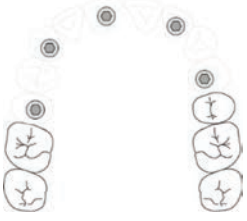
Range of anterior restoration	Mandibular position	Pattern of occlusion
incisor 2~3units 	Maximal intercuspal position (MI)	No contact
	Lateral movement	No contact
	Protrusive movement	No contact or weak guide
Including canines 5~6units 	Maximal intercuspal position (MI)	No contact
	Lateral movement	Group function of implant restoration and natural teeth
	Protrusive movement	Anterior guidance by implant restoration
Including premolars 8~10 unit 	Maximal intercuspal position (MI)	Vertical support at premolar
	Lateral movement	Group function by implant restoration
	Protrusive movement	Anterior guidance by implant restoration

Fig. 4-154. Depending on missing range, Kennedy Class IV is classified as missing limited less than 4 teeth, until canine involved, and until premolar involved type. Existence of canine influences total treatment plan.

(5) Occlusion of fully edentulous implant restoration

Occlusion of implant supported fixed restoration in fully edentulous patient without teeth cannot be expected to exhibit proprioception from periodontal membrane and feedback control of masticatory force. In such situation, it seems that the mechanism of osseoperception controls mandibular position and masticatory muscle force. And risk of overloading seems bigger than that of natural dentition. Hence, occlusion of implant supported fixed restoration in fully edentulous patient should focus on prevention of risk factors. In maximal intercuspal position, even occlusal contact of right and left posterior region is needed, and occlusal table should secure horizontal freedom through wide fossae and low cusp angles. Provide sufficient horizontal overjet at anterior region to avoid contacts at maximal intercuspal position. Make group function with many participating implants to avoid concentration of load at one point during the lateral movement. Distribute the load to many implants and gradually make shallow the anterior guidance during protrusive movement. This type of occlusion looks very similar to the occlusion of a conventional complete denture except that implant supported fixed restorations should not have bilateral balanced occlusion.**(Fig. 4-155~157)**

Occlusion of implant-supported fixed full arch restoration

= complete denture occlusion - bilateral balanced occlusion

Maximal Intercuspation	• Even contact of posterior teeth • No contact of anterior teeth • Horizontal freedom
Lateral movement	• Group function • No non-working contact
Protrusive movement	• Shallow anterior guidance

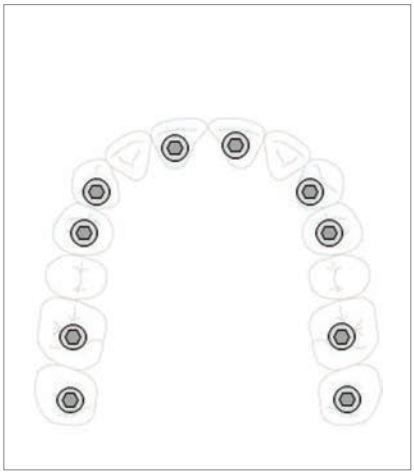


Fig. 4-155. Occlusion of implant supported fixed restoration in fully edentulous patient is very similar to that of complete denture. In maximal intercuspal position, posterior region contacts while anterior region does not.
The occlusal table has wide fossae and low cusp angles to secure horizontal freedom. Avoid contacts of the anterior teeth by allowing sufficient overjet in maximal intercuspal position. Make group function with as many participating implants to avoid the concentration of the load at a specific implant during the lateral movement.
Distribute the load to many implants and gradually make shallow the anterior guidance during protrusive movement.

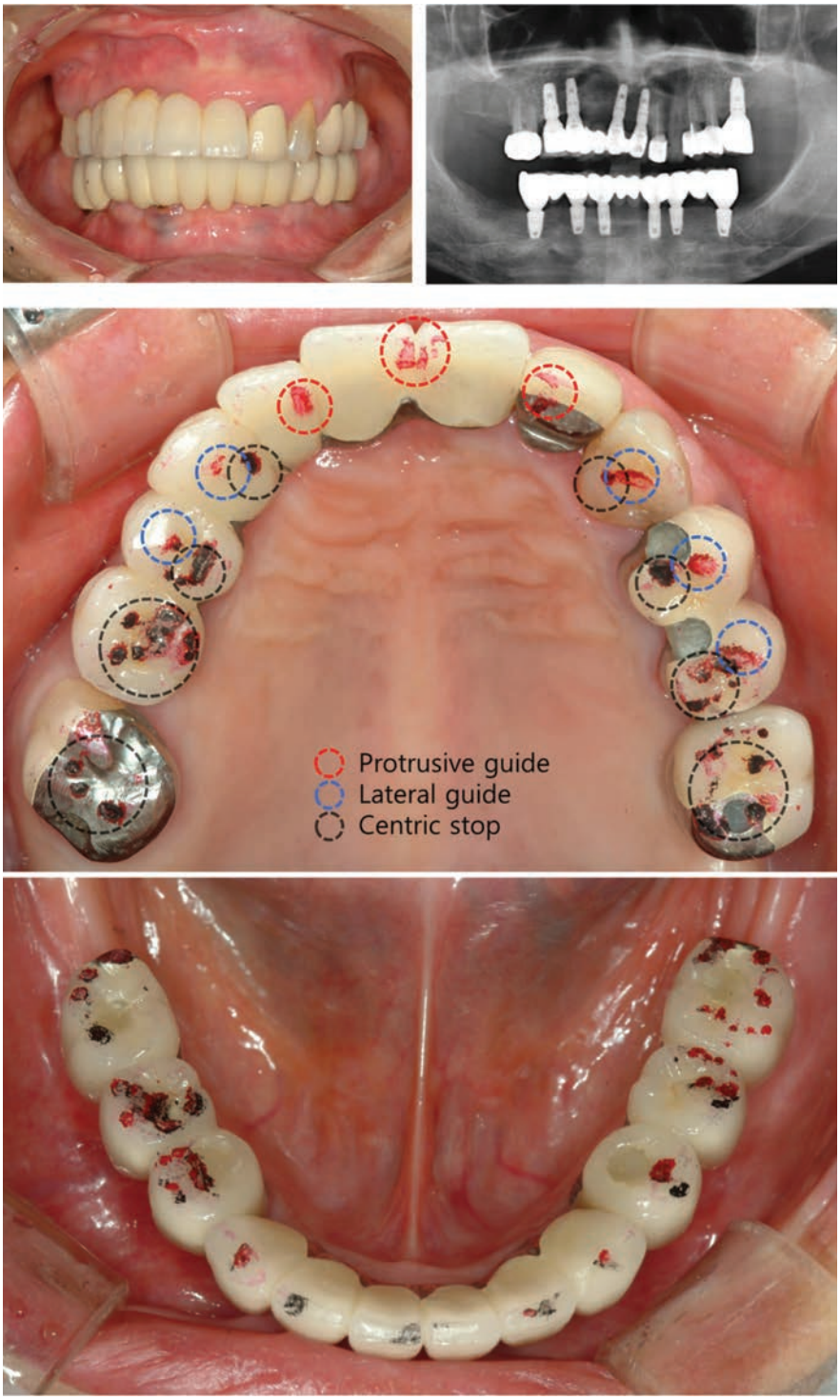


Fig. 4-156. Occlusion of mandibular complete edentulous restoration. Making points on maxillary premolar and molar with black occusal paper is occlussal contacts in maximal intercuspal position. Anterior guidance is expressed on central & lateral incisor with red occlusal paper. Making points on canine and premolar with red occusal paper shows group function during lateral movement.

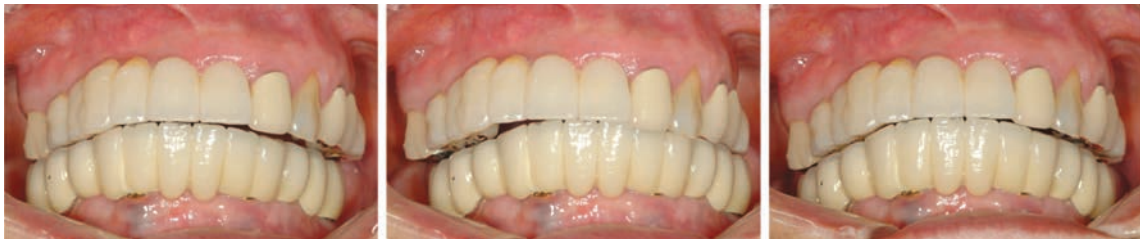


Fig. 4-157. we can see eccentric contact patterns of the previous case. Contralateral teeth are discluded during the right lateral excursion(a),and the left lateral excursion(b). Posterior teeth are discluded by the anterior teeth during the protrusive movement.

6) Summary

Principle of occlusion in implant restoration can summarized that it is succession of natural teeth occlusion adding protective concept.

1) In maximal intercuspal position, distribute occlusal load to the bilateral posterior teeth to make simultaneous contacts.
2) Guide the occlusal load to the long axis of the implants
3) Freedom in centric
   - low cusp angle
   - wide fossae
   - narrow occlusal tables
4) Group function guidance

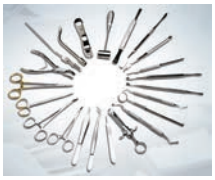
Exclusive theories and evidences for occlusion of implant-supported restoration is not established yet. However, we hope to arrange the ideas and suggest more definite guidelines in the near future.

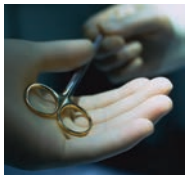
References

1. Kim Y, Oh T-J, Misch CE, Wang H-L. Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale. Clin Oral Implants Res 2005 ;16:26–35.
2. Rilo B, da Silva JL, Mora MJ, Santana U. Guidelines for occlusion strategy in implant-borne prostheses. A review. Int Dent J. 2008 Jun ; 58:139-45..
3. Gross MD. Occlusion in implant dentistry. A review of the literature of prosthetic determinants and current concepts. Aust Dent J. 2008 Jun ; 53 Suppl 1:S60-8.
4. Sadowsky SJ. The role of complete denture principles in implant prosthodontics. J Calif Dent Assoc 2003 ;31:905-9.
5. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications in fixed prosthodontics. J Prosthet Dent 2003 ;90:31-41
6. Isidor F. Histological evaluation of peri-implant bone at implants subjected to oclusal overload or plaque. Clin Oral Implants Res 1997 ; 8: 1-9.
7. Isidor F. Influence of forces on peri-implant bone. Clin Oral Implants Res 2006;17(Suppl 2):8–18. International Dental Journal (2008) 58, 139-145
8. Ogiso M, Tabata T, Kuo P, Borgese D. A histologic comparison of the functional loading capacity of an occluded dense apatite implant and the natural dentition. J Prosthet Dent 1994 ;71:581-8.
9. Heitz-Mayfield LJ, Schmid B, Weigel C, Gerber S, Bosshardt DD, Jonsson J, et al. Does excessive occlusal load affect osseointegration? An experimental study in the dog. Clin Oral Implants Res 2004 ;15:259-68.
10. Rilo B, da Silva JL, Mora MJ, Santana U. Guidelines for occlusion strategy in implant-borne prostheses. A review. Int Dent J. 2008 Jun ; 58:139-45.
11. Gross MD. Occlusion in implant dentistry. A review of the literature of prosthetic determinants and current concepts. Aust Dent J. 2008 Jun ; 53 Suppl 1:S60-8.
12. Sadowsky SJ. The role of complete denture principles in implant prosthodontics. J Calif Dent Assoc 2003 ;31:905-9.
13. Kim Y, Oh T-J, Misch CE, Wang H-L. Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale. Clin Oral Implants Res 2005 ;16:26–35.
14. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications in fixed prosthodontics. J Prosthet Dent 2003 ; 90:31-41
15. Theoharidou A, Petridis HP, Tzannas K, Garefis P. Abutment screw loosening in single-implant restorations: a systematic review. Int J Oral Maxillofac Implants. 2008 ; 23:681-90.
16. Smith GC, Pell JP. Parachute use to prevent death and major trauma related to gravitational challenge: systematic review of randomised controlled trials. BMJ. 2003 ; 327:1459-61.

2013

Osstem Implant System





V Surgical preparation and instrument management for implant

- By Dr. Oh, Young-Hak

OSSTEM IMPLANT

1. Preoperative preparation

For patients who need implants, significantly reducing the number of intraoral bacteria is necessary to diminish the potential for bacterial contamination or infection. **(Fig. 5-1, 2)**

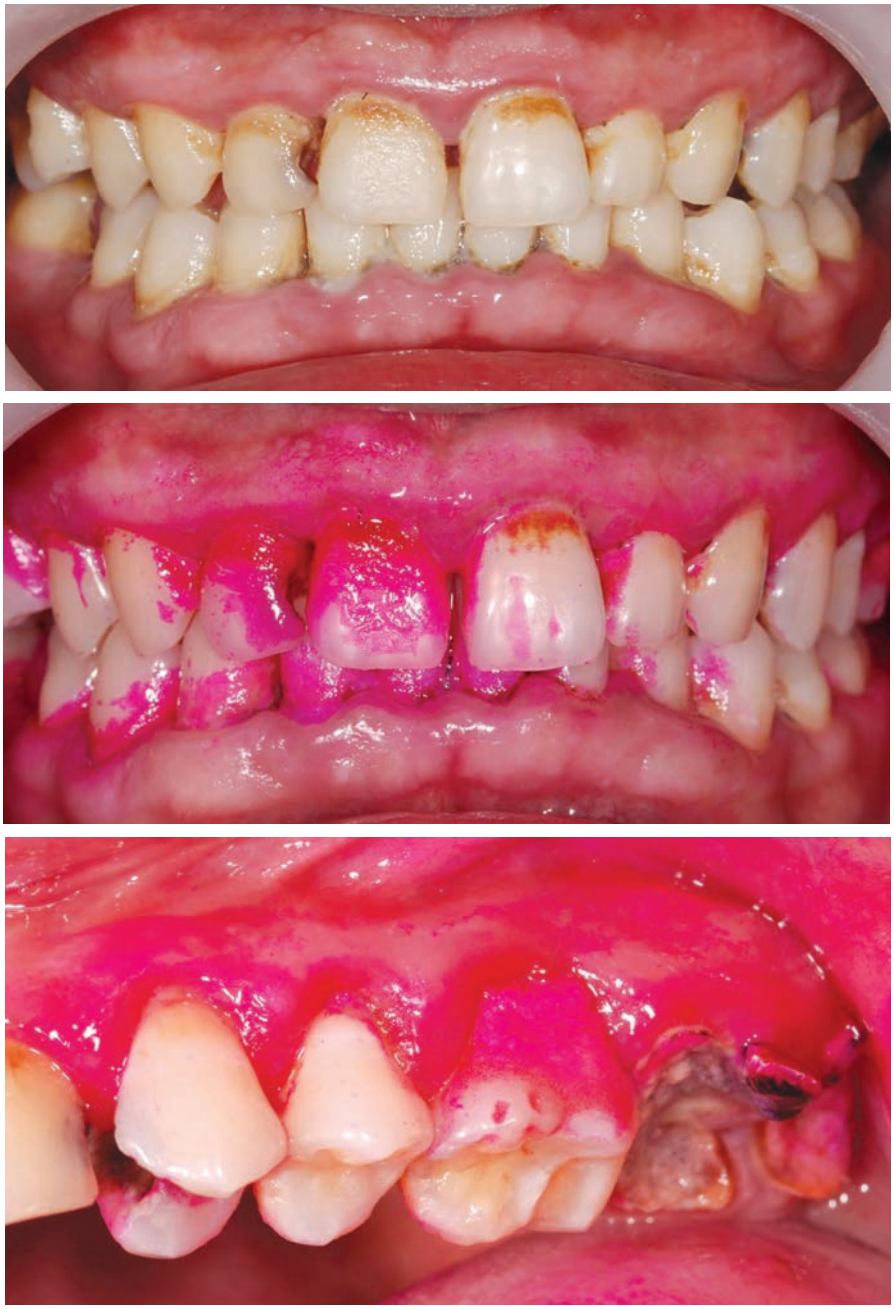


Fig. 5-1. The patient needs implant placement in missing right mandibular first molar. Intraoral plaque accumulation is severe, and periodontal diseases as well as decayed tooth exist. Meticulous plaque control, scaling, gum care, and decayed tooth treatment before surgery should significantly decrease the number of intraoral bacteria.

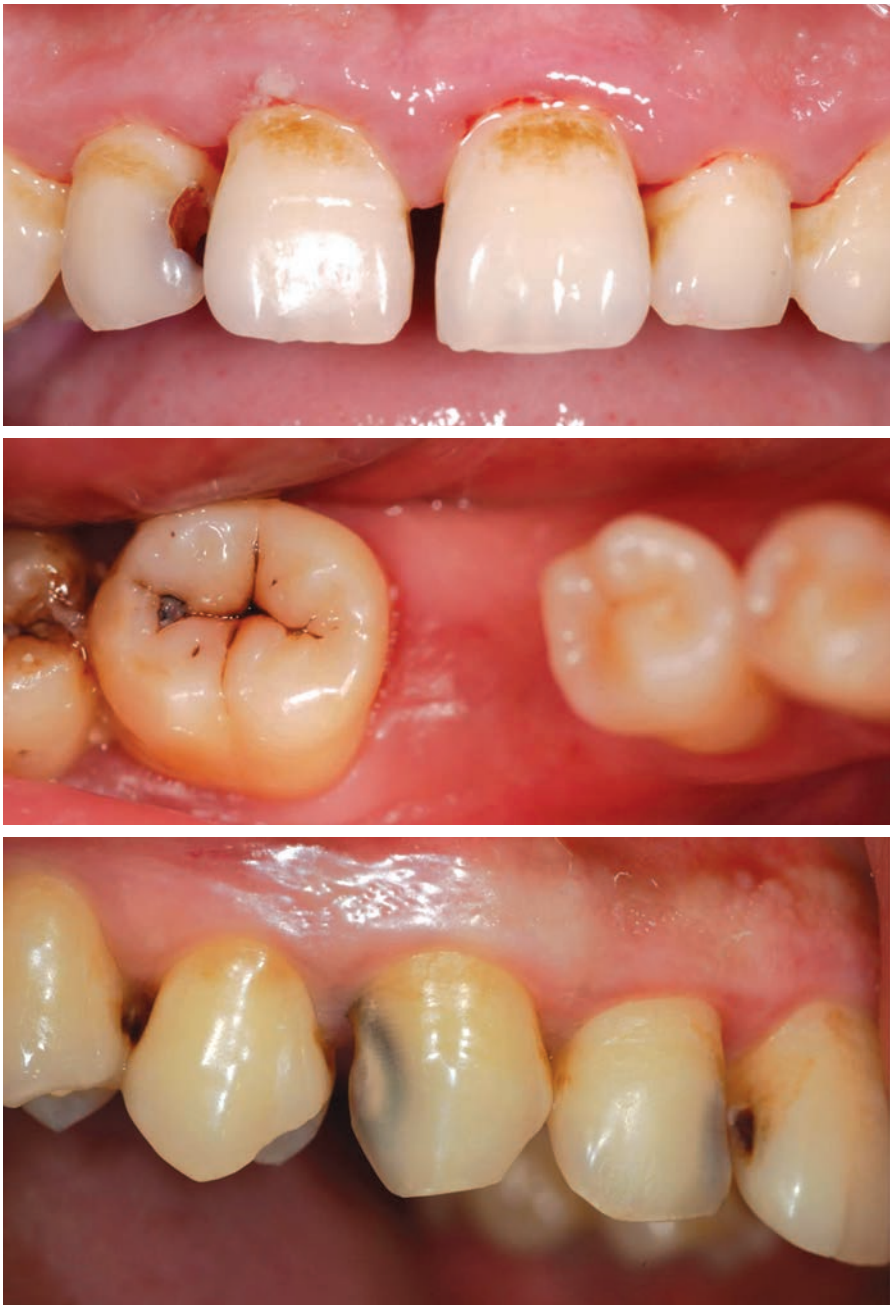


Fig. 5-2. Intraoral photo after scaling, oral hygiene instruction and plaque control suggests noticeable decrease in bacteria.

Thorough plaque control instruction is desirable to decrease intraoral bacteria pre-operation. Depending on conditions of the patient's gingival, calculus removal, root planning, and even gingival surgery may be necessary. Beforehand treatment of decayed tooth is also advised. Preoperative removal of periodontal disease and operative treatment can significantly decrease the number of intraoral bacteria, and thus minimizes wound contamination. By calling or texting, notify the patient of surgery plans a day ahead. Emphasize preoperative medication and promote use of gargle solution. Smokers need to stop smoking for at least a week before operation. Instruct to discourage make-ups and shaving. On surgery day, the operation chair needs to be sanitized using chemical disinfectant, or covered with disposable cover. When the patient arrives, send him/her to the bathroom, brush teeth for approximately 5 minutes, and intraoral sterilize using gargle solutions as Listerine. Anesthetize sufficiently, and locate the patient so that the operator and the patient may operate more efficiently and comfortably. Sterilize around the patient's mouth, setup the lights, and cover around the patient's mouth and the tools table with sterilized surgical cloth. **(Fig. 5-3)**

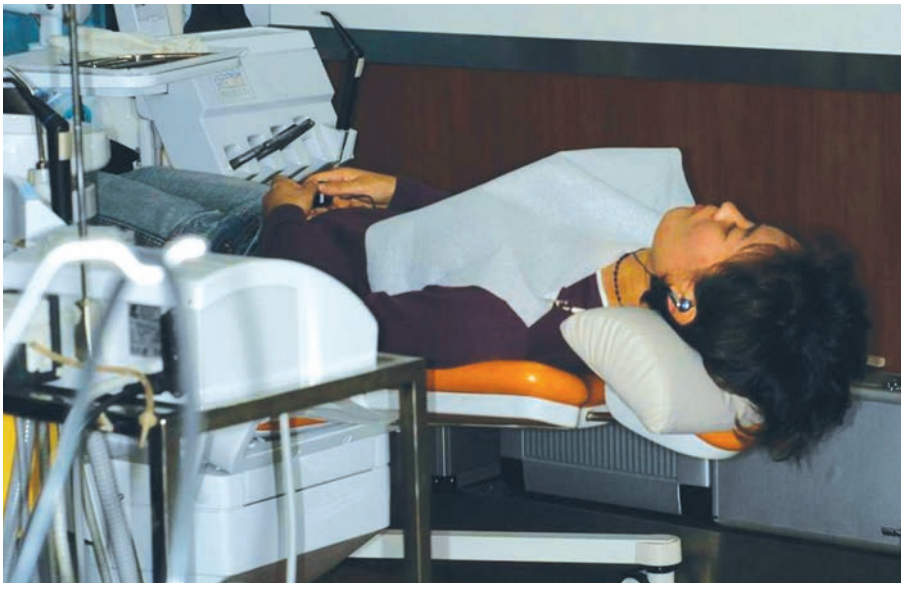


Fig. 5-3. Locate the patient so that the operator and the patient may operate more efficiently and comfortably

Surgical personnel must primarily wear clean hat, mask, and face shield. Hands should be sanitized using antiseptic solution, and then dried with sterile towel. Wear sterile operating gown with the help of 2nd assistant. The front is the aseptic area, and above neck and back is the clean area. These two areas need to be strictly differentiated, and hands with sterile gloves should only make contact in the aseptic area, never going to & fro both areas.

First, 1st assistant wears sterile gloves using the aseptic technique, and then covers patient and surroundings using sterile surgical cloth. Place tools and machines for convenient access, and help operator wear sterile gloves in the aseptic area. The operator wears hat and mask, wash hands using antiseptic solution, and dry with sterile towel. Then the operator may wear sterile gloves with help from 1st assistant. **(Fig. 5-4)**

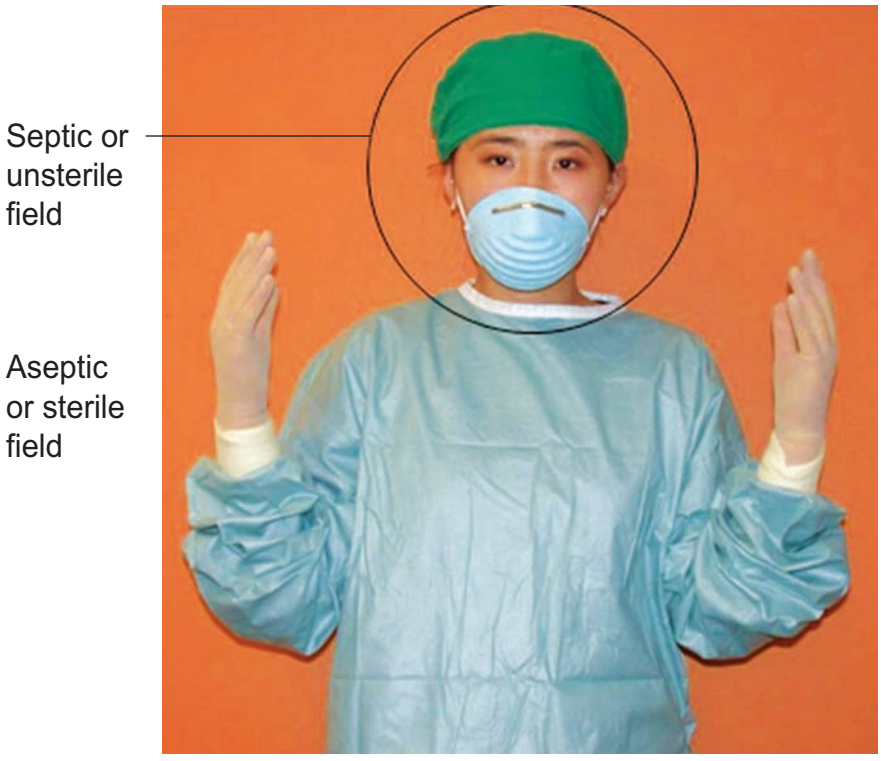


Fig. 5-4. Operator prepared for surgery needs to distinguish, before contacting, his/her aseptic area and clean area. Above chest and back is the clean area, where no hands with surgical gloves should touch.

Sequence of preoperative preparation of patient, 1st assistant, and operator
• 1st assistant wears cap and mask
• 1st assistant washes hands
• 1st assistant dries hands with sterilized hand towel
• 1st assistant wears sterilized surgical gown by assist of 2nd assistant
• 1st assistant wears surgical glove by herself with aseptic technique
• Arrange sterilized kits and instruments of for
• Wear surgical cap and mask
• Operator washes hands
• Operator dries hands with sterilized hand towel
• Operator wears sterilized surgical gown by assist of 2nd assistant
• Operator wears surgical glove by assist of 1st assistant

2. Arrangement of the surgical instruments

Implant surgery requires many instruments. You will waste times to find necessary instrument if they are scattered. Make a rule and habitually put the instruments at original positions and let the 1st assist arrange the instruments during the surgical assisting.

Although there is no special rule of instrument arrangement, it is convenient to arrange instrument in usage order to avoid confusion between medical personnel. Arrange diagnostic tools such as mirror, pincette, explorer and probe at first, followed by flap incision and elevation tools such as blade, orban knife, and, periosteal elevator. Next arrange various curettes for root planning or removing inflammatory tissue, chisels for osteoplasty, followed by suture instruments such as needle holder and scissor. Arrange irrigation syringe and surgical micromotor at margin not to interrupt hand movement.**(Fig. 5-5)**

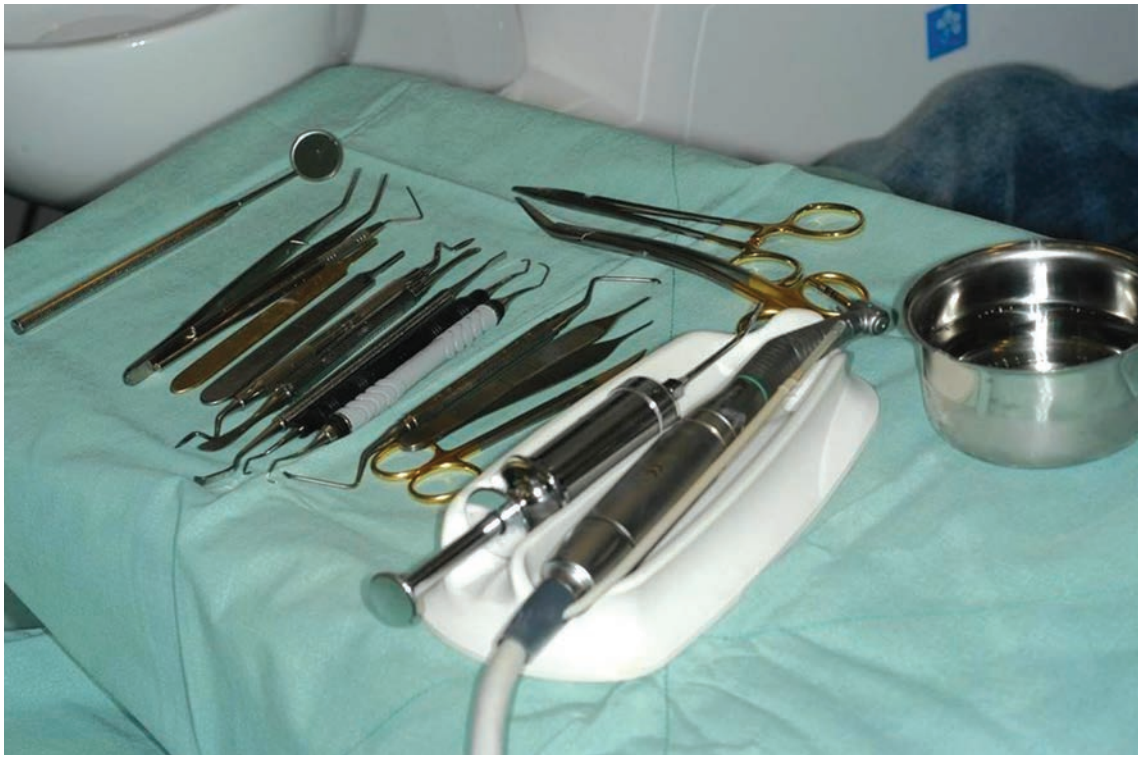


Fig. 5-5. Arrange the instruments in the following order; diagnostic tool, incision and flap elevation tool, instrument for inflammation removal, osteoplasty tool, and suture tool.

Suction system is very important for surgery. Connect sterilized rubber tube at suction line and connect suction line for surgery at opposite side, and then position it in the surgical field.

3. Infection control during implant surgery

In the past restorative therapy was the main field in dentistry, but, now surgical therapy is increasingly performed because implants have become popular. Dentist performs minor surgeries such as crown lengthening procedure, flap operation with osseous surgery, surgical extraction, apicoectomy, hemisection, root amputation, intentional replantation, autotransplantation, sinus graft, GBR, and implant. Every surgery requires infection control depending on specific surgical situations. During these kinds of surgeries, it is better to use surgical multiplying handpiece instead of high speed handpiece attached on dental unit chair to perform osteoplasty or tooth preparation easily. The high speed handpiece cannot keep adequate sterile condition for surgery. It cannot avoid contamination from water pipe, handling process, and compressed air. We offer several suggestions for better infection control.

1) Let's try to reduce numbers of microorganisms in the mouth before surgery

Surgical activity temporarily destruct epithelial layer which protect our body from outside, so remember that it is unavoidable to experience some level of infection during surgery. Hence, to decrease possible infection, it is important to reduce much numbers of oral microorganisms preoperatively which can elicit infection. To reduce oral microorganisms preoperatively, perform plaque control, scaling & root planning. Oral gargle solution can reduce the microorganisms, but, it is more effective to use oral gargle with through tooth brushing.

2) Let's use surgical micromotor (Fig. 5-6)

In the past, high speed handpiece attached on dental unit chair or low speed handpiece (if dentists cared more) was frequently used because surgical motor was not popular in dental clinics. However both of these are not suitable to use in risky therapy which involves incision and flap elevation. As mentioned before, we cannot keep sterile condition because of possible contamination from water tube, handling process, and compressed air. In these days, most of dental clinics have implant motor, and using this motor we can perform most minor surgeries under conditions with greatly reduced microorganisms. Surgical motor used in implant surgery can rotate to 40,000~50,000 rpm and can be increased to 100,000 rpm if it is connected to multiplying handpiece. This motor has same effect as highspeed handpiece rotating at 200,000~300,000 rpm because it is an electrical motor which has high torque. Excellent foot control functions reduce surface contamination that would result from using hands control. Surface care of micromotor part which connects handpiece is easy because it can be sterilized or covered with sterilized vinyl.

Micro motor has various modes of action and most of them should be controlled by foot pedal to minimize surface contamination during the surgery. Operator must be familiar with foot pedal control and habitually use it.

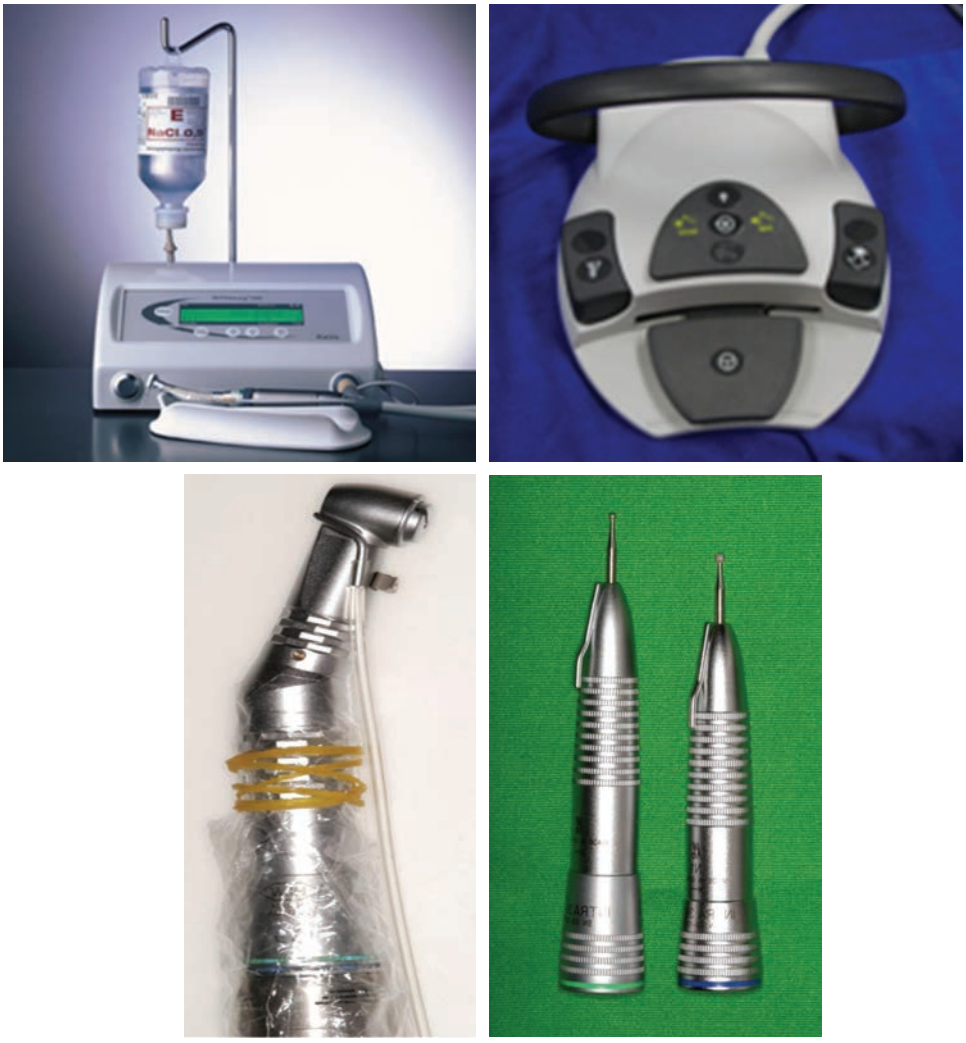


Fig. 5-6. Motor and handpiece fit for implant surgery. Surgical motor has various foot pedal function to minimize hand action. Handipece can be dissembled for internal cleaning.

3) Let's use adequate handpiece

There are several factors for selecting handpiece; first, it needs to be able to be connected to irrigation tube, and every part should be disassembled for easy internal cleansing. And, its head must have friction grip type multiplying handpiece to use surgical bur. My 10 years experience revealed excellent durability of the handpiece. Mechanical damage of the handpiece due to sterilization from autoclave is also not serious.**(Fig. 5-6)**

4) Let's equip proper suction system for surgery

Powerful suction system is essential for surgery. Suction tubing attached to unit chair is difficult to maintain surface care and inconvenient to use. However, it is convenient to use and keep sterilized condition if we connect surgical suction tip to autoclavable rubber tube and fix the rubber tube at surgical field using towel clamp. Additional light source will be helpful to brighten surgical field. Prepare various sizes of suction tips and don't forget a wire to break through the blocked suction tip.**(Fig. 5-7)**

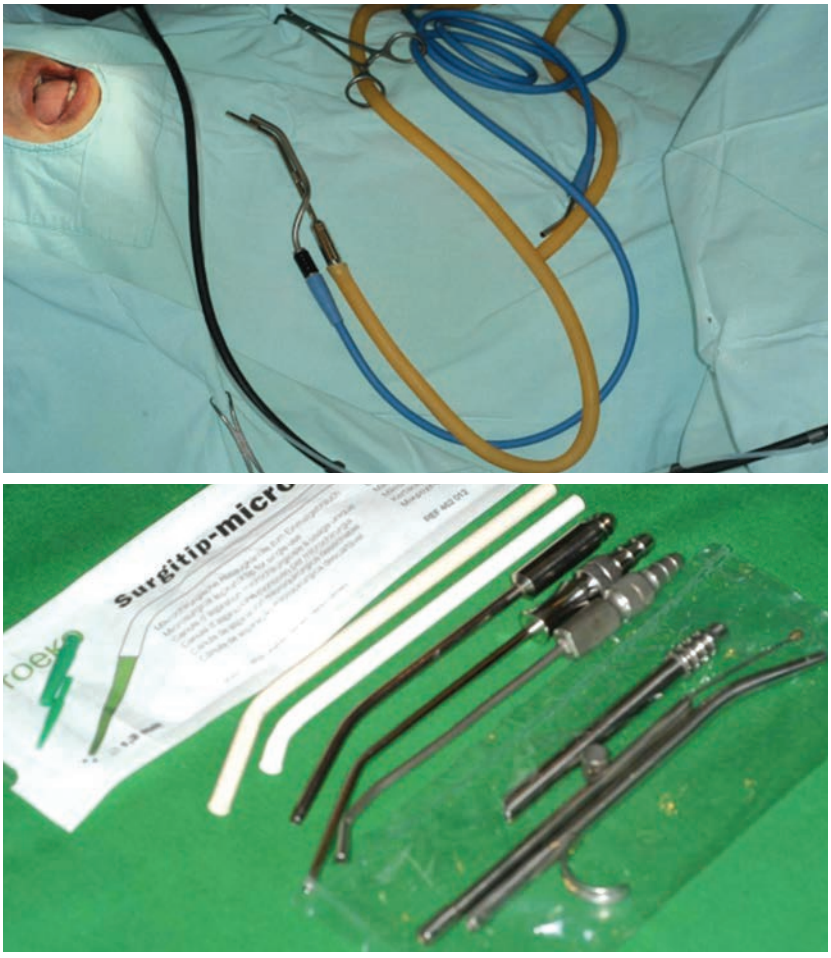


Fig. 5-7. Suction system which attaches light source and various kinds of suction tips

5) Aseptic irrigation syringe is useful

Securing a clear view is very important in surgery. Slight hesitation after bleeding can interfere with surgical view even after attempts of suctioning. In this situation, suctioning after saline irrigation is helpful to secure surgical view. Use disposable plastic suction syringe exclusive for surgery or metal irrigation syringe.**(Fig. 5-8)**

Fig. 5-8. Use a good metal syringe which is durable and can be sterilized. After use, disassemble, clean, dry, pack, and sterilize.

6) Prepare to perform additional anesthesia aseptically during surgery

It is very embarrassing when patient complains pain during surgery. Additional anesthesia is not effective because flap is already elevated. Aseptic anesthesia is not easy also. Anesthetic technique during the surgery has some problems, but, a special system such as Safe Plus enables aseptic additional anesthesia and preservation of anesthetic solution. Despite its cost, it is better to prepare as it is not frequently used.**(Fig. 5-9)**

Fig. 5-9. Product to perform anesthesia with aseptic technique

7) Let's standardize every instruments and machines

Surgery requires many instruments. The more complex the surgery the more instruments required and you may waste more time finding necessary instruments if they are not well arranged.**(Fig. 5-10)**
So, it is important to put instruments habitually at original position following a certain rule. Generally, it is useful to arrange instruments in usage order; put diagnostic instruments first, followed by incision and flap retraction instruments, curette instruments, bone surgery instruments, and suture instruments.

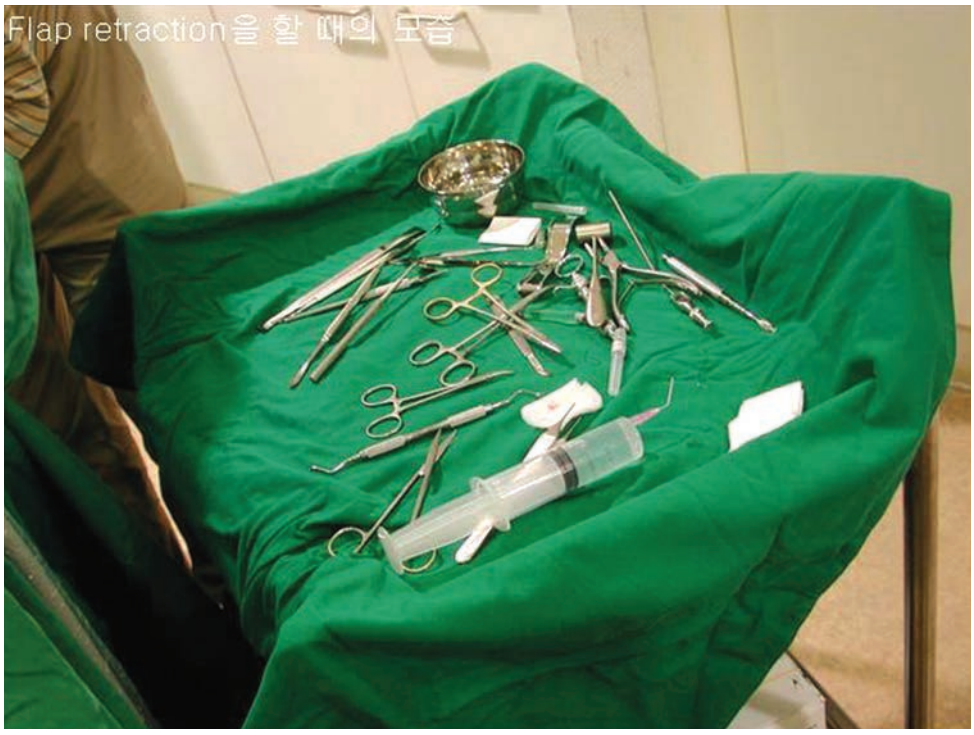


Fig. 5-10. You may waste time finding necessary instruments in such a disorder.

8) Divide septic and aseptic area during surgery

Even with perfectly prepared aseptic surgical condition, surgical field can be easily contaminated if you don't divide septic and aseptic area during the surgery. Machines and areas possibly involved in surgery should be covered with sterilized vinyl and in unavoidable area ask help of 2nd assistant.

9) Prepare system to take X-ray aseptically during surgery

Sometimes it happens: urgent situations which require identification of the position of root rest or mandibular canal during the surgery. Radiograph is greatly helpful in this situation. To take X-ray aseptically during the surgery is not easy. First it is better to digitalize the X-ray system. Plate type sensor similar to old film seems convenient for infection control. Linear type X-ray generator and tube is easy for surface care. It is urgent to supply the Stands for X-ray generator because current X-ray tube is lighter than previous one. Activate the switch attached to long line, and wireless remote controller is the best.**(Fig. 5-11)** Devices such as X-cp indicator that stabilizes sensors at standardized positions in the mouth should be widely used.

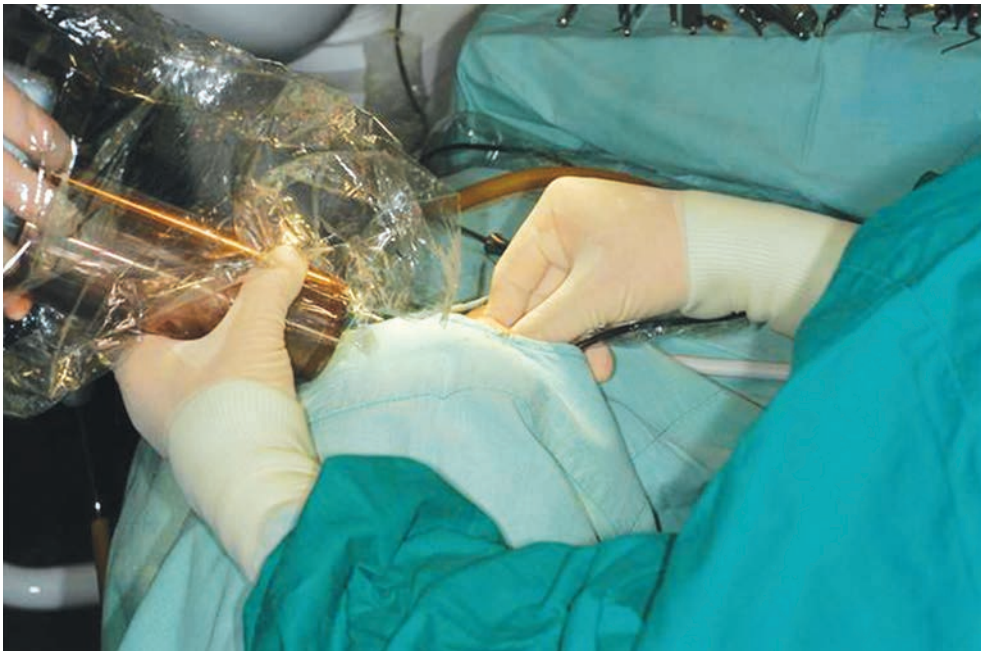


Fig. 5-11. Prepare aseptic X-ray taking system during surgery.

4. Postoperative patient management

Recall the patient for checking and dressing of the wound within 24 hours after surgery. Dental personnel should carefully clean the surgical site and surrounding tissue because patient cannot perform normal plaque control in surgical site easily. Let patient control plaque carefully and use oral gargle solution.
The interval and frequency of recall check depend on seriousness of the surgery. 1 week after the surgery, remove stitches from the nearest point from the tissue using slightly lifting & cutting method to prevent circulation of contaminated part.

5. Infection control during prosthetic procedure

Fixture level impression taking is common during the prosthetic procedure. Connection of impression coping increases infection risk because it penetrates the transmucosla area. Use sterilized impression coping and abutment which will be connected on the fixture. However during abutment level impression or crown delivery procedures which have relatively low risk of infection, absolute sterilization is not recommended.

6. Management of small tools

Implant surgery needs many small tools. Although it is difficult, careful care and sterilization of these tool is important to prevent cross infection during and after surgery. Every implant system has exclusive surgical kit to standardize drilling procedure. Surgical tool has many small tools at certain positions. During the surgery, select and use a tool from the kit and arrange used tool at extra bur stand for easy reuse.

Cycle process of small tools

1) Immerse used small tools into standby solution. Select a metal corrosion free chemical disinfectant for standby solution. It is better to use a synthetic phenol type chemical disinfectant instead of gluta-aldehyde or sodium hypochlorite type sterile solution which has strong metal corrosion characteristics. Standby solution has some sterililization effect and makes easy cleaning the foreign material on the surface of tools after immersing tools for a period of time. Moreover, the solution prevents air contamination.
2) Wash the tool immersed into the standby solution under running water and hand wash with brush which can clean the detail area. It is important to remove foreign body on the surface of the tool for maximum sterilization effect. Wear a long sleeve gown, mask, face shield, and durable rubber gloves during brush washing.
3) Ultrasonic cleaner has 5 times better foreign body removal efficiency than brush washing. Ultrasonic cleaning is performed after putting small tools in a container with minute net not to touch the floor of ultrasonic cleaner. Adding metal corrosion free disinfection solution with solution in the ultrasonic cleaner will be helpful.

4) After ultrasonic cleansing, wash the tools under running water and completely dry with towel or dryer. Much residual moisture due to incomplete drying can be left after sterilization and accelerate corrosion of tools.
5) Arrange sufficiently dried tools in the surgical kit.
6) After packaging, insert sterilization indicator.
7) The most common sterilization method is to steam under pressure sterilization. Implant surgery requires a lot of surgical cloths and instruments, so it is better to equip big sized sterilizer and B class sterilizer which can penetrate inside the long tube. Especially, to sterilize packaged instruments, use sterilization method which has good penetration ability. Unsaturated chemical steam sterilization method is not recommended because of poor penetration ability.
   Appoint a person in charge of sterilizer to care and check regularly. Sterilization means reducing numbers of microorganism to less than 0.0001% of the population, and it is essential to select adequate sterile method specific for each instrument.**(Fig. 5-12, 13)**

Fig. 5-12. Select sterilization method reducing number of microorganism to 0.0001%.

Fig. 5-13. Implant surgery requires many instruments, goods, and materials. Big sized B class pressure steam sterilizer which has excellent micro penetration ability is most commonly used. This machine automatically saves activation process and can print if necessary.

8) Storage

Store sterilized instruments in the shelf which has door and sterile area less exposed to contamination by outside air. Avoid long storage because permitted period of storage depends on packaging method. We recommend sterilization of instruments the day before operation.

9) Management of handpiece and micro-motor

Use a handpiece which has separable head for internal cleansing because blood can infiltrate the handpiece. Immerse head of used handpiece in the distilled water and perform idling for 1 minute. Then separate it from the micromotor and disassemble head & cover to clean under running water. Following steps are drying, assembling, internal oiling, and removing of extra oil. Disassemble again and package them. Handpiece and micromotor are dangerous machines which require sterilization. Exposing them long time under high temperature is not good because the tools are precise and weak against heat. Use a sterilizer with small chamber to expose them under high temperature for as short time as possible. Small cassette type B class sterilizer such as Statim is recommended.**(Fig. 5-14, 15)**

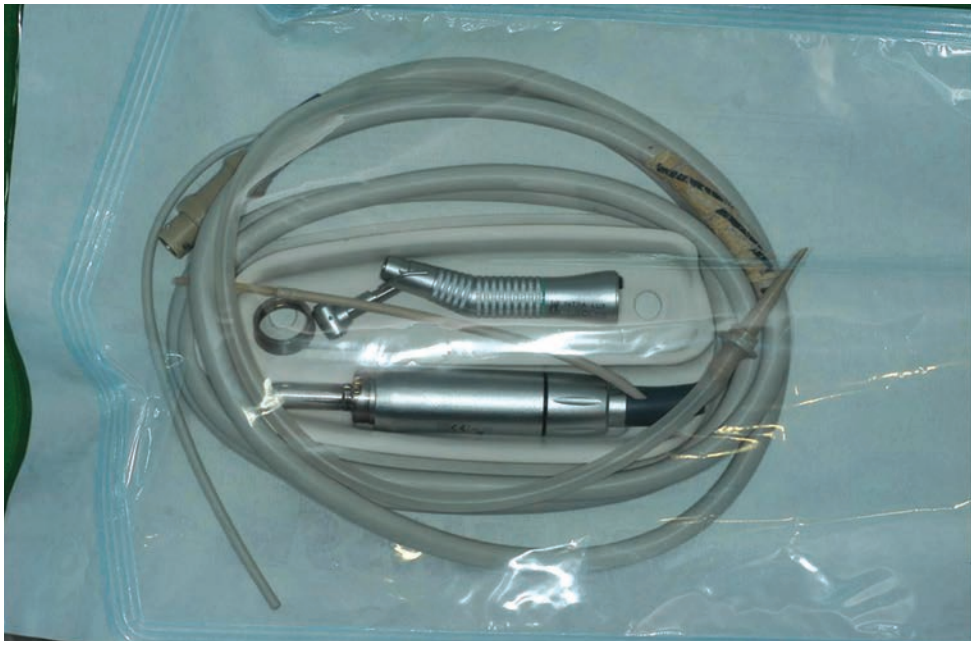


Fig. 5-14. Separable handpiece is easy for internal cleaning.

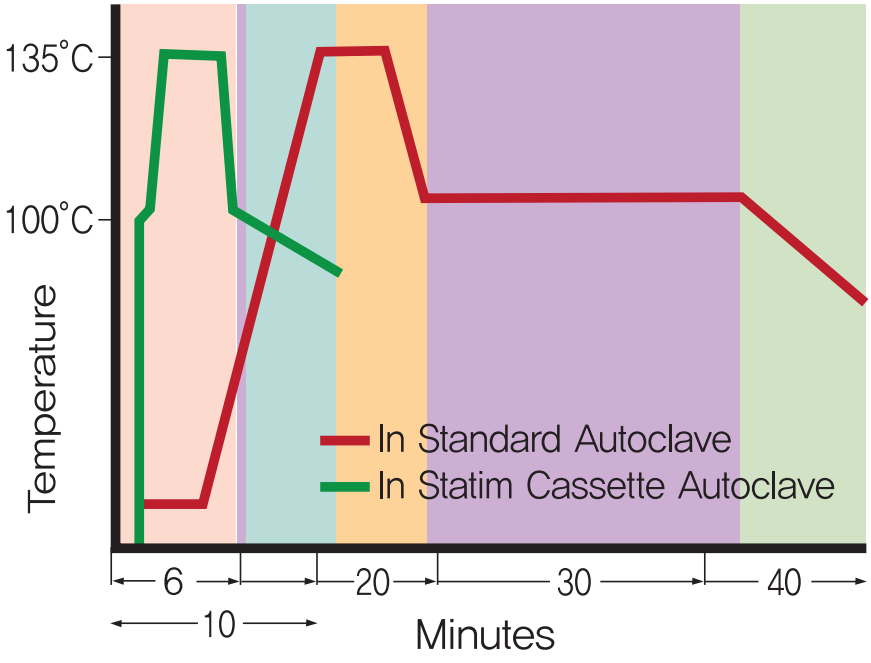


Fig. 5-15. A sterilizer with small chamber has short healing and cooling time. It can decreases damage of handpiece following sterilization because handpiece will be exposed to heat shortly.

2013
Osstem Implant System

VI Clinical Cases of Osstem Implant System

OSSTEM IMPLANT

Contents

Case | Implant position: #24 | Age:32, Sex:M

1

Acro Dental Clinic

Director

Oh, Sang-Yoon

Nonsubmerged GBR Using Customized 3D Titanium Membrane(SMARTbuilder)

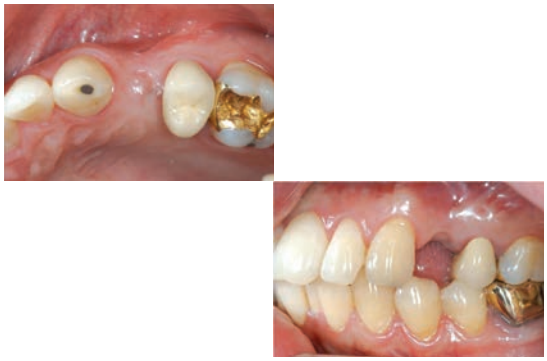


Fig. 1. A Preoperative intraoral view (postext. 4ms).
Horizontal deficiency at labial side (#24).

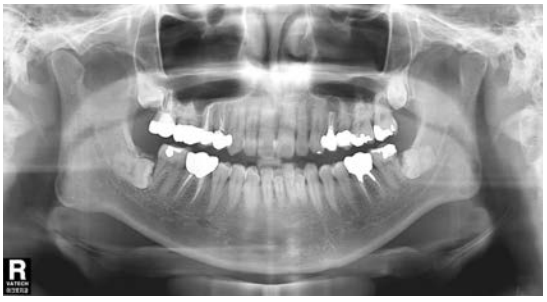


Fig. 2. Initial panorama.

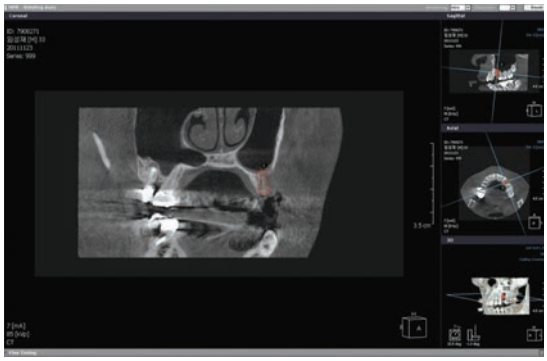
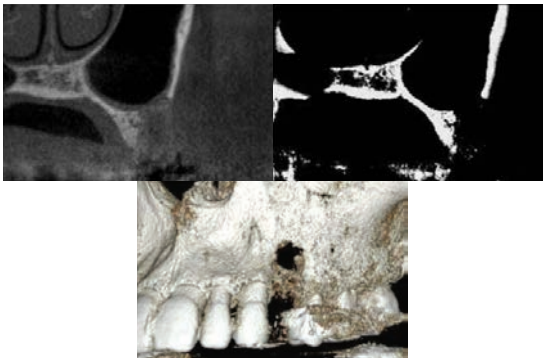


Fig. 3~4. Preop CT (#24).
Severe Labial bone resorption.



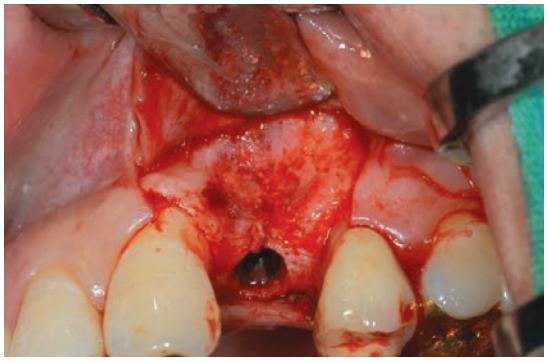
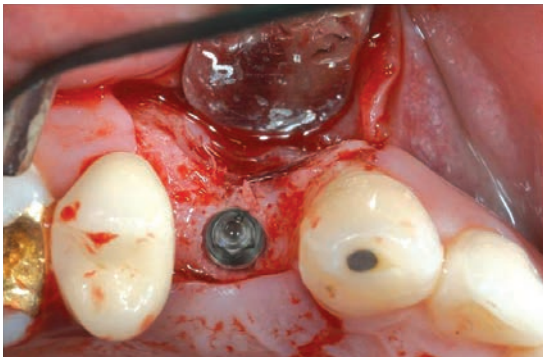


Fig. 5~6. Impalantation (TSIII SA) & sinus lifting.
Labial bone deficiency.



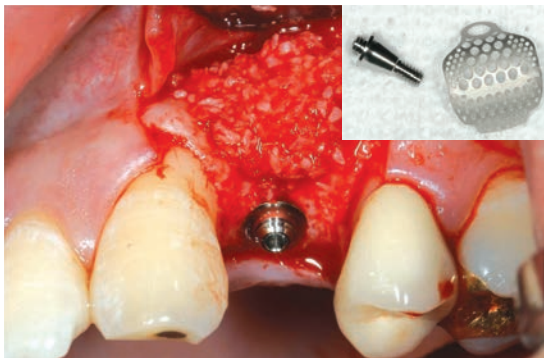


Fig. 7. Bone Graft for labial augmentation.

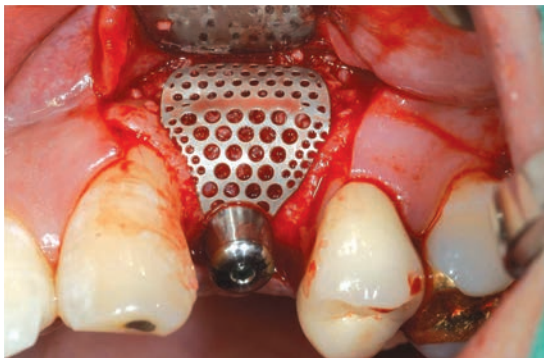


Fig. 8. Osstem SMARTbuilder (1wall augmentation).

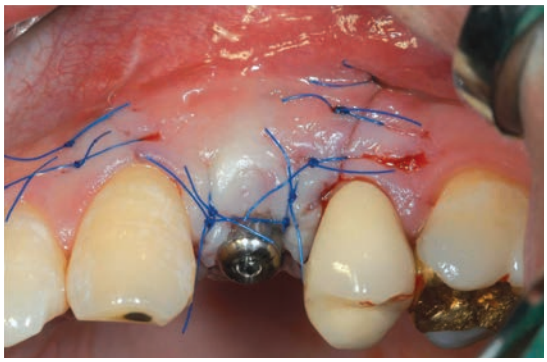


Fig. 9. Nonsubmerged GBR using healing abutment.

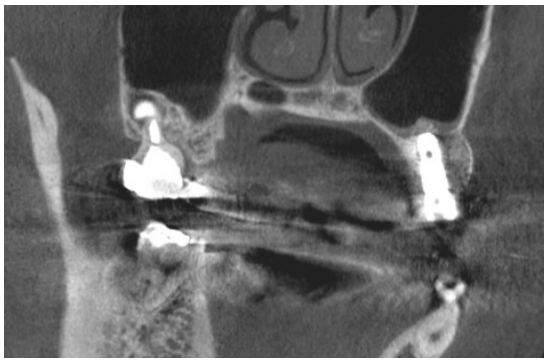


Fig. 10. Postop CT (#24).
Labial augmentation using bone graft & SMARTbuilder.

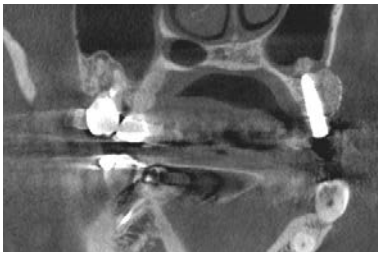
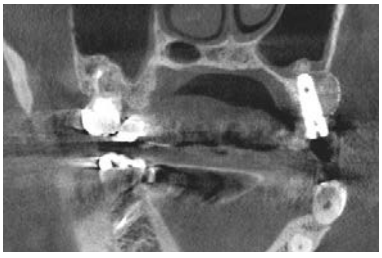
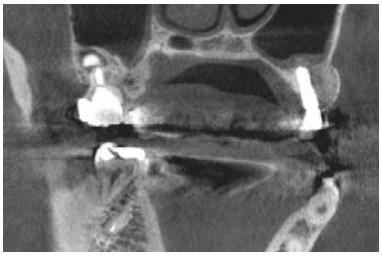


Fig. 11~ 13. 2ms later postop. CT (#24).
* Coronal section at mesial side.



* Coronal section at center area.



* Coronal section at distal side.

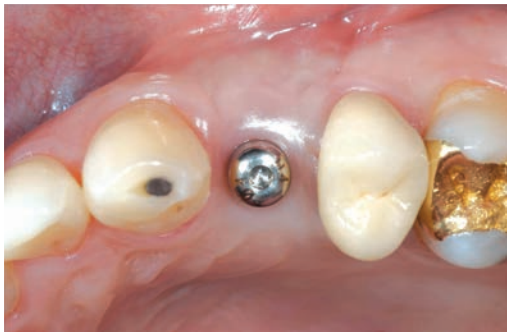


Fig. 14. 2ms later.
Good nonsubmerged healing of GBR.

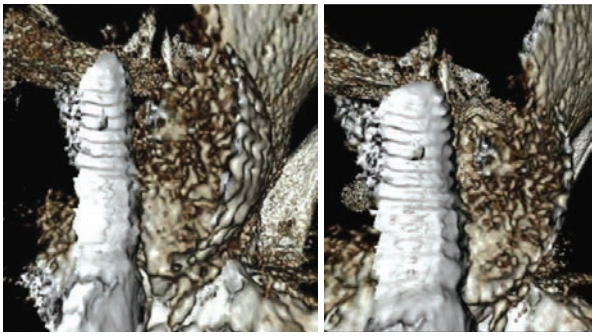
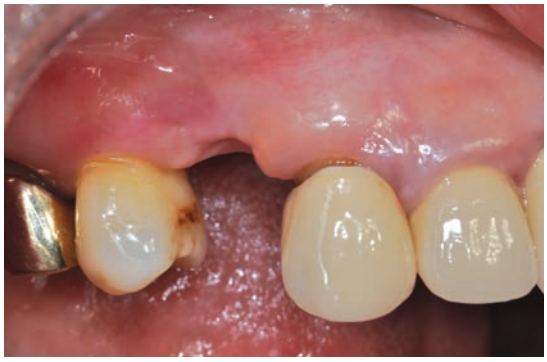


Fig. 15~16. 2ms later 3D CT (#24).
Incredible space maintenance.
No loss of graft material in the SMARTbuilder.

Case 2 | Implant position: #14 | Age : 59, Sex : F

GBR on Premolar Defect Using the SMARTbuilder

Apsun Dental Clinic
Director
Cho, Yong-Seok



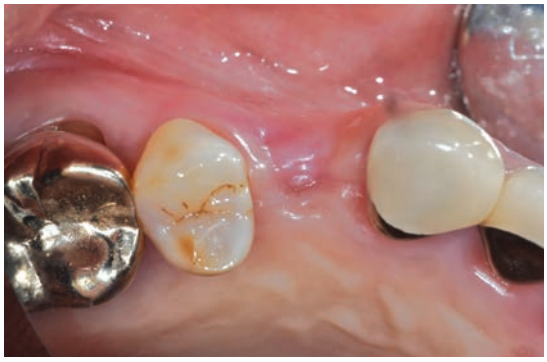


Fig. 1~2. 59 years old female visited to place an implant at upper right 1st premolar missing site. She received implant 7 years ago and it was retrieved 7 months ago due to the mobility of the implant which involved in severe peri-implantitis. Soft tissue was well healed but it showed insufficient tissue volume.

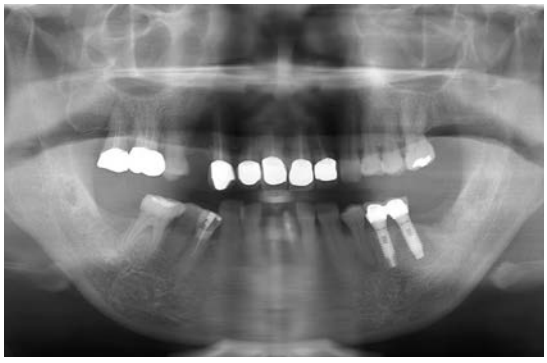


Fig. 3. Panoramic view shows relatively radiolucent image of premolar missing site

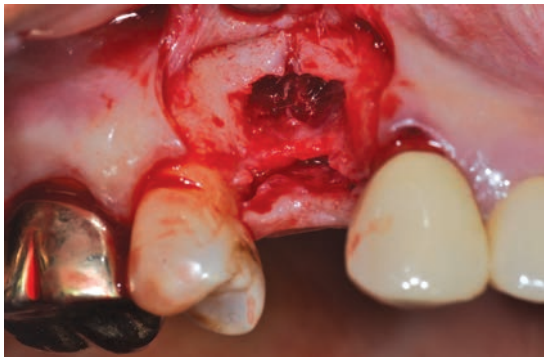


Fig. 4. Bone was exposed after mucoperiosteal flap elevation. Bone healing was very poor even 7 months after the fixture removal.

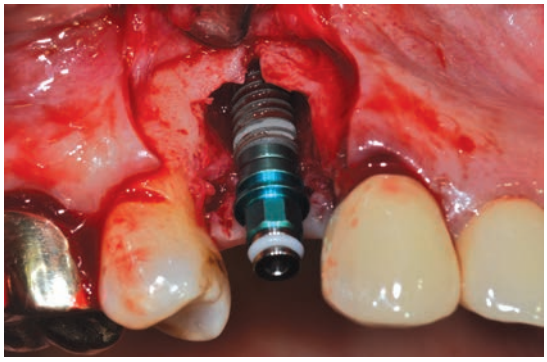


Fig. 5. After site preparation TSIII SA ⌀4.0x11.5mm fixture was installed.

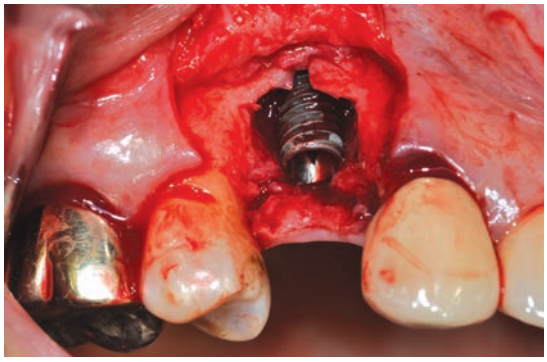


Fig. 6. Bone defect around the fixture was carefully examined to select a SMARTbuilder. Buccal and proximal and slight palatal bone defects were observed.

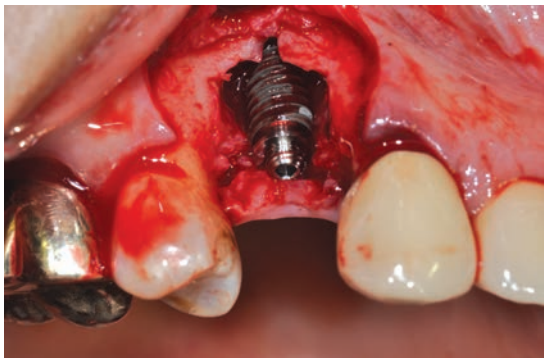


Fig. 7~8. Height of 1.0mm was selected and connected on the fixture.

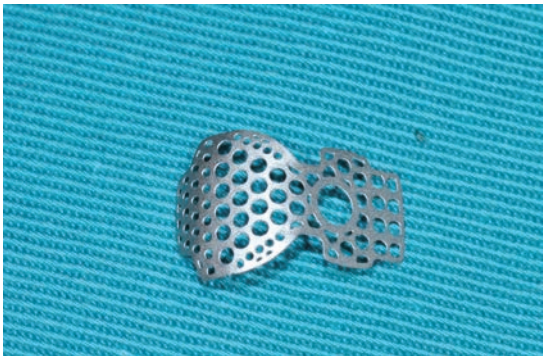


Fig. 9. SMARTbuilder(3wall augmentation) was selected.

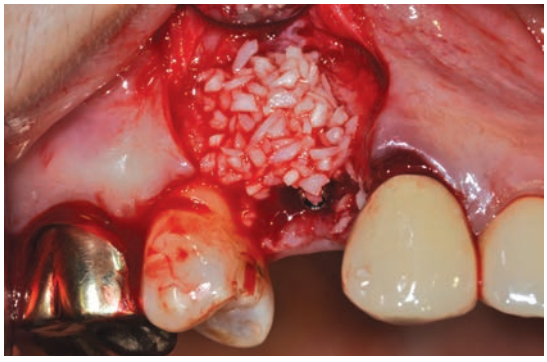
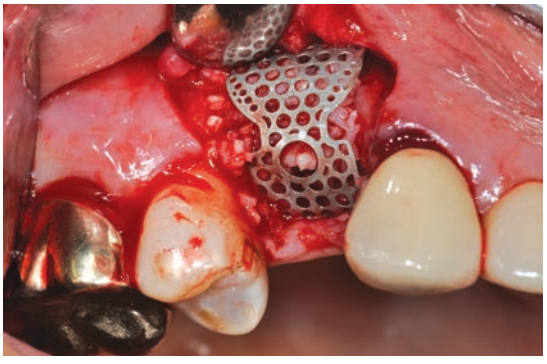


Fig. 10. An allogenic bone substitute (SureOss 0.25cc) was grafted to fill the bone defects.



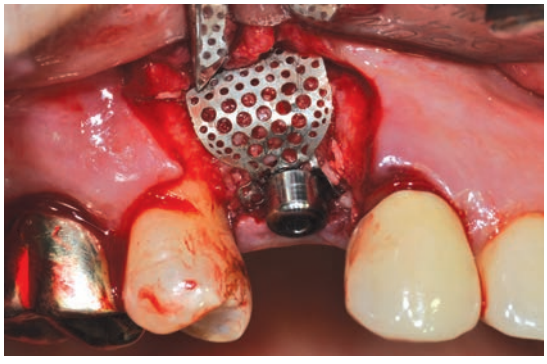


Fig. 11~12. The SMARTbuilder was fixed on the height using a healing abutment. The SMARTbuilder was directly applied without modification.

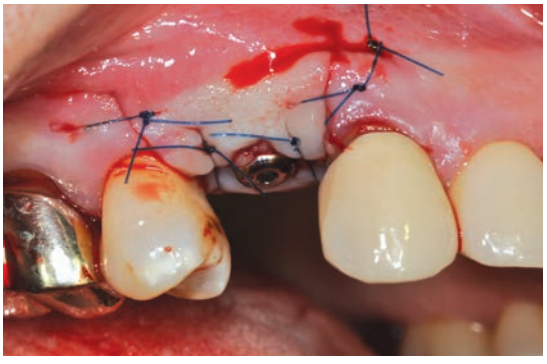


Fig. 13. Flap was closed with 5-0 nylon.

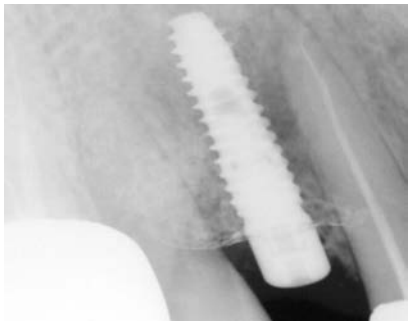


Fig. 14. POP Standard X-ray shows well adapted SMARTbuilder over the fixture and height.

Case | Implant position: #31, #42 | Age:75, Sex:M

1

Yena Dental Clinic

Director

Yang, Choon-Mo

Immediate Implant Placement and Immediate Loading with Simultaneous Guided Bone Regeneration

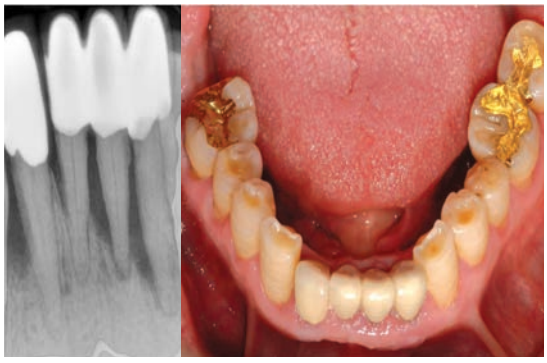


Fig. 1. A 75 year old male with failing fixed bridge at sites #32 to #42 due to advanced periodontal pathology.

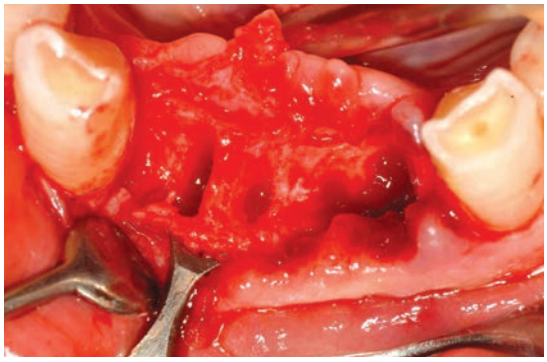


Fig. 2. Following the extraction, sharp and irregular bony spines were trimmed by chisel and collected for bone grafting.

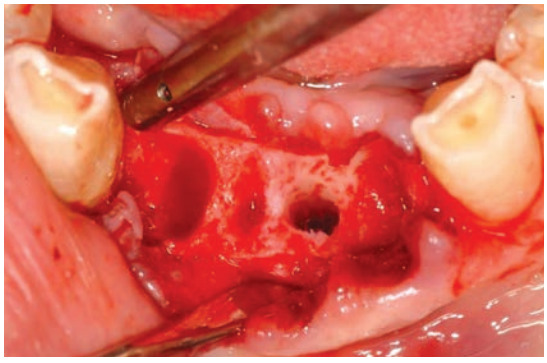


Fig. 3. Final osteotomy in sites #31 and #42.

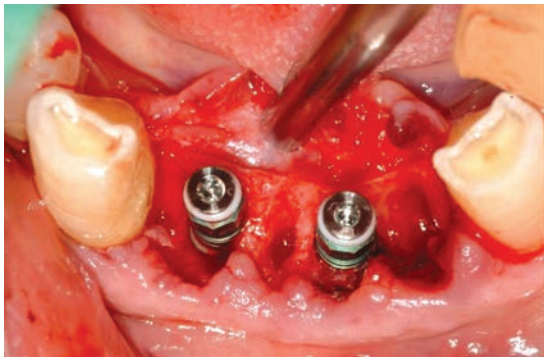


Fig. 4. Osstem TSIII SA implants placed at site #31 with insertion torque of 37Ncm and #42 with 27Ncm.

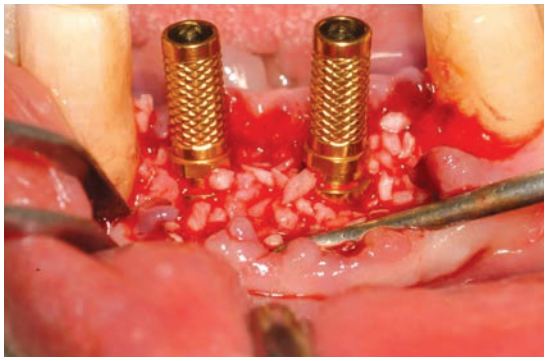


Fig. 5. Temporary abutments attached to the implants and mixture of particulated autogenous bone and FDBA(OsteOss) placed into defective socket. Barrier membrane was not used.

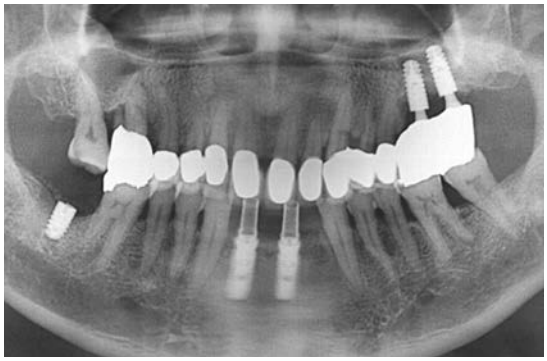


Fig. 6. Post-operative panoramic view before making provisional restoration.

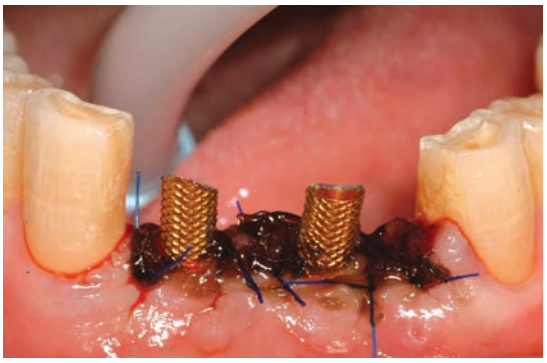


Fig. 7. Gingival protecting gel with nanoemulsion ingredients (NBF).

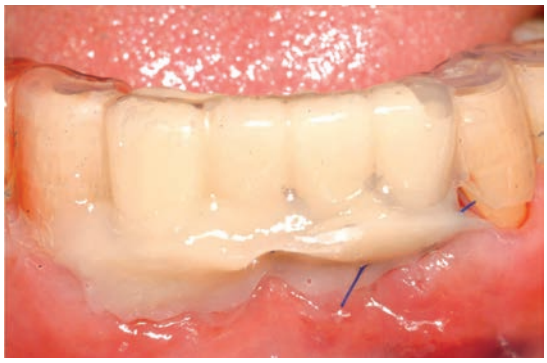


Fig. 8. Chair-side provisional restoration was made by relining the prefabricated omni-vec shell with autopolymerizing resin (Bis-Acryl Protemp).

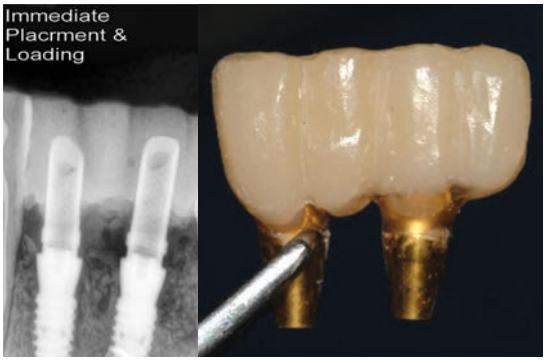


Fig. 9. Immediate post-operative periapical radiograph and retrievable screw-retained provisional restoration.

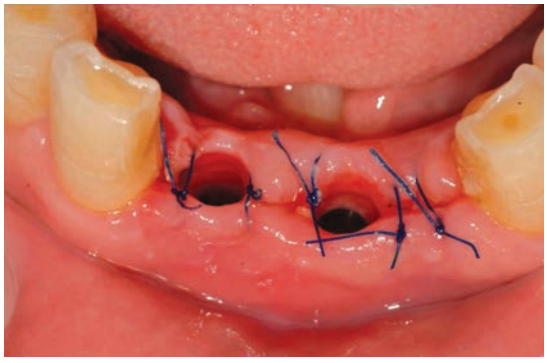


Fig. 10. Soft tissue healing at 2 weeks after surgery.

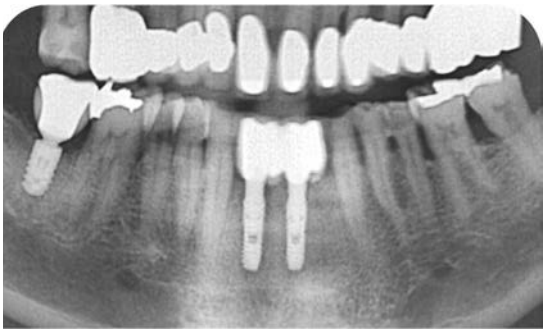


Fig. 11. 6 months after immediate loading.

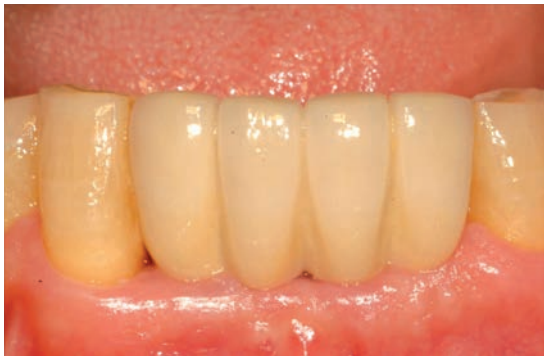


Fig. 12. Definite fixed partial denture at 1 year of immediate loading.

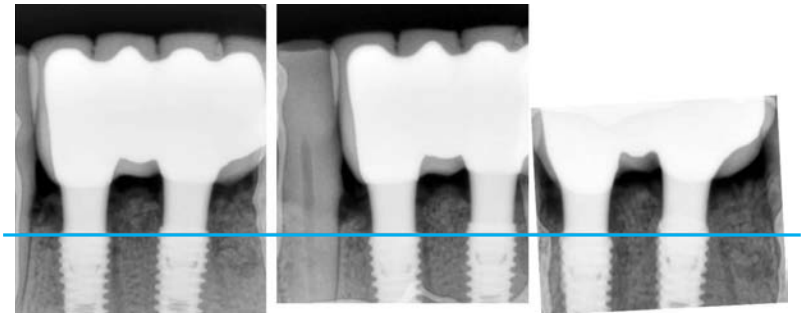


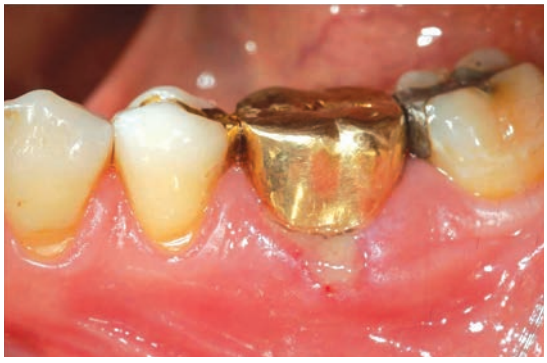
Fig. 13. Periapical radiograph at various remodeling period.

Case | Implant position: #37 | Age : 49, Sex : F

2

All Dental Clinic
Director
Oh, Young-Hak

TSIII SA
Immediate Implant Installation



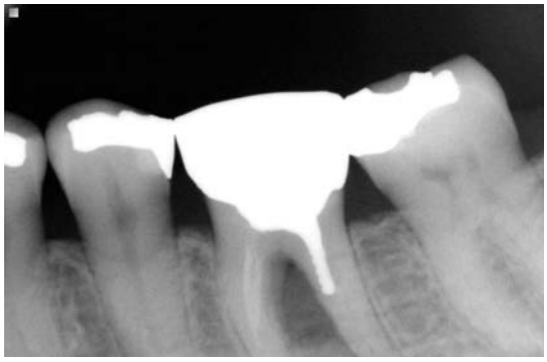
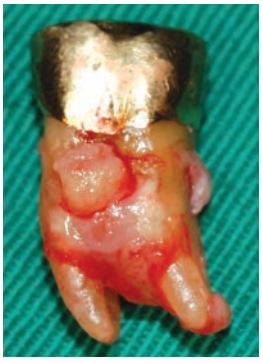


Fig. 1~2. Pre-operative photo and radiograph (Root bifurcation lesion owing to improper post surgery).



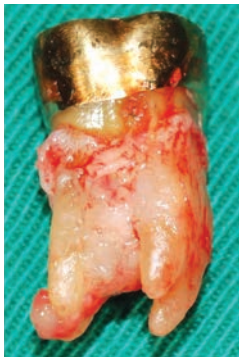


Fig. 3. Hyperparakeratosis acanthosis, with mild epithelial dysplasia.

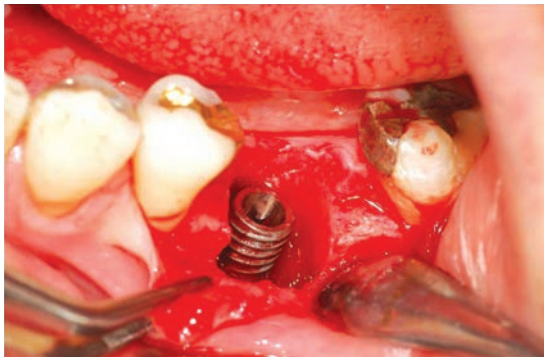


Fig. 4. Bone graft(MBCP) with immediate implantation.

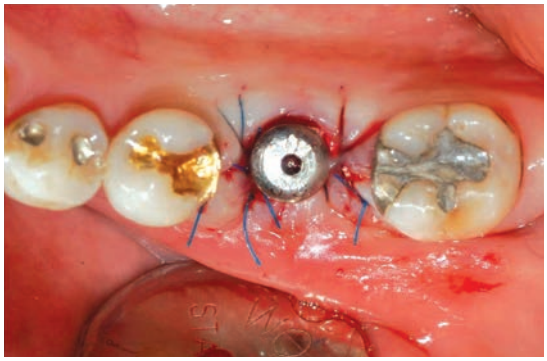


Fig. 5. One stage surgery
(TSIII SA ⌀ 5.0x10mm, MBCP 0.5g).

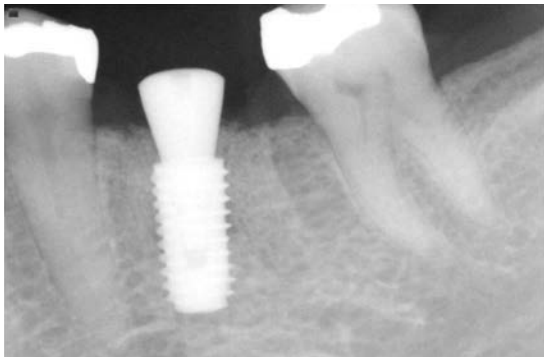


Fig. 6. Periapical radiograph after implantation (Good initial stability).

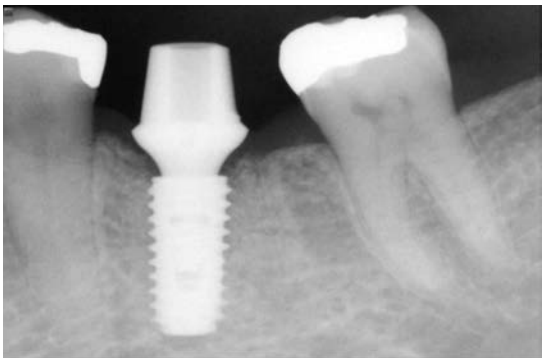
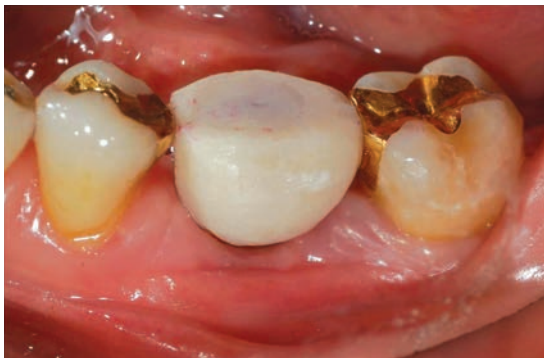



Fig. 7~8. 2 months after implant placement, transfer abutment(temporary) was connected and repeatedly tightened to 30Ncm. The cusp angle formed was low so that the shape and the form of the temporary protheses are less exposed to masticatory pressure.

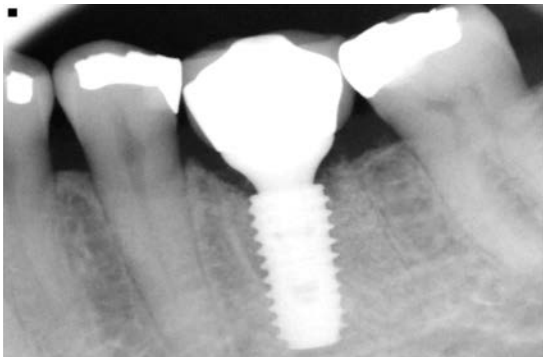
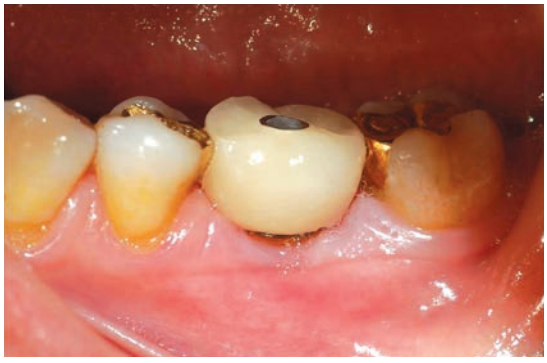



Fig. 9~10. Final prosthesis setting at 3 months after implant placement.

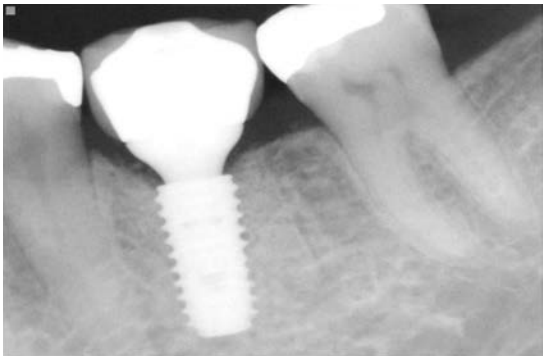
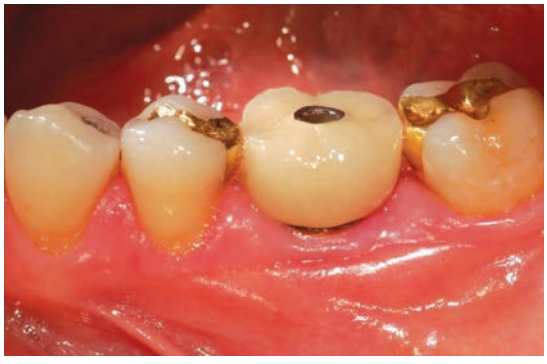



Fig. 11~12. 9 months after implant placement. Well-matured soft tissues are shown.

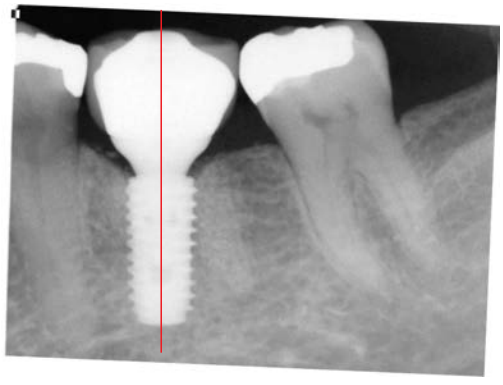


Fig. 13. Periapical radiograph at 18 months after implant placement. We accomplished functional need and stable bone response around implants. The results were clinically satisfactory.

Case | Implant position: Multi. | Age: 32, Sex: F

3

Seoul Dental Clinic

Director
Lee, Dae-Hee

Delayed Implantation of TSIII SA after Ridge Augmentation

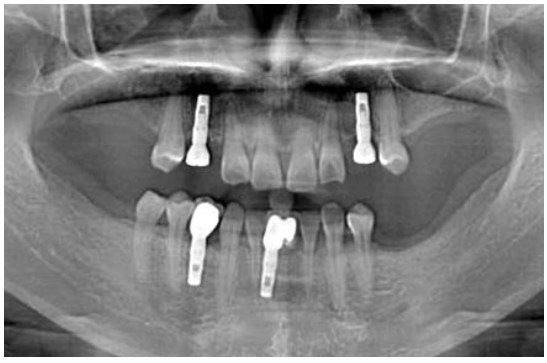


Fig. 1. This(He was a referred case for severe atrophy of molar region and bone graft on the existing implant site.

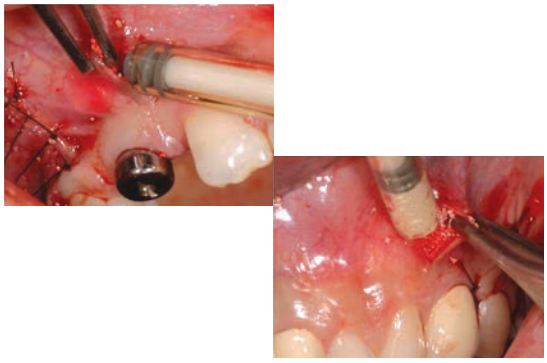


Fig. 2. Previous fixtures were given the GBR through the vertical incision only.

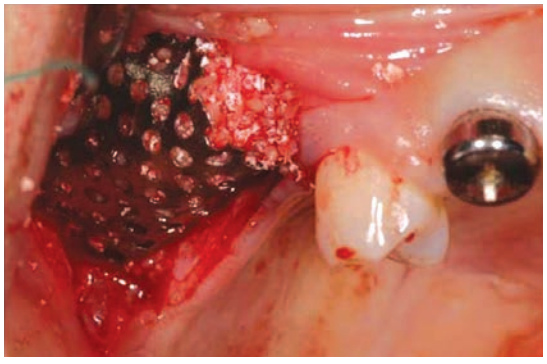


Fig. 3. Vertical & horizontal ridge augmentation was performed in right upper side using titanium mesh.

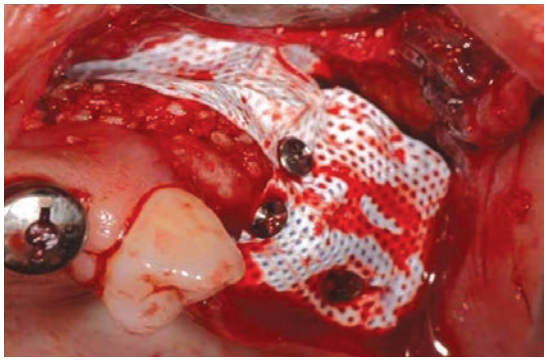
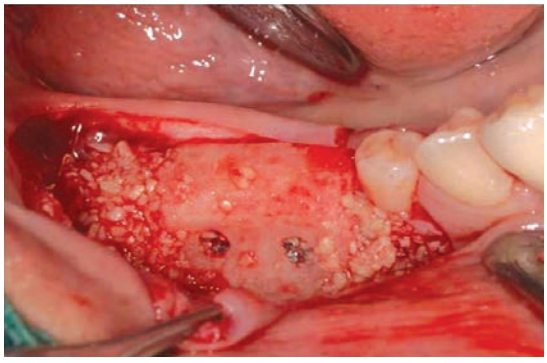


Fig. 4. In left upper area, sinus graft and ridge augmentation was done and flap was secured with the aid of buccal fat pad.



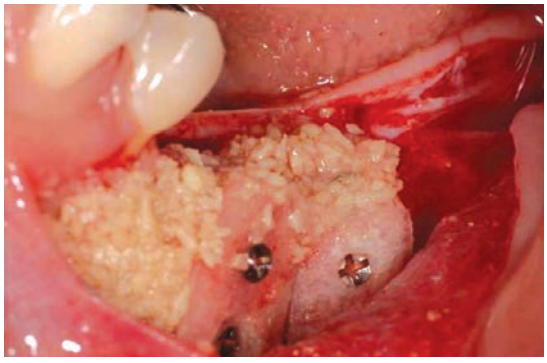


Fig. 5~6. Lower area shows the ridge augmentation with allogenic block bone which area was covered with Ossix membrane.

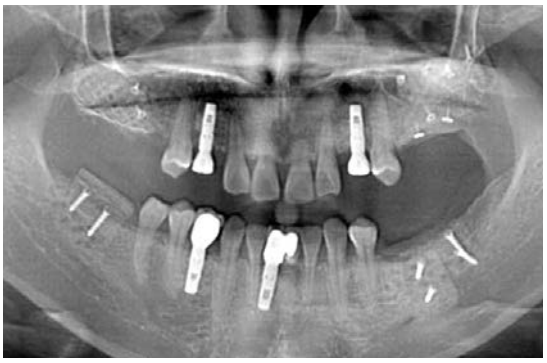


Fig. 7. This panoramic view shows the ridge augmented appearance.

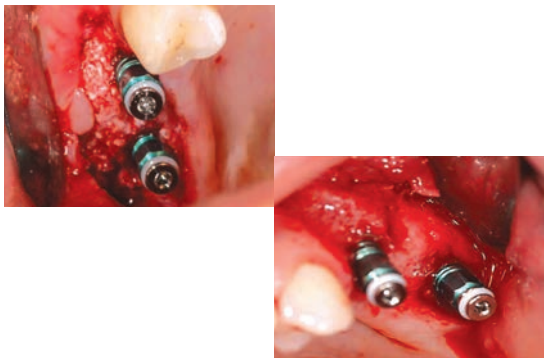


Fig. 8. Titanium mesh was removed after 5 months and four TSIII SA fixtures were installed in upper area.

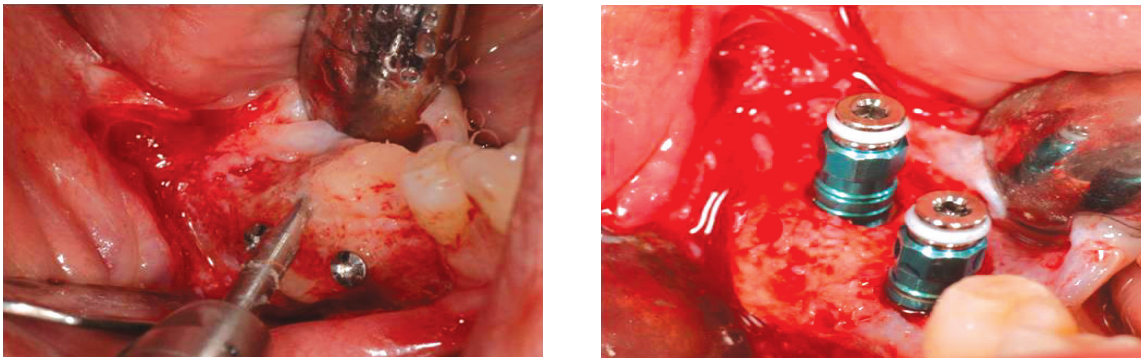


Fig. 9~10. Allogenic bone were combined well with host bone with a minor resorption. Excessive vertical bone was cut to the desirable amount.

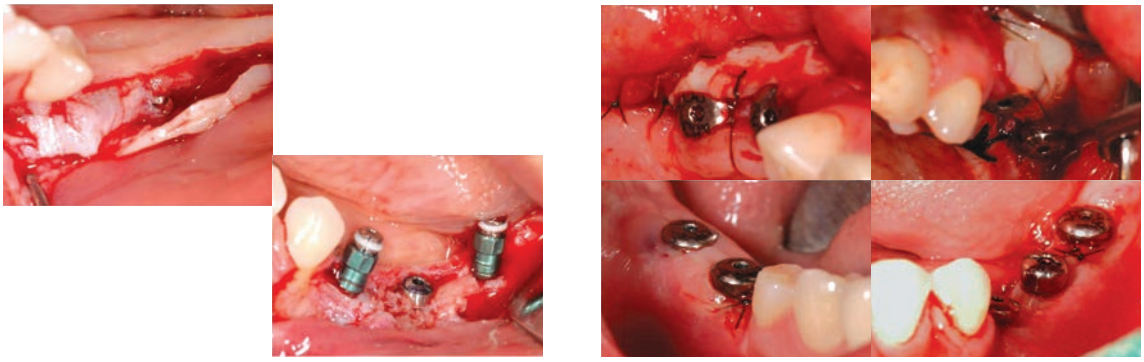


Fig. 11~12. Lt. side also showed the desirable amount of new bone at that time. All the fixtures were submerged in this surgery. 2nd surgery was prepared with APF & FGG in upper side and punch technique in lower side after 2 months.

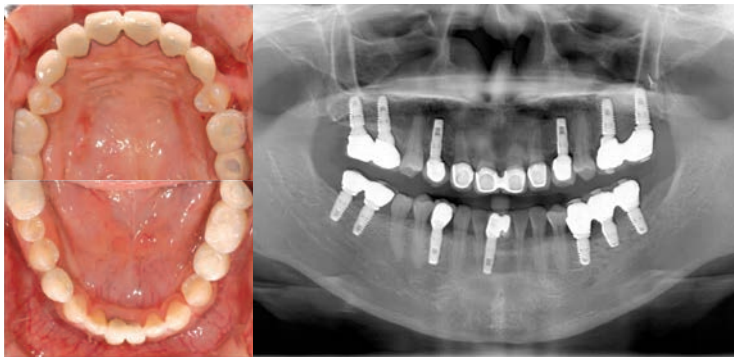


Fig. 13. The final restorations were engaged after passing through the periods of provisional restoration.

Case | Implant position: #26 | Age: 54, Sex: M

4

Seoul National University Bundang Hospital
Professor
Kim,Young-Kyun
Yi, Yang-Jin

Early loading three months after the TSIII SA installation, which was conducted four months after a left maxillary sinus graft

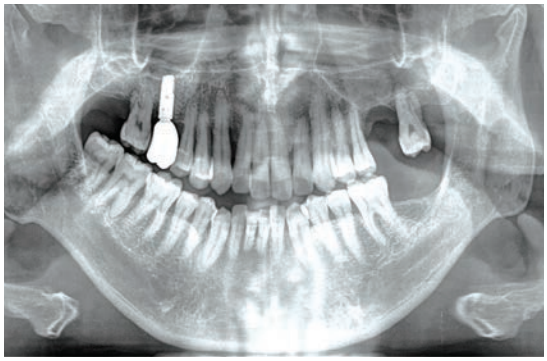


Fig. 1. Initial panoramic radiograph of a 54 year-old male patient. The radiograph was taken one month after extraction of tooth #26; the residual bone mass was as little as 1 mm-level thick.

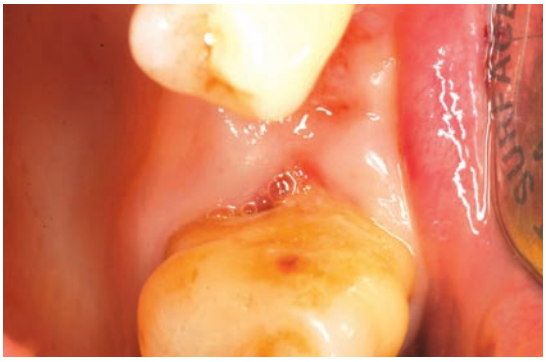


Fig. 2. Initial intraoral picture

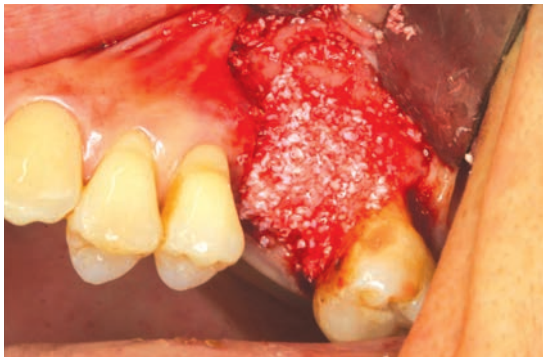


Fig. 3. Sinus bone graft was performed via lateral approach. A mixture of autogenous tooth bone graft material using extracted tooth from the patient and Bio-Oss was used for the bone graft. Vertical ridge augmentation was performed simultaneously.

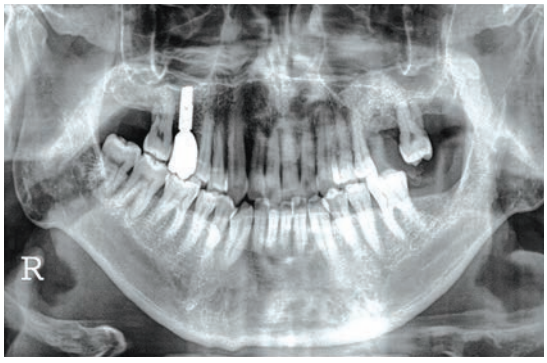


Fig. 4. Panoramic radiograph after procedure. It can be observed that the vertical ridge augmentation was performed simultaneously with the maxillary sinus bone graft.

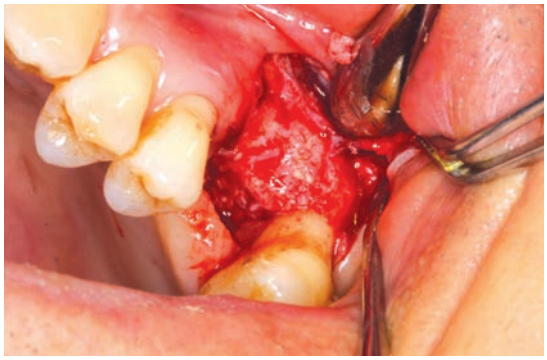


Fig. 5. Flap elevation performed four months after bone graft. The area where the vertical ridge augmentation was performed shows a fairly good healing progress.

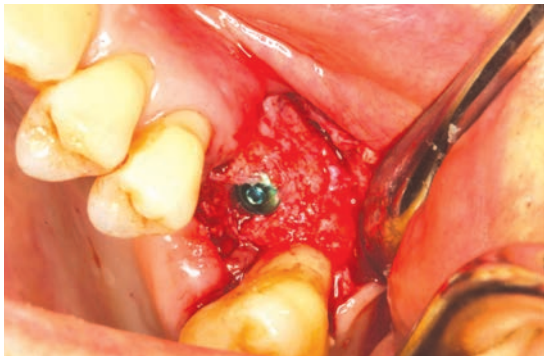


Fig. 6. After installation of the implant (TSIII SA, 4D/11.5L). The initial stability value was 56 ISQ, as measured with the OSSTELL Mentor

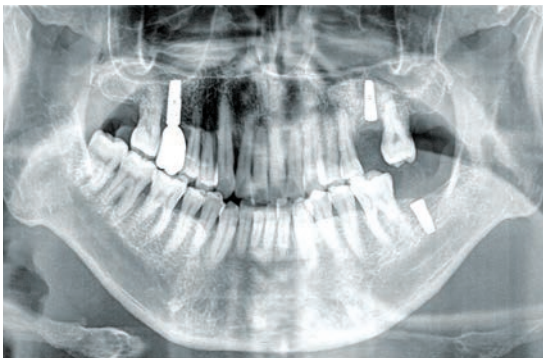


Fig. 7. Panoramic radiograph after the implant installation

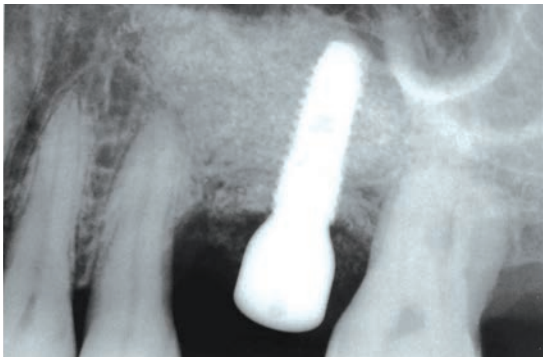


Fig. 8. Periapical radiograph after the second surgery.
The second surgery was performed 2.5 months after the implant installation. Secondary stability value was 72 ISQ, re-measured by using OSSTELL Mentor

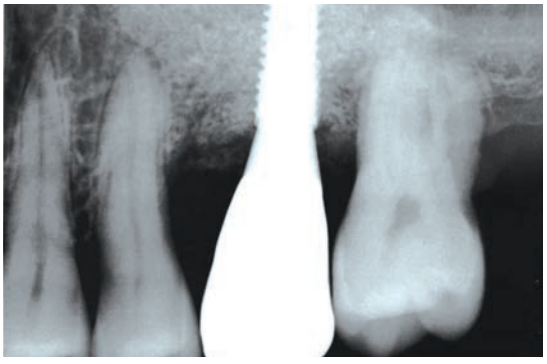


Fig. 9. Periapical radiograph one month after the final prosthesis.
The final prosthesis was installed three months after the implant installation.

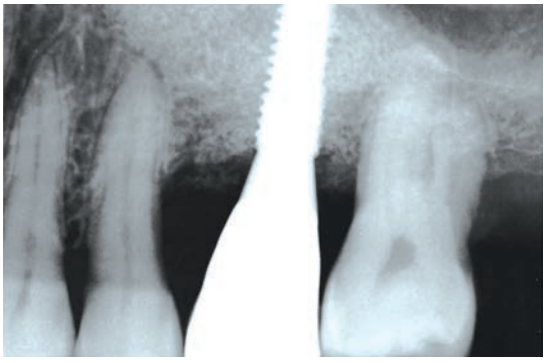


Fig. 10. The periapical radiograph was 13 months after the final prosthesis

Case | Implant position: #16, #17 | Age:64, Sex:F

5

Toba Dental Clinic

Director
Shuhei Toba

Implant placement into sites with periapical infections

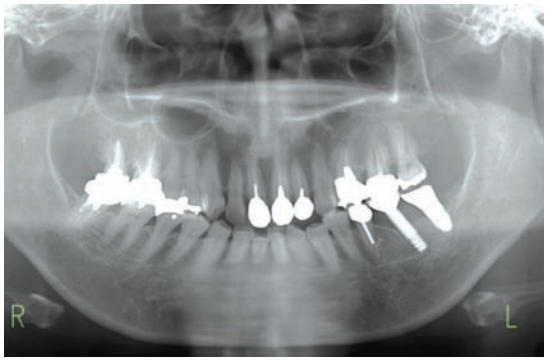


Fig. 1. Panoramic first diagnosis Observed shadows at end of UR 6&7

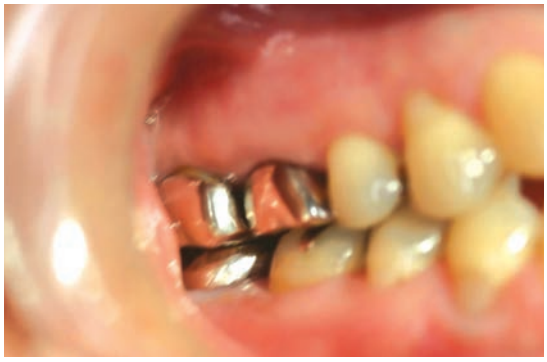


Fig. 2. at first diagnosis Patient felt pain when bit.

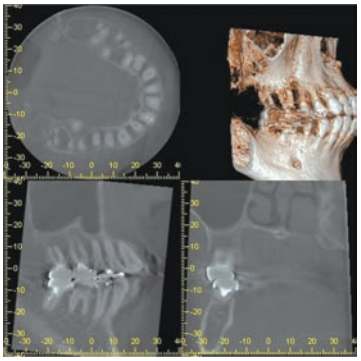


Fig. 3. CT at 1st daignosis Infection existed 7 to 7 of root, and it was 8mm diameter. The bone height from the extracted root to sinus was 3mm. Sinus membrane was normal thickness.

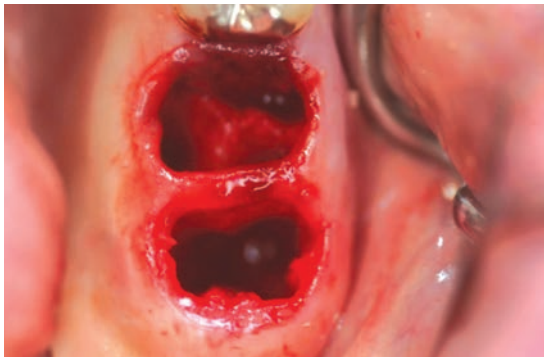


Fig. 4. from occlusal plane, Carefully extracted so that soft tissue being not damaged. Completely cleaned up inside.

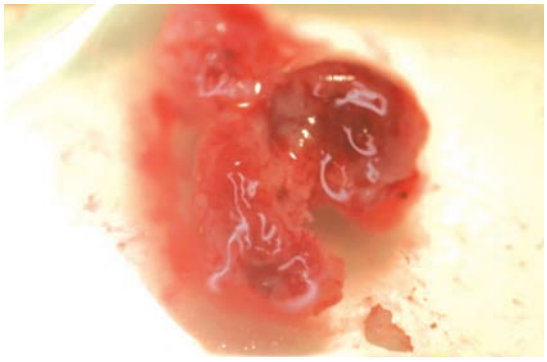


Fig. 5. Removed infected tissue
Pathologic test said granuloma of root

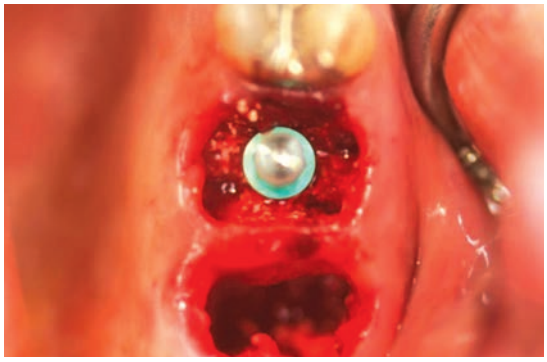


Fig. 6. Placed 6 septum
Primary stability was 25Ncm. Filled extracted sockets, with mixed granule of HA, β-TCP, and DFDBA applying layering technique. Formed placement hole with Ossteotome and placed fixtures.

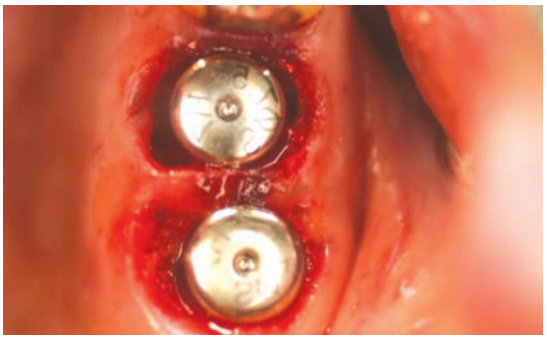


Fig. 7. after placement
For UR7, primary stability was gained at 29 Ncm, and decided to one-stage operation with healing abutment. This was performed using 3.8 mm Ossteotome as placed 4.5 mm fixture.

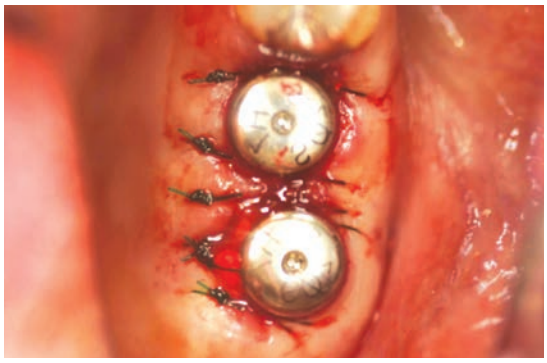


Fig. 8. Used only DFDBA to fill the gap of the socket. Sutured so that filled the gap and not to lose bone graft materials.

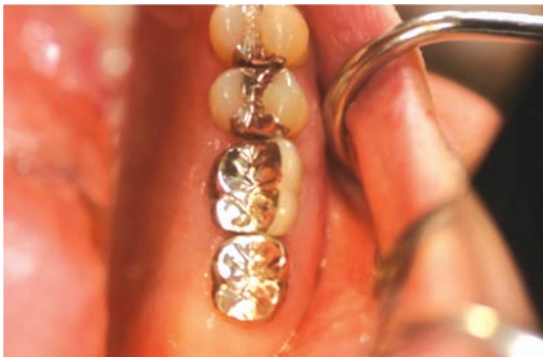


Fig. 9. Occlusal view of upper structure
Upper structure was set 6 months after the surgery. Buccal side of mandible base is preserved.

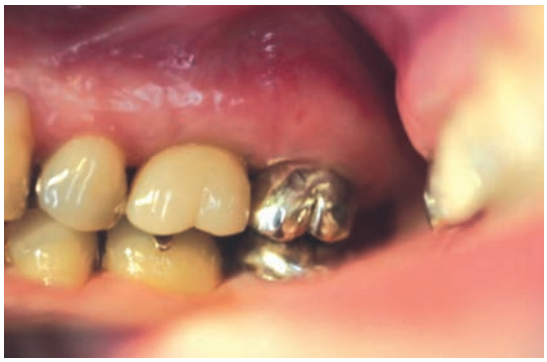


Fig. 10. Labial view of upper structure
Single structure for ease of cleaning

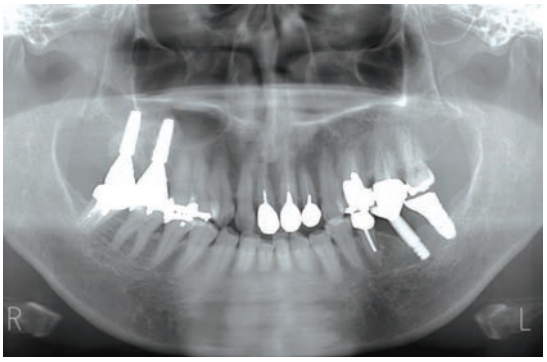


Fig. 11. Panoramic X-ray after prosthetic delivery
Fixture TSIII SA 4.5mm × 13mm

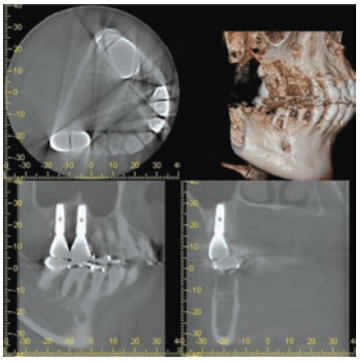


Fig. 12. Comment on CT Bone around GBR has yet to be formed enough, but functions enough.

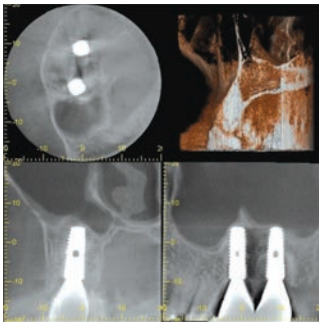


Fig. 9. 3 years after operation, UR 6 , CT
Over structure set after 6 months of placement.
Bone was preserved both labial and buccal sides.

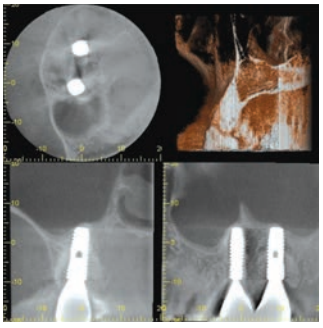


Fig.10. 3 years after operation, UR7 CT.

Filled HA,, β-TCP and surrounding bone was preserved. Bone-like tissue was observed around the fixture. No granuloma was observed.

Success factor was complete removal of infected area, GBR, and selection of fixtures.

Case | Implant location: multiple | Age : 50, Sex : F

6

Seoul Dental Clinic

Director

Lee, Dae-Hee

A maxillary full-mouth implant-supported fixed prosthesis using TSIII SA

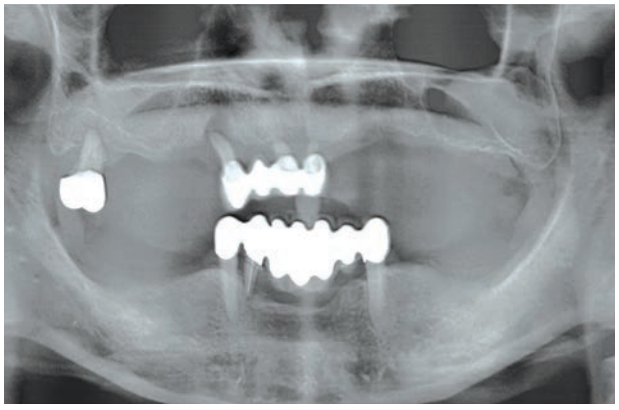


Fig. 1. Though the patient had dentures on the mandible and maxilla, it was very urgent to extract the teeth due to severe mobility caused by periodontitis. We decided to place a fixed prosthesis by using an implant after extracting the maxillary teeth and allowing the soft tissue to recover. According to the patient's request, we decided to reconstruct the anterior part first.

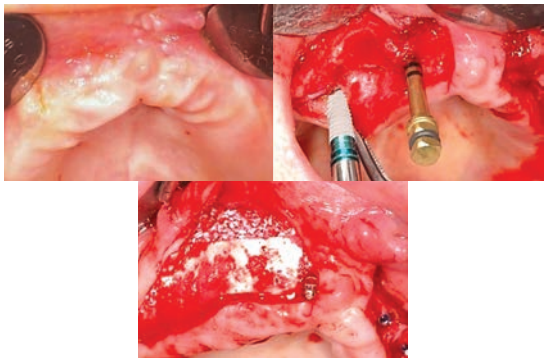


Fig. 2. Bone graft was conducted on the buccal side while installing two TSIII implants in the right maxillary teeth.

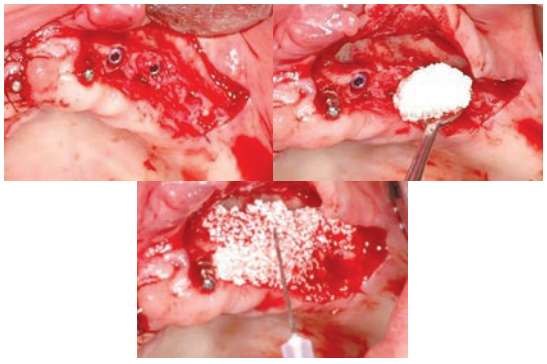


Fig. 3. Bone graft was conducted by using synthetic bone and BMP-2 in a dehiscence defect area that was generated while installing two TSIII implants in the left maxillary teeth.

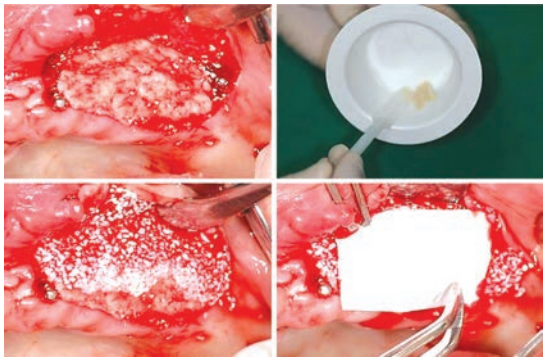


Fig. 4. Guided bone regeneration was performed by using resorbable membrane, while protecting bone graft area by using DBM putty.

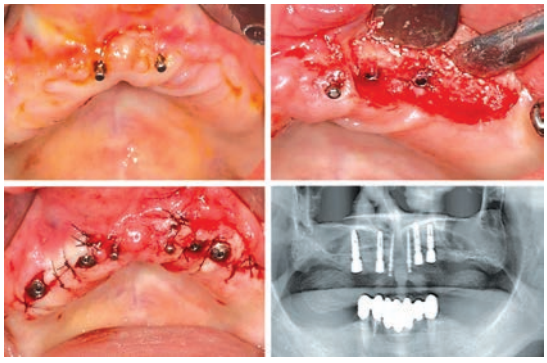


Fig. 5. A temporary implant was removed after about two months, which had been installed to protect the bone graft lesion during second surgery.

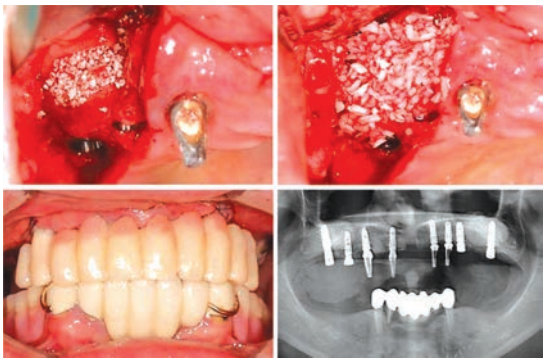


Fig. 6. A temporary prosthesis was placed in the maxillary anterior part and an implant was installed on both sides of the posterior region with accompanied maxillary sinus lift and bone graft on the buccal side.

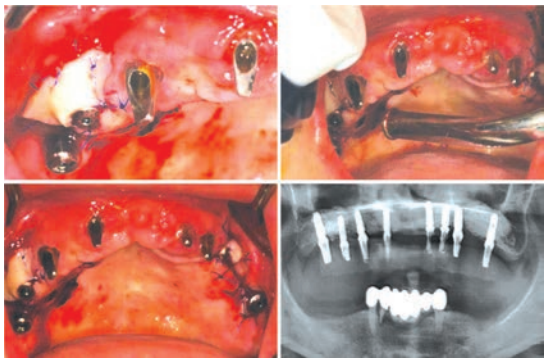


Fig. 7. Apically positioned flap and free gingival graft were performed in molar teeth part with deficient keratinized gingiva, and temporary prostheses were placed.

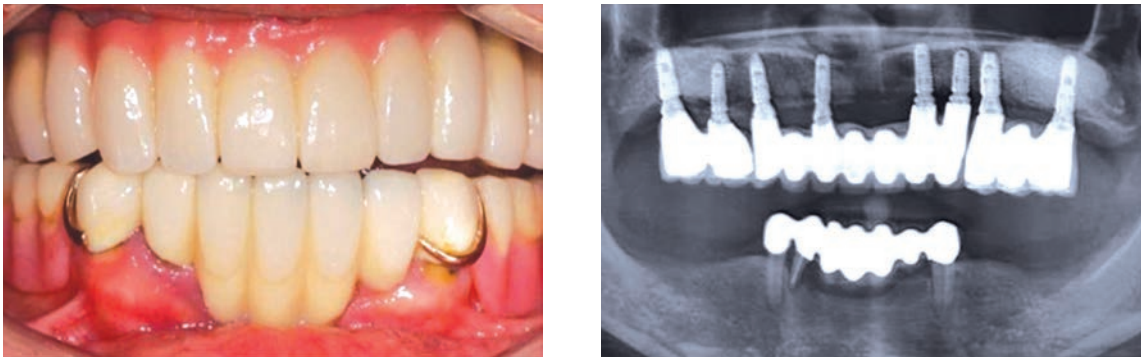


Fig. 8. A picture of the front part and panoramic radiograph taken after placing the final prostheses. Implant-supported, full-mouth prosthetic reconstruction was completed by using 8 implants.

Case | Implant location: #16,17, 26,27,36,37,45,46,47 | Age : 52, Sex : F

7

Seoul Dental Clinic

Director

Lee, Dae-Hee

A clinical case of prosthetic treatment using TSIII SA after a bone graft in a region lacking vertical and horizontal bone mass

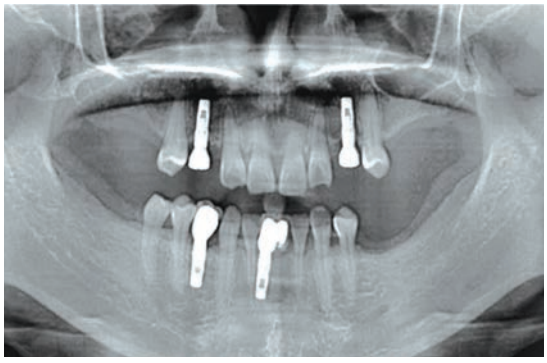


Fig. 1. The transferred patient had lots of missing teeth both in the maxillary and mandibular molar regions. The metal color of the fixture showed through the mucosal membrane in the anterior region where the implant was installed, so this is where the guided bone regeneration was required.

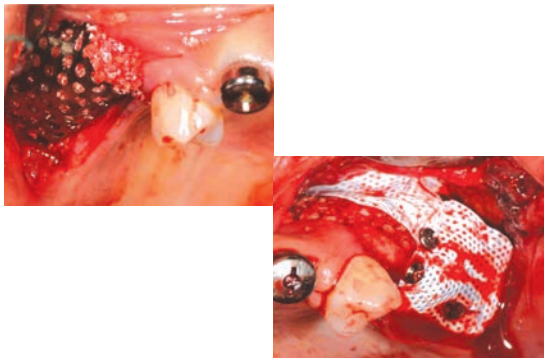


Fig. 2. Guided bone regeneration was performed by using ridge augmentation with titanium mash in the right maxillary molar region and a non-resorbable membrane after the maxillary sinus lift in maxillary left molar region.

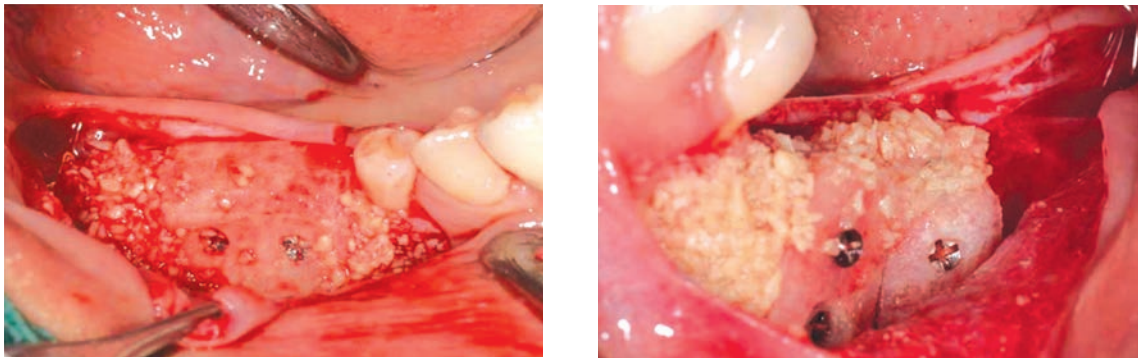


Fig. 3. Horizontal bone augmentation was performed by using an allogeneic block bone on both sides of the mandibular molar region.

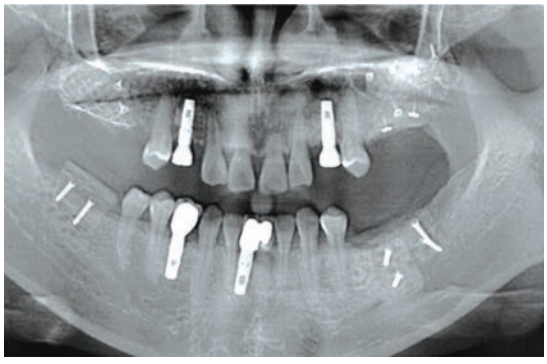


Fig. 4. Panoramic radiograph after bone graft procedure

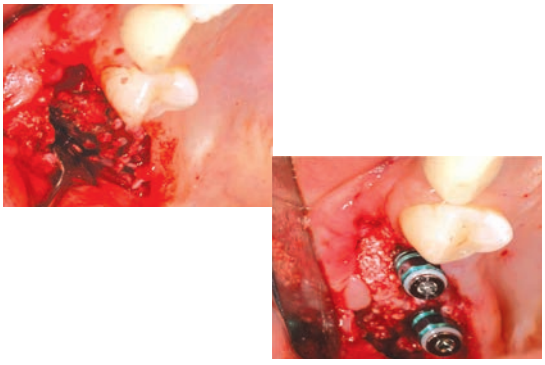


Fig. 5. TSIII implants were installed by using a submerged procedure in the maxillary right molar region after about five months.

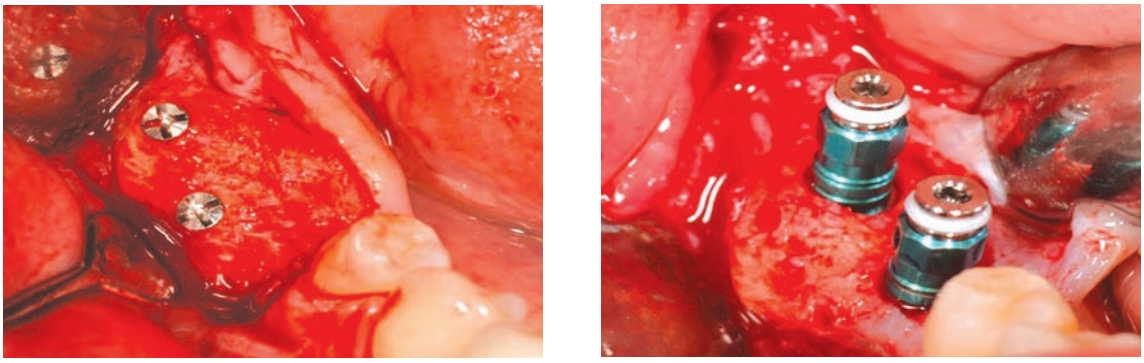


Fig. 6. An allogeneic bone block, grafted in the mandibular right molar region, was found well integrated without absorption. Two TSIII implants were installed after removing excessive bone.

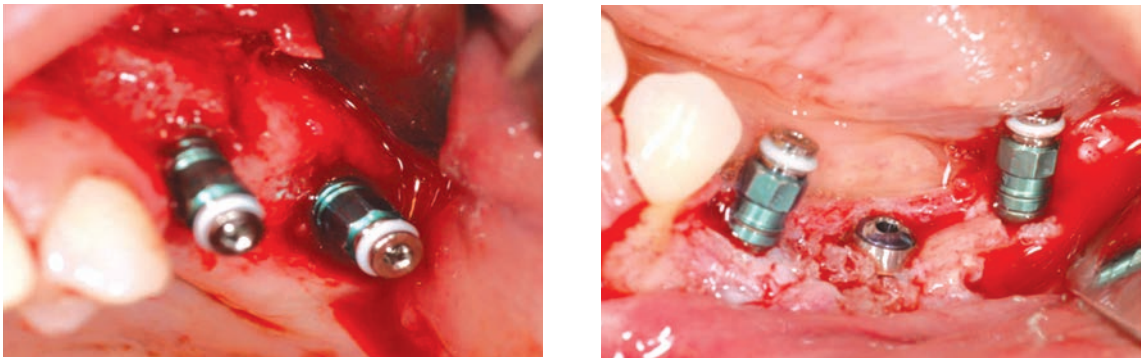


Fig. 7. TSIII implants were installed in the maxillary left molar region and the mandibular molar region as well.

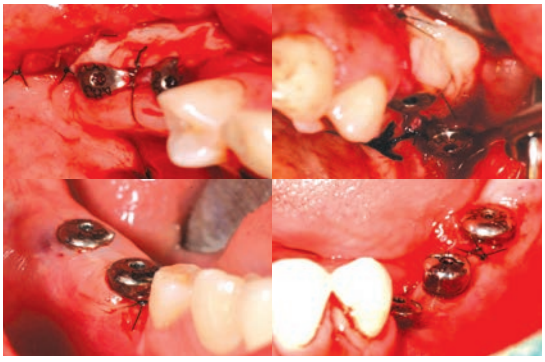


Fig. 8. The second surgery was done using punch in the mandible about 2 months after the implant installation, and the apically positioned flap and free gingival graft were performed in the maxilla to extend the width of the keratinized gingiva.

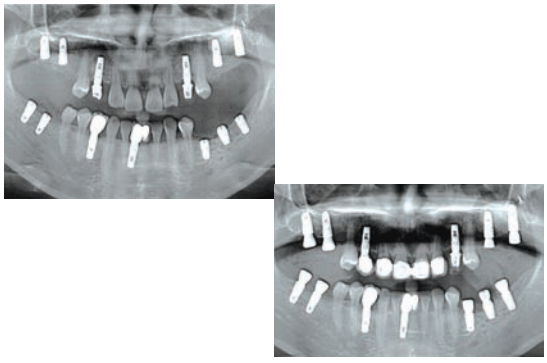


Fig. 9. The upper picture was taken after the first surgery while the bottom one shows a radiograph right after completion of the second surgery.

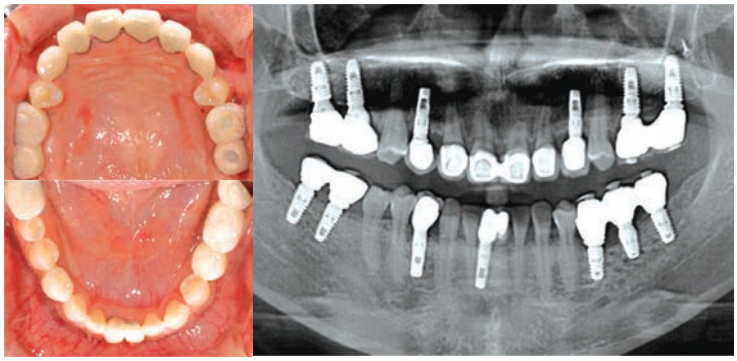


Fig. 10. Final prosthesis was installed after three months of use of temporary prosthesis.

Case | Implant location: #11 | Age : 53, Sex : F

8

Chungbuk National University Hospital

Professor

Kim, Kyeong-won

An implant installation accompanied with a bone graft after extraction of the maxillary anterior tooth

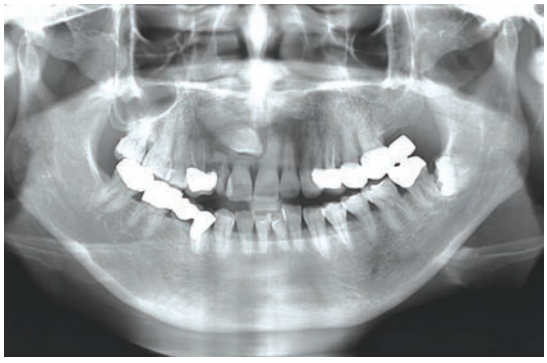


Fig. 1. Initial panoramic radiograph. A central incisor with mostly resorbed root, a lateral incisor, and a completely impacted canine were observed.

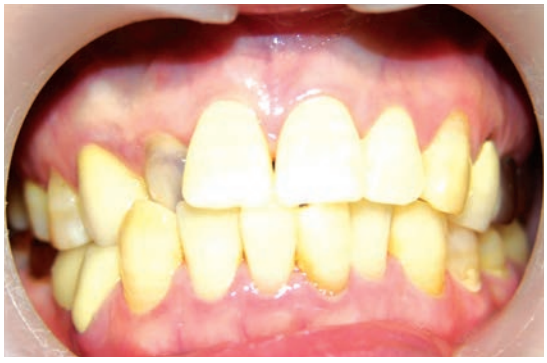


Fig. 2. Initial intra oral findings. It was impossible to install two implants due to the linguoclination of the lateral incisor and crowding.

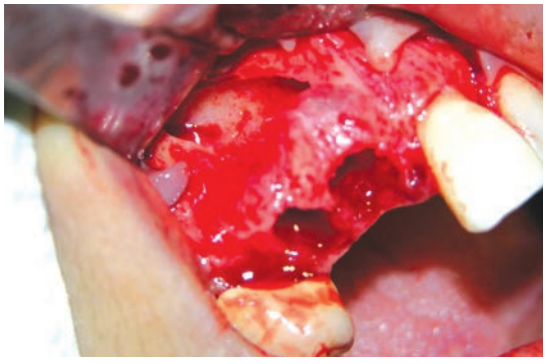


Fig. 3. Extraction was done by smashing the completely impacted canine into small pieces while preserving the alveolar bone in the lateral incisor position.

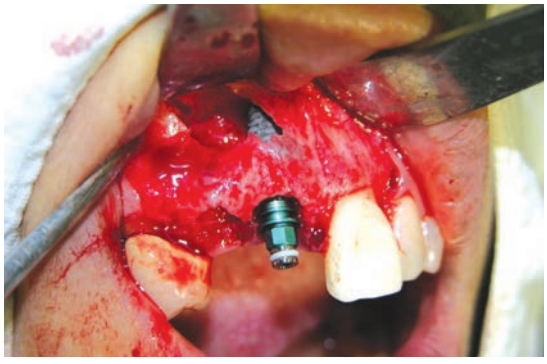


Fig. 4. Intraoral picture after installation of the implant (TSIII, 4.0 X 13mm) in the position of the lateral incisor. Since the bone loss was severe in the position of the completely impacted tooth, it was not possible to obtain an initial fixation on the upper part of the TSIII fixture. Therefore, the initial fixation was secured by installing about 2~3mm of the fixture into the alveolar bone.

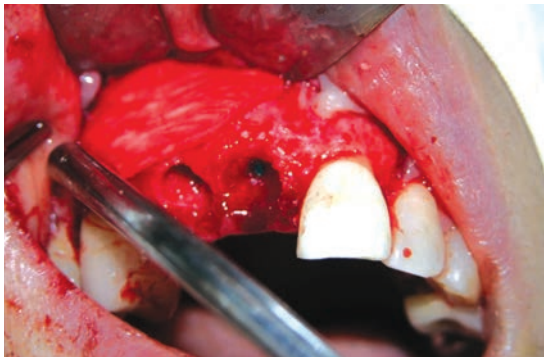


Fig. 5. Defect covered with resorbable collagen membrane after allogeneic bone graft (SureOss) in the position with bone loss.

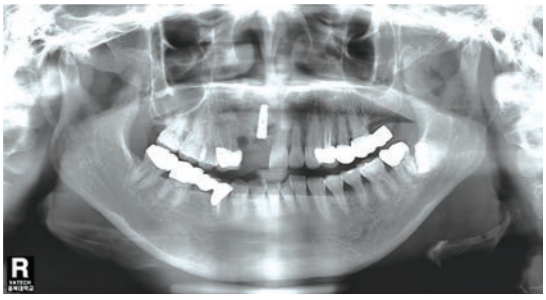


Fig. 6. Panoramic radiograph right after the procedure

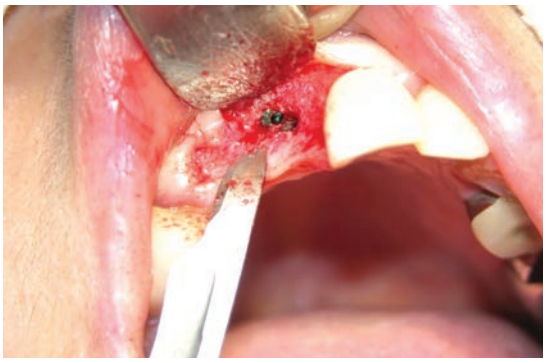


Fig. 7. Intraoral picture after exposing implant by second surgery 4 months after first surgery. It was observed that top of cover screw was covered with bone tissue after flap elevation.

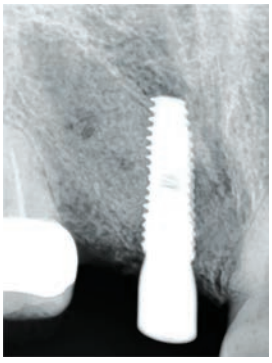


Fig. 8. Periapical radiographic view after second surgery

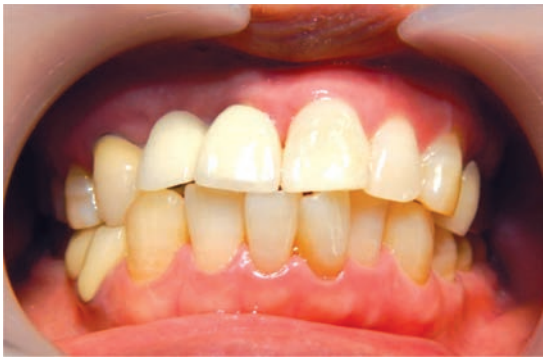


Fig. 9. Intra-oral view after 1 year and 9 months since the final prosthetic placement

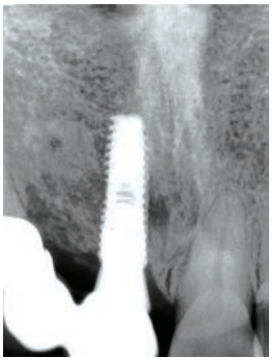


Fig. 10. Periapical radiography after 1 year and 9 months since the final prosthetic placement

Case | Location #33, 43 | Age : 64, Sex : F

9

Seoul Ace Dental Clinic
Director
Park, Hwee-Woong

An overdenture case using TSIII Implant Locator Abutment

Full-teeth extraction from the maxilla and mandible
An implant installation in the mandibular canine region : TSIII SA 4D/10L, 4D/11.5L
Primary stability: Insertion torque 40-50 Ncm

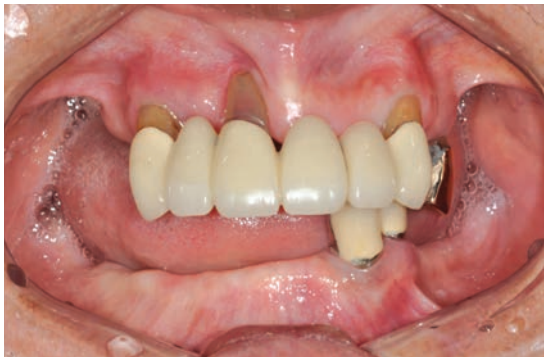


Fig. 1. An intra-oral view taken on the initial visit. Even though remaining teeth were fixed and connected from one to another; they showed severe mobility.

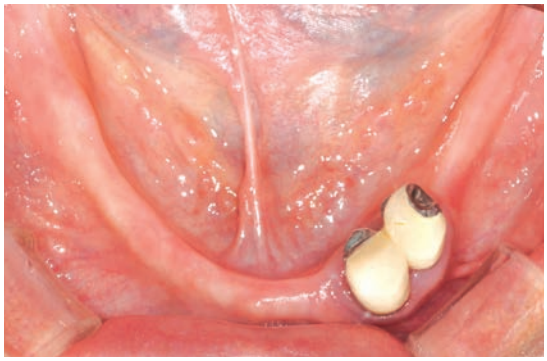


Fig. 2. Mandibular occlusal view

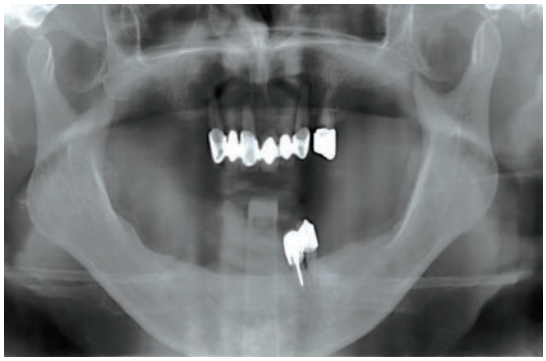


Fig. 3. Panoramic radiograph before the procedure

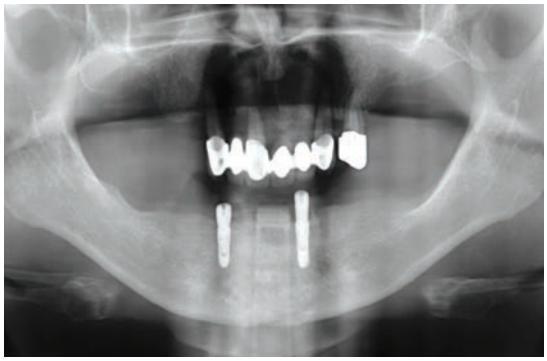


Fig. 4. Two TSIII implants (diameter, 4mm; length, 10, 11.5mm) were installed in the canine positions after extracting the remaining mandibular teeth.

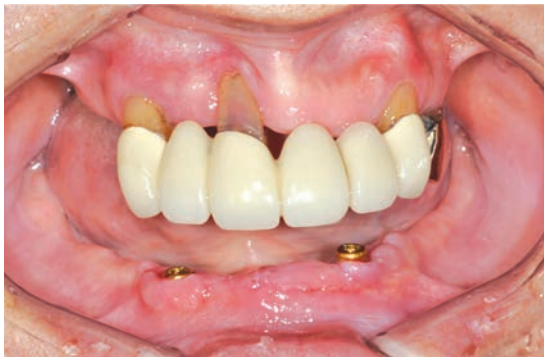


Fig. 5. We decided to connect a Locator abutment ten days after the implant installation to help support and hold the denture.

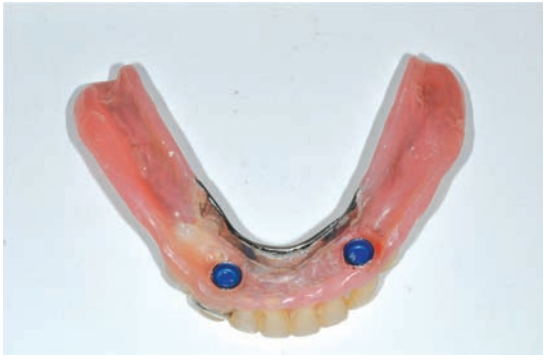


Fig. 6. The locator attachment is connected to the previous prosthesis after repairing. Early loading was attempted ten days after installation of the mandibular implant.

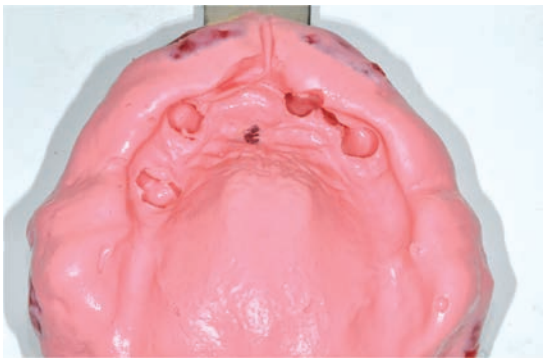
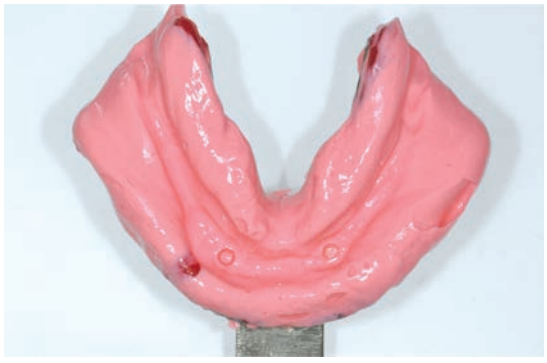



Fig. 7. An arginate impression was taken from both the mandible and maxilla for a new immediate denture.

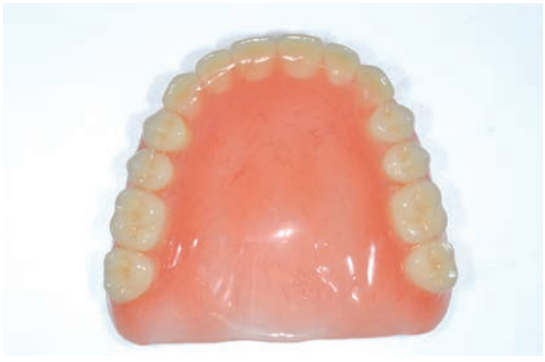
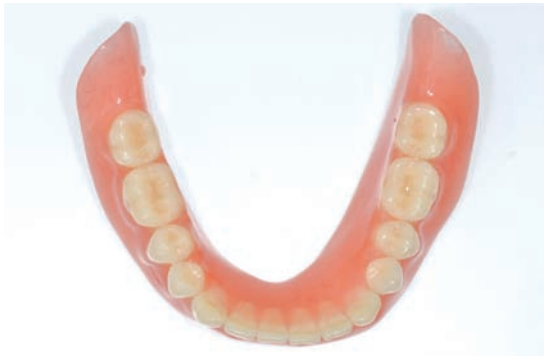



Fig. 8. The completed immediate denture of the mandible and maxilla

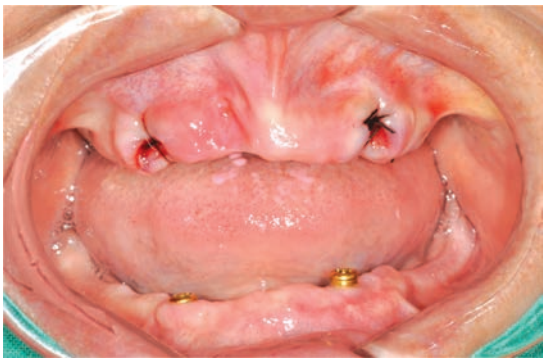


Fig. 9. The remaining teeth were all extracted from the mandible and maxilla.

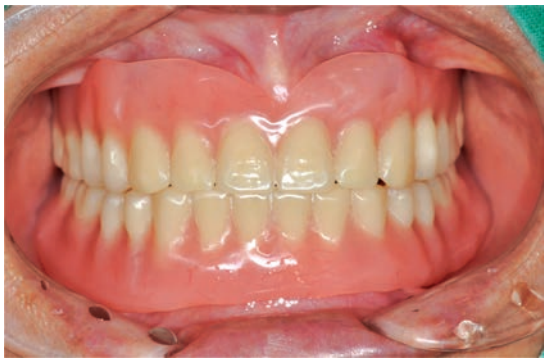


Fig. 10. The immediate denture was placed in the maxilla and the Locator attachment was connected to the implants in the mandible.

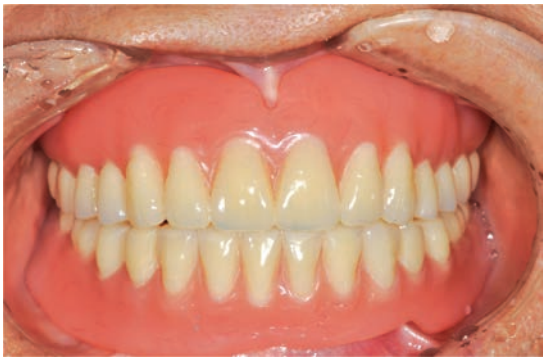


Fig. 11. Trial placement of the final prosthesis for the mandible and maxilla

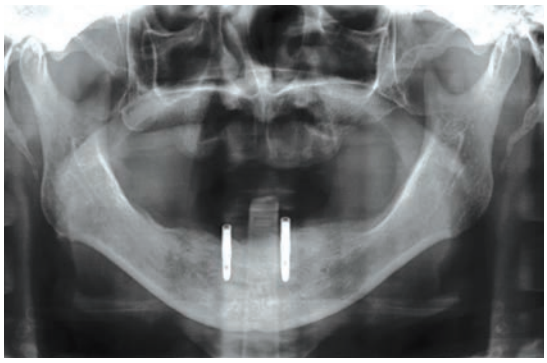
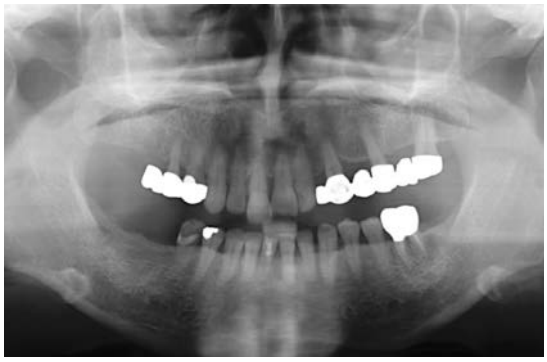


Fig. 12. Panoramic radiograph after treatment completion

Case 1 | Implant position: Multi. | Age:64, Sex:F

Milling CAD/CAM Titanium Abutment for Implant Prosthesis-Clinical Result

A' dent Dental Clinic
Director
Cho, Hyun-Ki



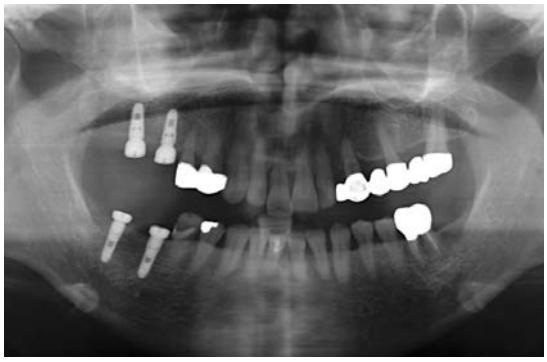
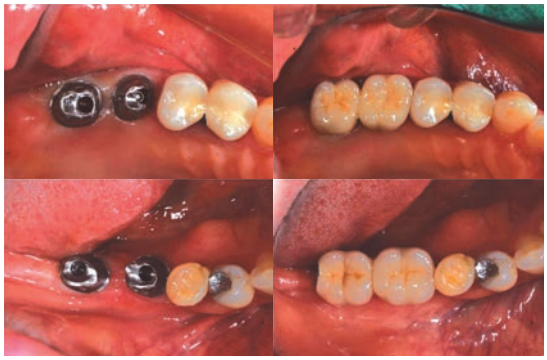


Fig. 1~2. #16, 17, 46, 47 TSIIISA Implant placement. One-stage method (2010. 5. 31).



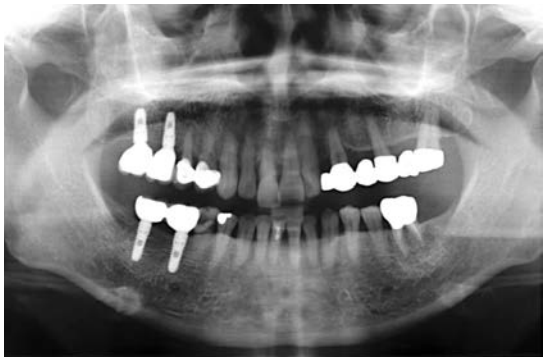
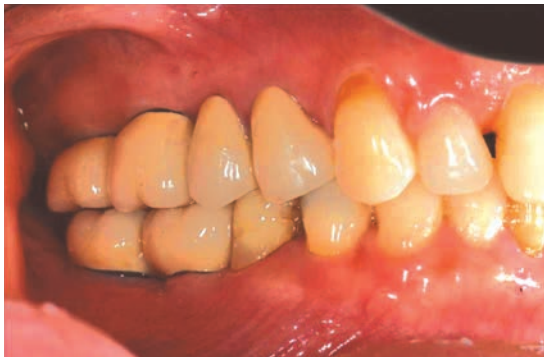


Fig. 3~8 #16, 17, 46, 47 final crown with custom abutment (2010. 8. 18).



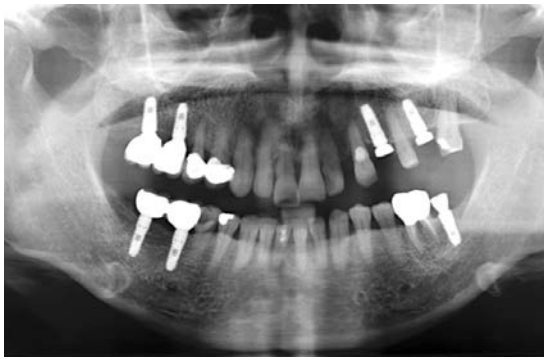


Fig. 9. #23-27 crown and bridge removal.
#24, 26, 37 implant placement one-stage method (2010. 8. 31).

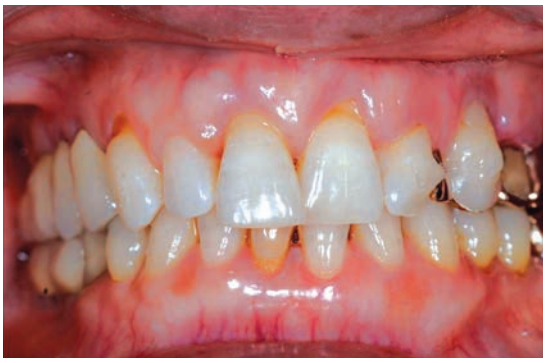


Fig. 10. #23 mesial space, #11 labial position.
Start of orthodontics treatment for labioversion and space recovery (2010. 9. 8).

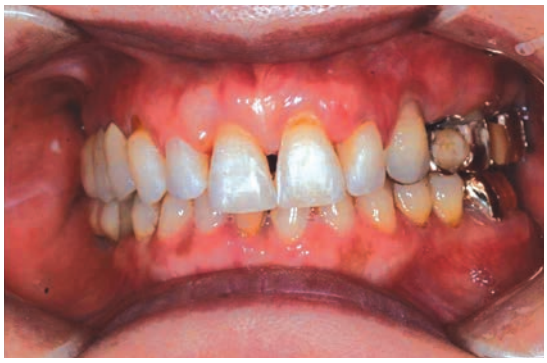
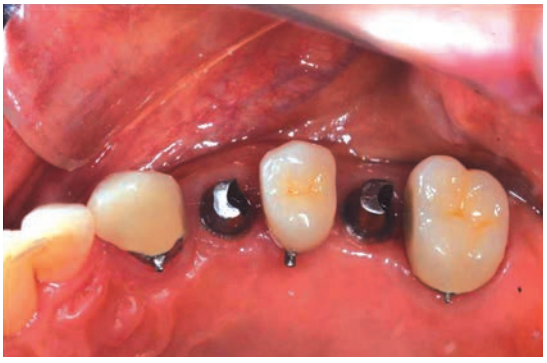


Fig. 11. #11 finish of orthodontics treatment (2010. 12. 7).



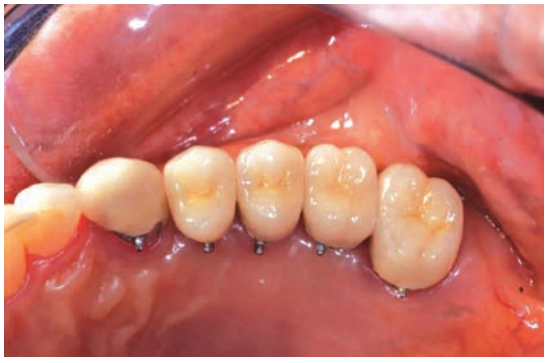
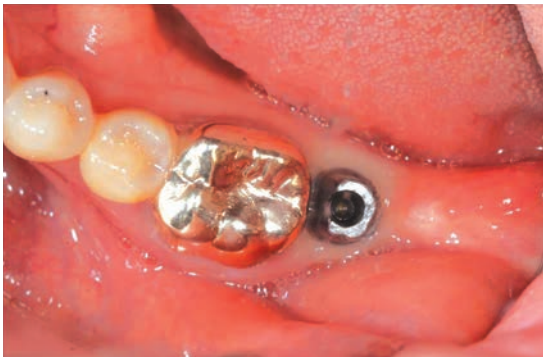


Fig. 12~13. #24, 26 final crown with transfer abutment (2010. 12. 22).



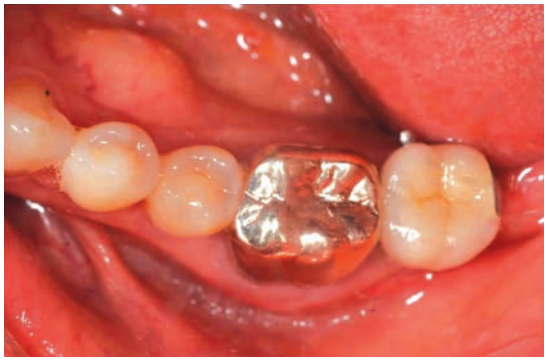
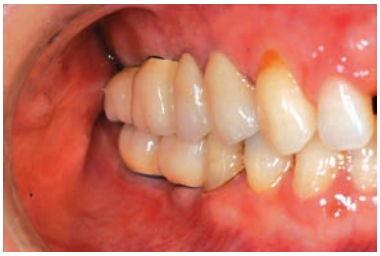
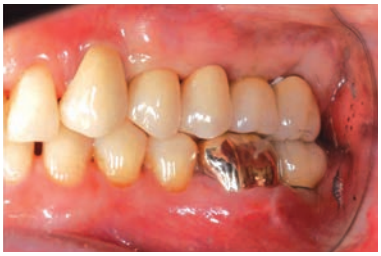


Fig. 14~15. #37 final crown with transfer abutment (2010. 12. 22).





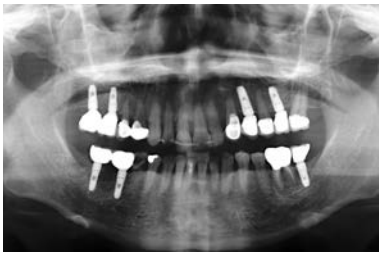


Fig. 16~18. Final prosthesis (2010. 12. 22).

Case 2 | Implant position: #36, #37 | Age:49, Sex:M

Maximizing Esthetic and Functional Outcomes through the Evolution in Implant Abutment Design: Osstem CAD/CAM "SmartFit" Abutment

Namsang Dental Clinic
Director
Kim, Ki-Seong

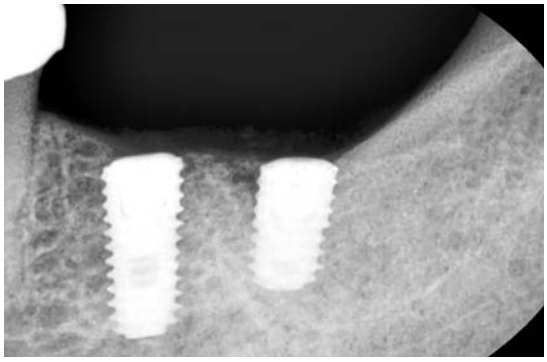


Fig. 1. Placed #36, #37 TSIII SA implants.

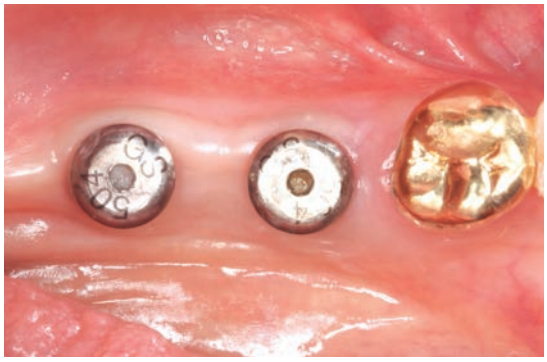


Fig. 2. Setting the healing abutment.

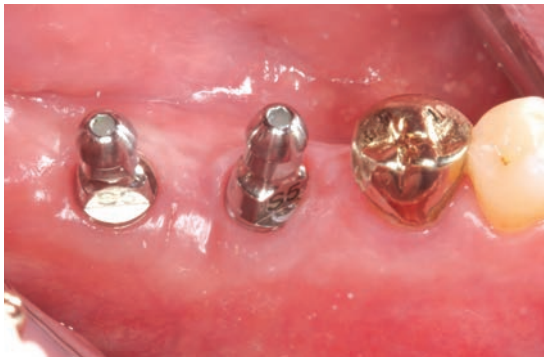


Fig. 3. Taking fixture-level impression.

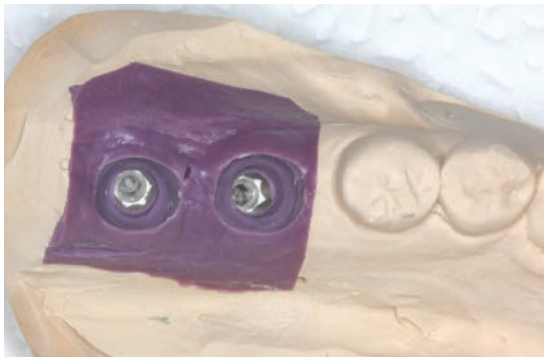
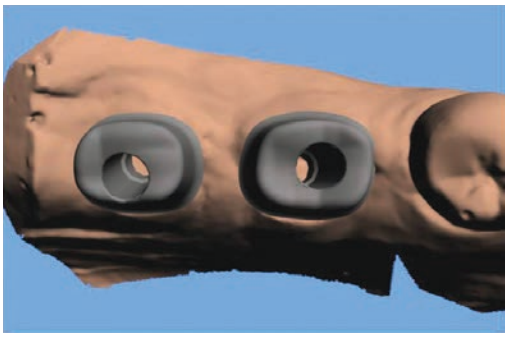
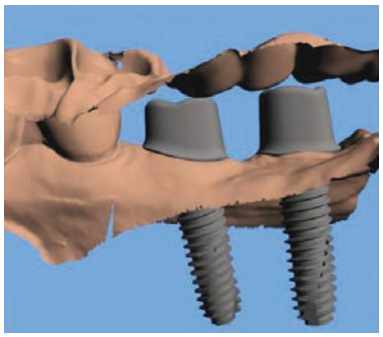


Fig. 4. Checking the working model.





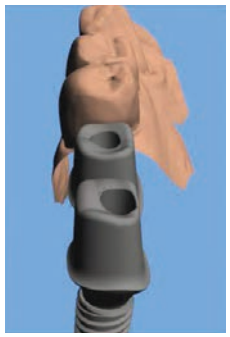


Fig. 5~7. 3D interactive abutment design confirmation.


Fig. 8~9. Cast-gold and milling abutment limitations were overcome with SmartFit abutment for Osstem implants to which CAD/CAM technology were applied. They were regarded as a good alternative to aesthetic and functional implant restoration.

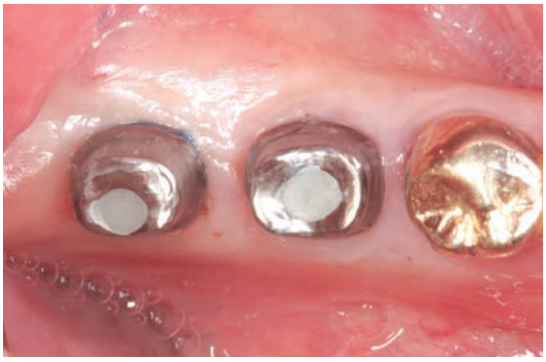
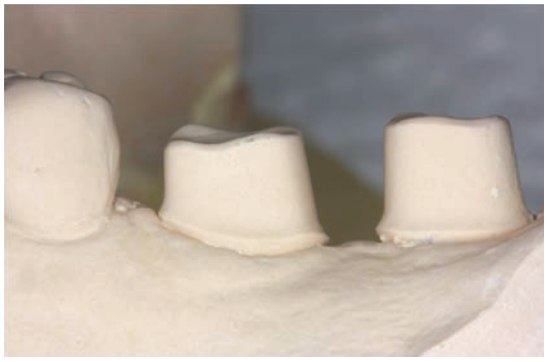



Fig. 10~11. Abutment positioning. The abutment screw is retightened at least twice at 30Ncm with 10 minutes interval. The abutment margin is exposed using the retraction cord if necessary, and then abutment level impression is made.

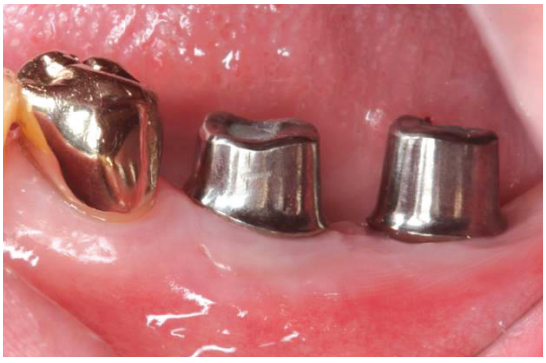
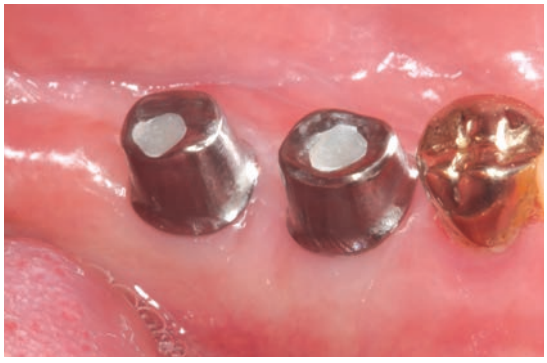



Fig. 12~13. Removing the provisional restoration for final restoration delivery.

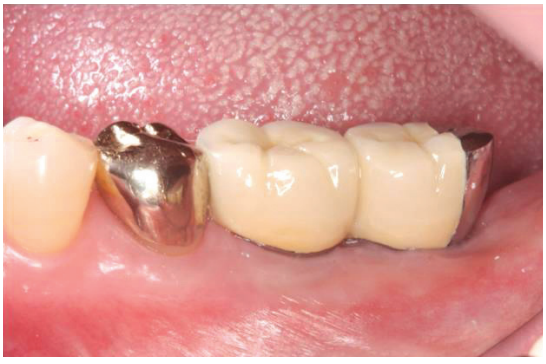
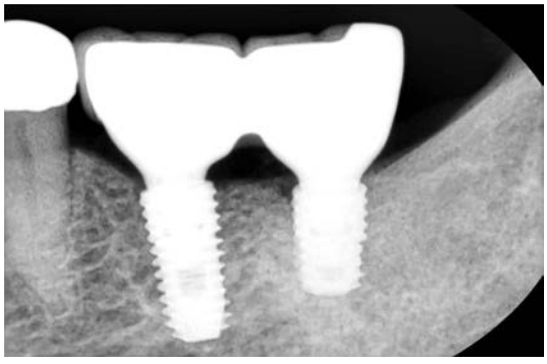



Fig. 14. Cementation with temporary cement.

Fig. 15. Periapical radiograph for checking the residual excess cement.

Case | Implant position: #35, #36, #37 | Age:70, Sex:F

3

Yena Dental Clinic

Director
Yang, Choon-Mo

CAD/CAM Guided Flapless Implant Surgery and Immediate Loading Utilizing OsstemGuide

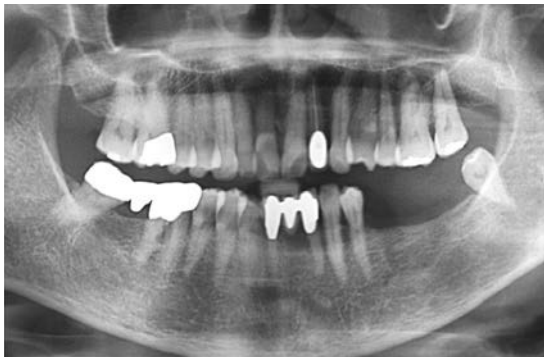


Fig. 1. A 70 year old female patient.
3 month healing after extraction of #35 tooth due to root decay.

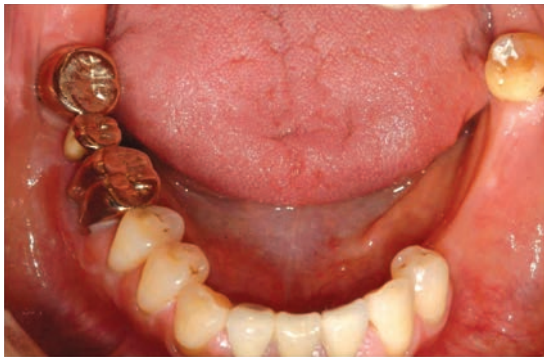


Fig. 2. Minimal attached gingiva was observed and considerable horizontal alveolar bone resorption was estimated in lower left quadrant.

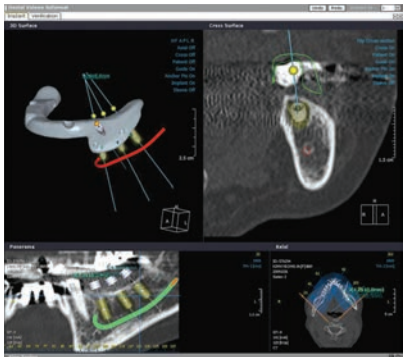


Fig. 3. 3D planning for OsstemGuide.

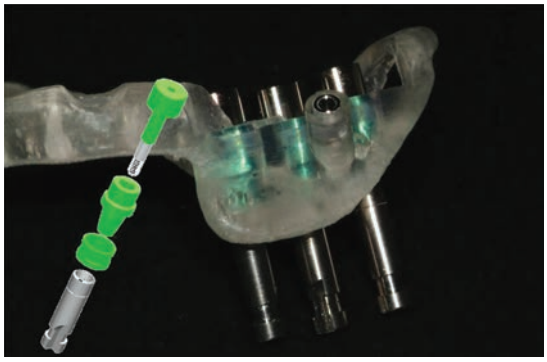


Fig. 4. Implant replica placed into the sleeves of surgical guide for making working cast.

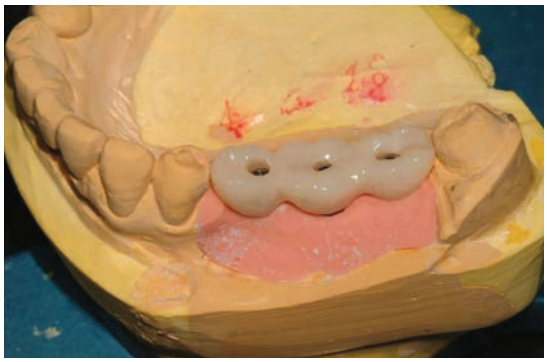


Fig. 5. Prefabrication of provisional restoration before implant surgery.

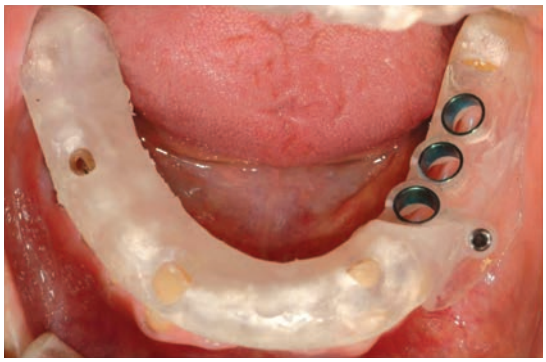


Fig. 6. Anchored surgical guide in the mouth for flapless implant placement.

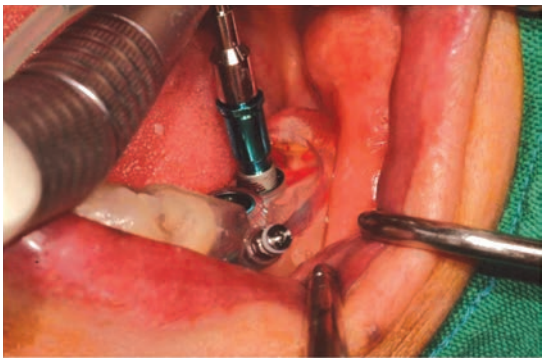


Fig.7. Implants were placed into the computer-planned sites through sleeves of OsstemGuide.

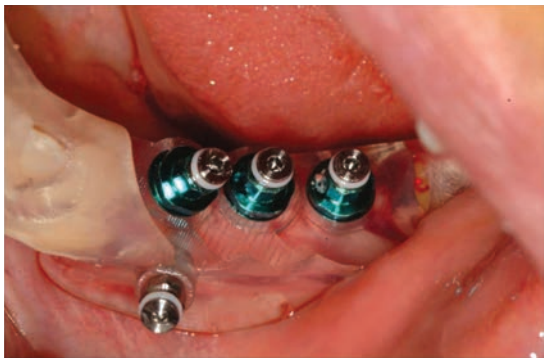


Fig.8. Implants in ideal position and with optimized angulation

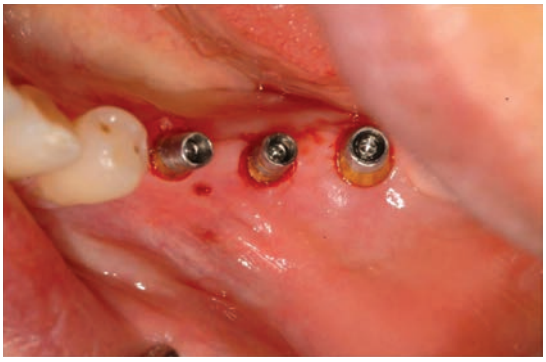


Fig. 9. Temporary abutments attached to the implants. Ready to load immediately.

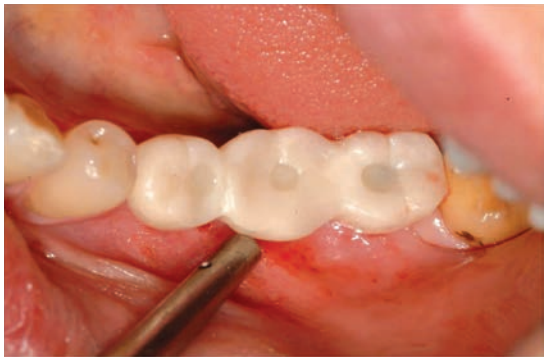


Fig. 10. Immediately loaded screw-retained provisional prosthesis.

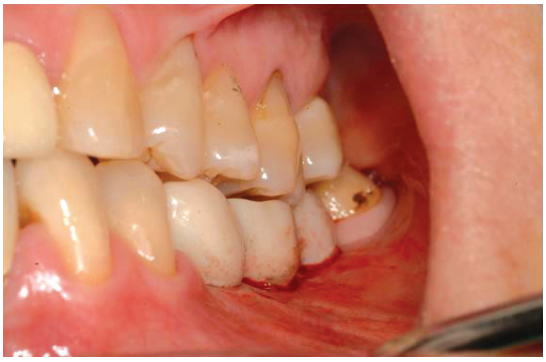


Fig. 11. Minimally invasive surgery and immediate loading by prefabricated provisional prosthesis.

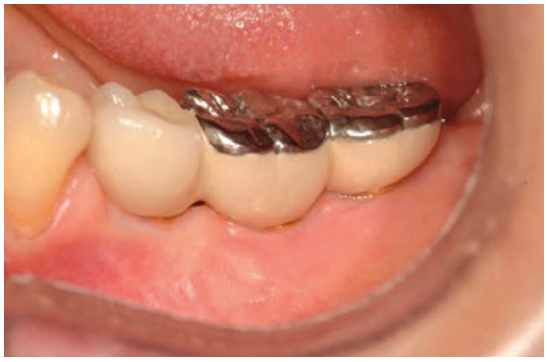


Fig. 12. Definite prosthesis delivered after 5 months of loading by provisional restoration.

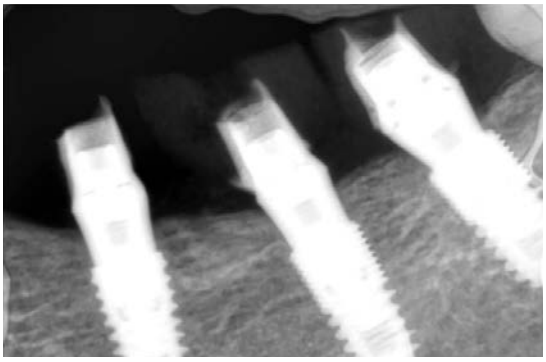


Fig. 13. Immediate provisional resin restoration at the day of surgery.

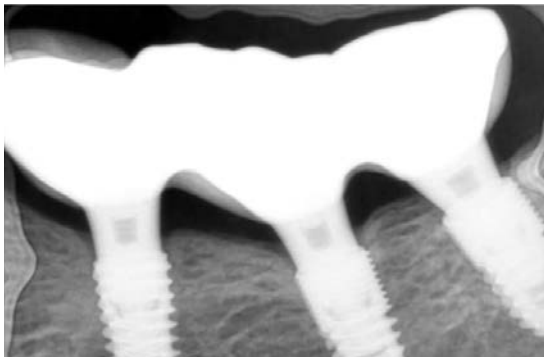


Fig. 14. Definite prosthesis after 1 and half year of loading. Note increased bone remodeling around implant fixtures.

Case | Implant position: #11 | Age:27, Sex:F

4

Restoration of the maxillary anterior region using the TSIII Implant and SmartFit Abutment

Seoul Ace Dental Clinic
Director
Park, Hwee-Woong

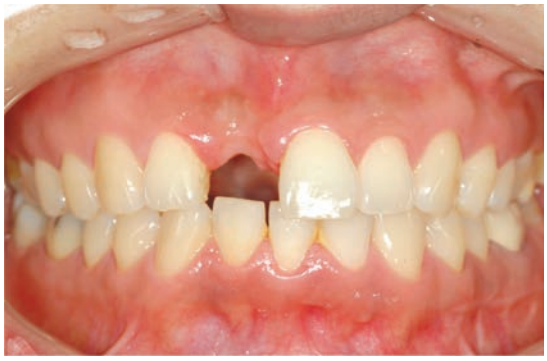


Fig. 1. Resorption and concavity of the labial side of alveolar ridge was observed in the first visit.

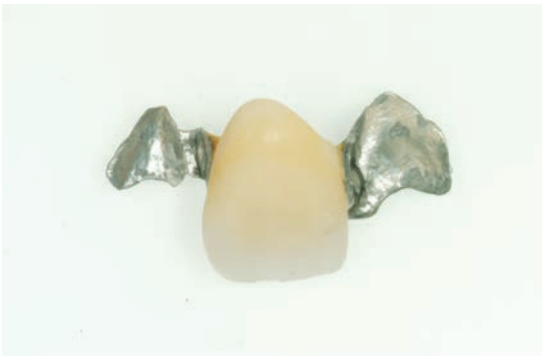


Fig. 2. According to the patient, this adhesion bridge had been used for 17 years with repeating detachment and reattachment.

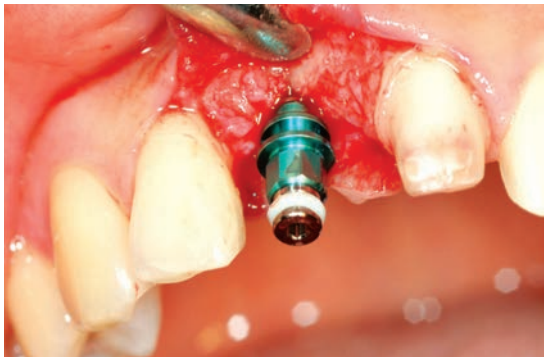


Fig. 3. Implant (TSIII SA 4D, 10L) was installed, and synthetic bone (BCP) was grafted in the region with a shortage of alveolar bone mass on the labial side. Since primary stability was found to be as weak as insertion torque of 30N cm, which was not enough for immediate restoration, short healing abutment was connected and the wound was sutured.

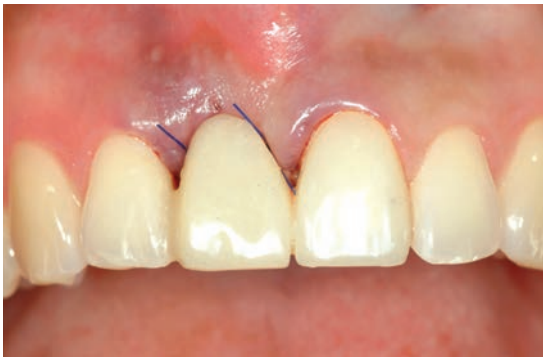


Fig. 4. The picture was taken after placing a fixed temporary prosthesis by using proximal teeth on the day of its installation

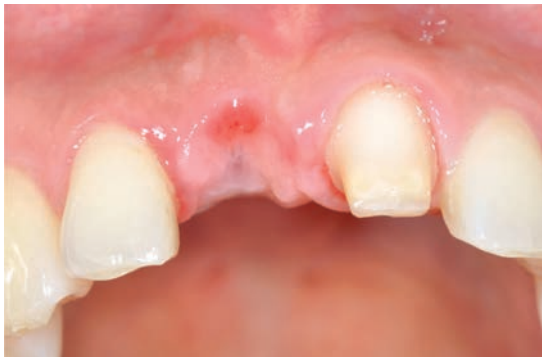


Fig. 5. This picture was taken 3 months after the installation

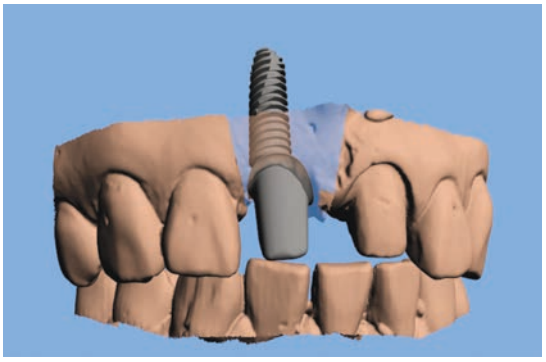


Fig. 6. A fixture-level impression was taken after the second surgery and the CAD model was generated to produce SmartFit Abutment.

Fig.7. Fabricated SmartFit Abutment and screw

Fig.8. Finished SmartFit Abutment shows a similar shape to that of natural abutment teeth.

Fig. 9. A ceramic-veneered zirconia crown was made as a final prosthesis.

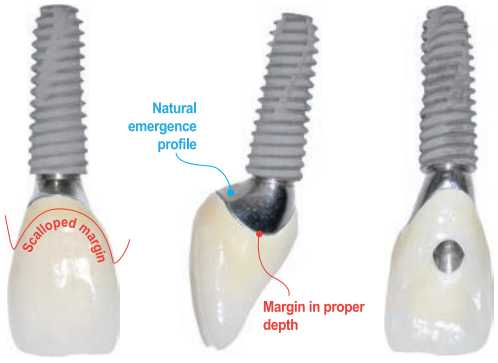


Fig. 10. Soft tissue, which is more similar to natural teeth in anatomical structure and aesthetically better, can be obtained by using SmartFit Abutment. Moreover, since the margin is formed with constant depth along the gingiva, it is easy to remove residual cement. A screw hole was formed on the lingual to keep retreivability.

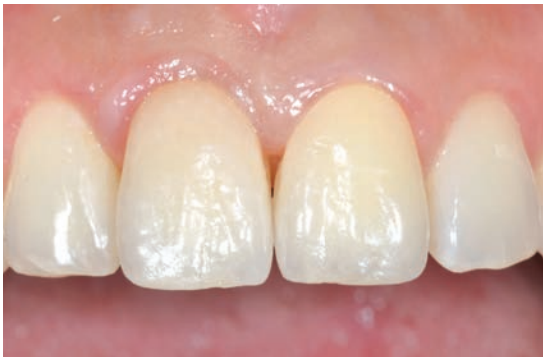


Fig. 11. After placement of the final prosthesis

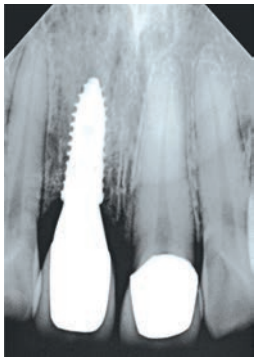


Fig. 12. Periapical radiograph after placement of final prosthesis

Case 1 | Implant position : #16 | Age : 62, Sex : M

Wide Diameter Implant Installation with Sinus Graft

All Dental Clinic
Director
Oh, Young-Hak

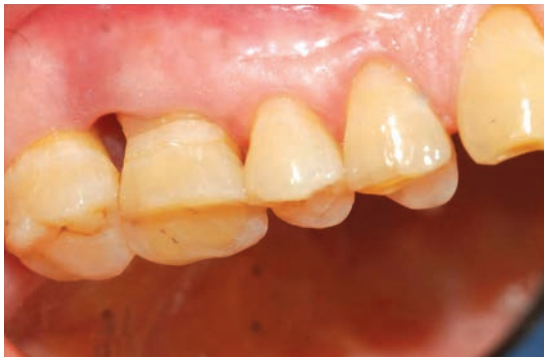


Fig. 1. The patient visited the clinic chiefly complaining of mastication troubles with food packing problem.

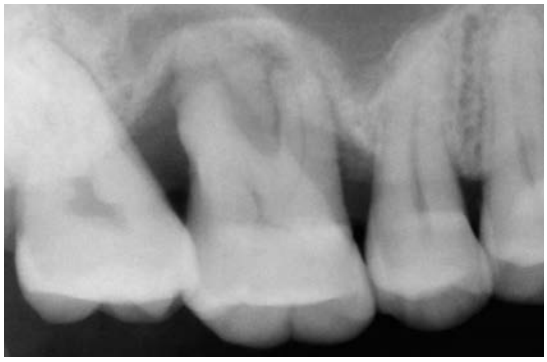


Fig. 2. Pre-operative radiograph of extraction.

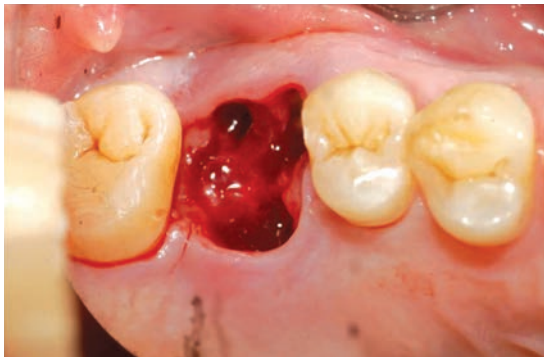


Fig. 3. After the extraction.

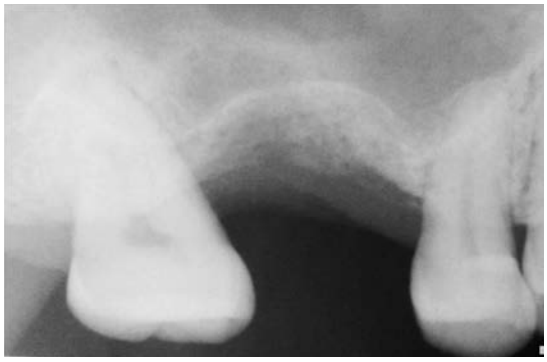


Fig. 4. Periapical radiograph after 3 months of the extraction.

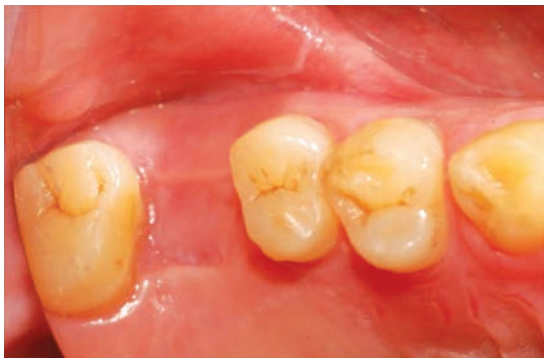


Fig. 5. Photographics of the Intra-oral cavity after 3 months of the extraction. Well-matured soft tissues are shown.

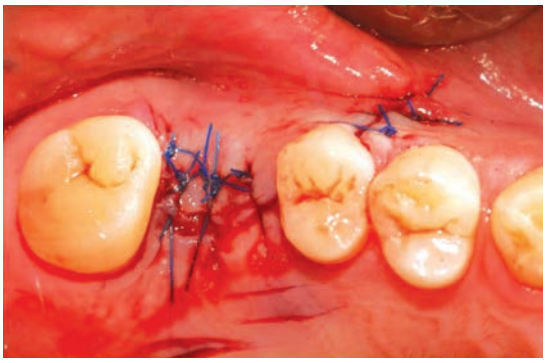


Fig. 6. Wide implant implantation with sinus graft & GBR (MBCP, Tutoplast & CYTOPLAST).

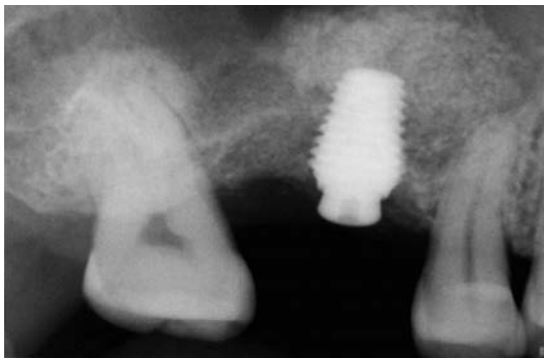


Fig. 7. 2.5 months after implant placement.

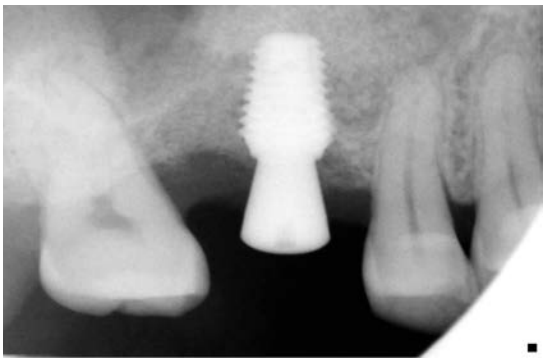
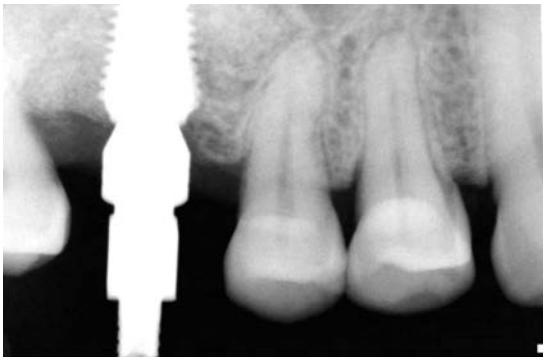


Fig. 8. 4 months after 2nd surgery.



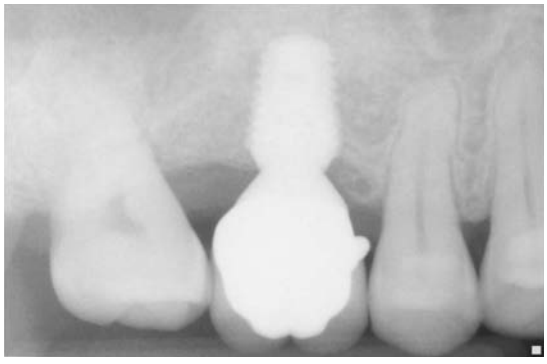
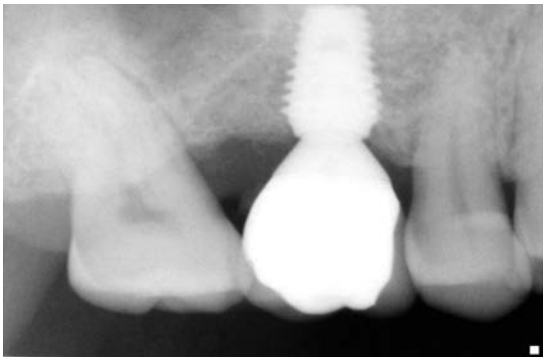


Fig. 9~10. Impression and final prosthesis setting at 6 months after implant placement.



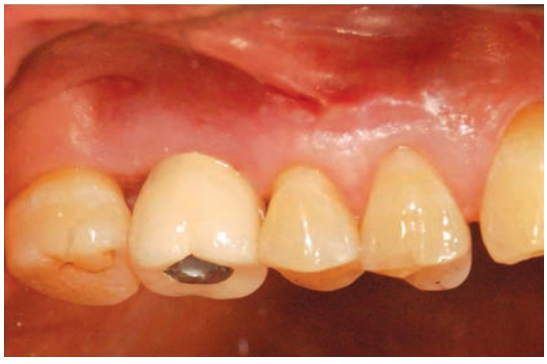


Fig. 11~12. Periapical radiograph at 7 months after implant placement. Well-matured soft tissues are shown.

Case | Location : #27 | Age : 48, Sex : F

2

Apsun Dental Clinic

Director
Cho, Yong-Seok

Immediate Ultra-Wide USII implant placement after extraction of maxillary left 2nd molar

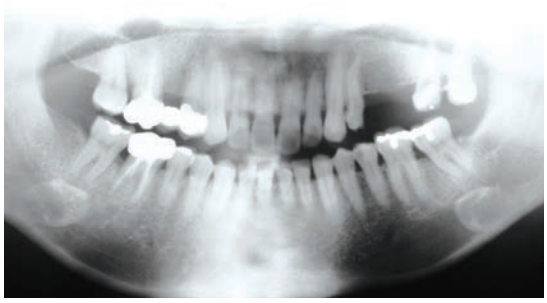


Fig. 1. 48 years old female patient visited for mobility of #27 and #28.

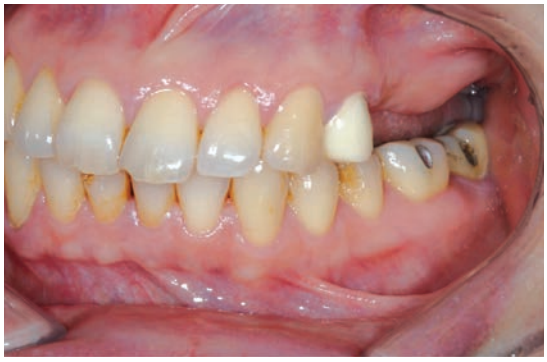


Fig. 2. 1 week after extraction of #27 and #28.

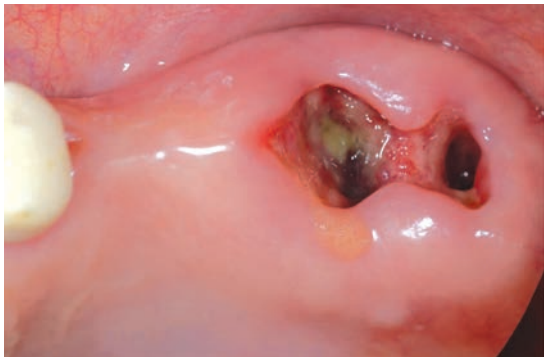


Fig. 3. In Occlusal view wide extraction socket of #27 was seen.

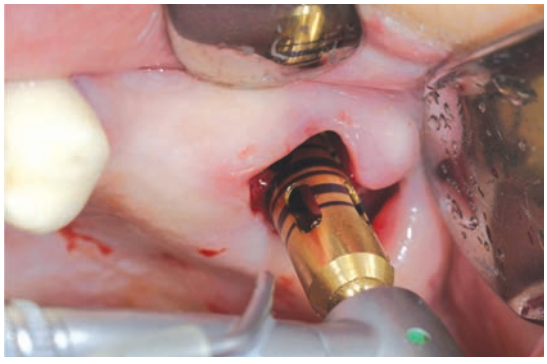


Fig. 4. Using ID ⌀5.3mm trephine bur implant site of #27 was enlarged

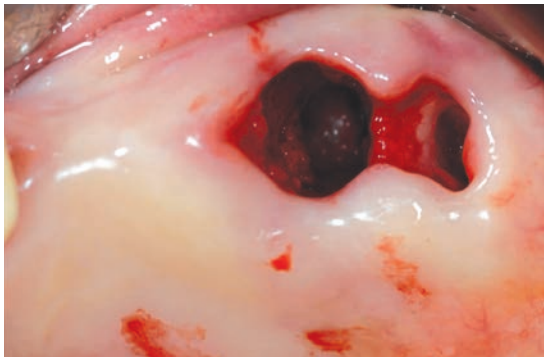


Fig. 5. Drilling was finished at one stroke

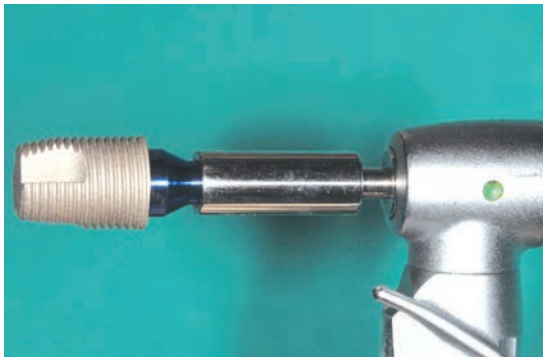


Fig. 6. USII Ultra-Wide 7.0x10.0mm fixture was prepared

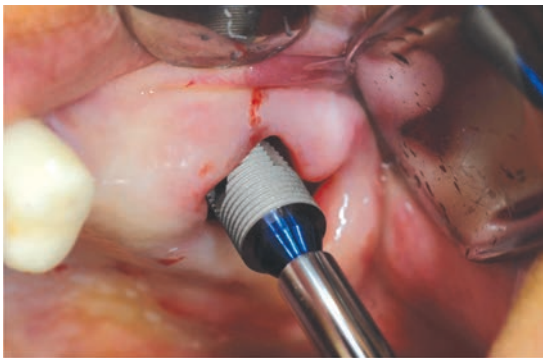


Fig. 7. USII Ultra-Wide 7.0x10.0mm fixture was installed at #27

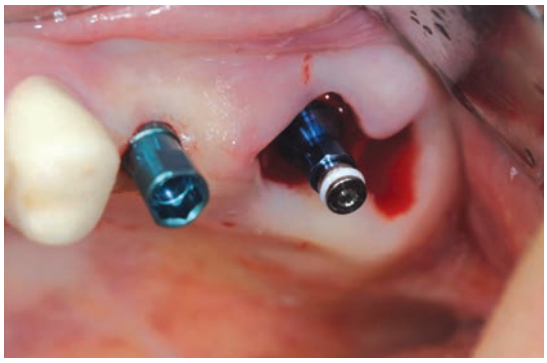


Fig. 8. GSII 4.0x11.5mm fixture was installed at #25 with flapless surgery

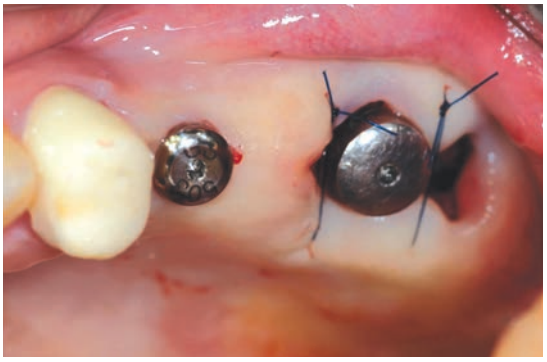


Fig. 9. After healing abutment connection flap was approximated with interrupted sutures

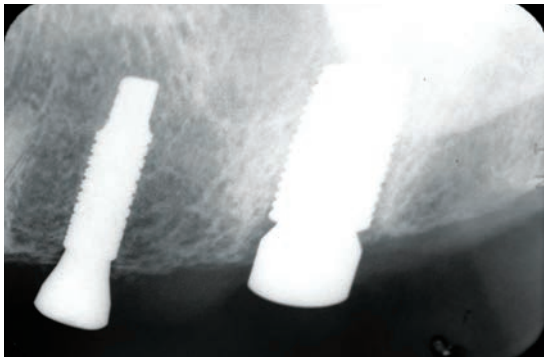


Fig. 10. POP Standard X-ray view showed well positioned implants

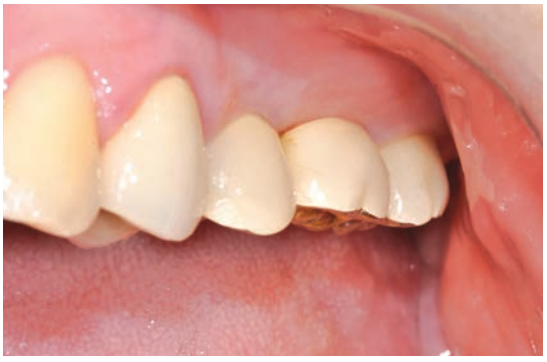


Fig. 11. Clinical photo of 4 years and 9 months after bridge delivery

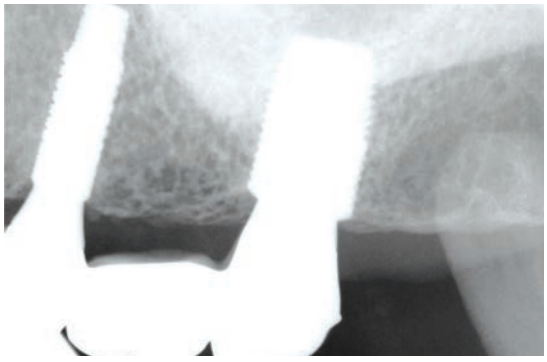


Fig. 12. Standard X-ray of 4 years and 9 months after bridge delivery

Case | Location : #46, 47 | Age : 54, Sex : F

3

Seoul National University Bundang Hospital
Professor
Kim,Young-Kyun
Yi, Yang-Jin

GSII Ultra-Wide in the mandibular posterior region

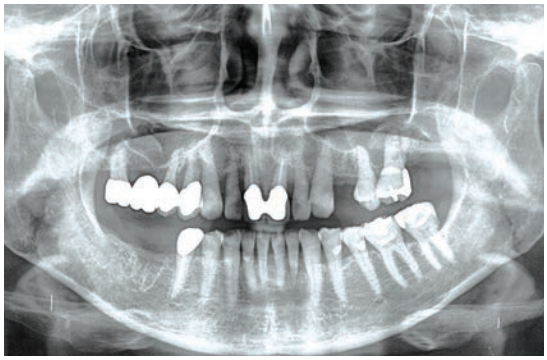


Fig. 1. Initial panoramic radiograph. one month after extraction of the teeth(#46, 47)

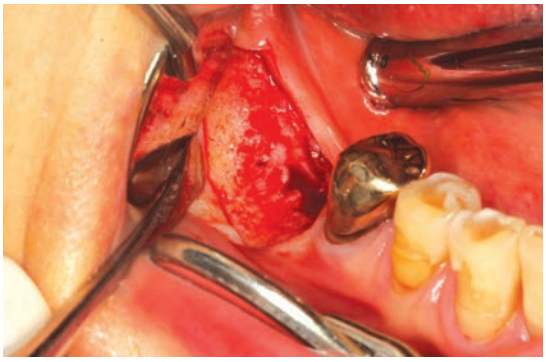


Fig. 2. Elevated flap

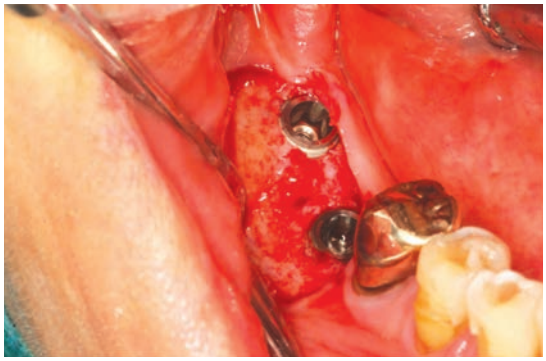
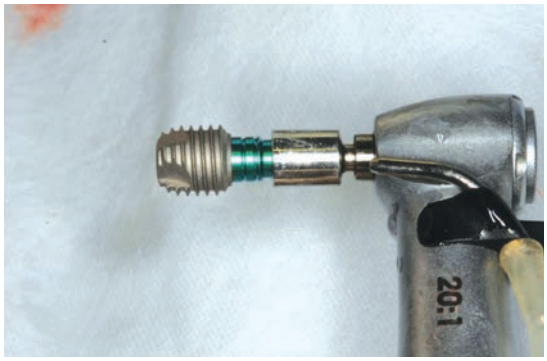


Fig. 3. Implant installed(GSII Ultra-Wide 6D/6L)



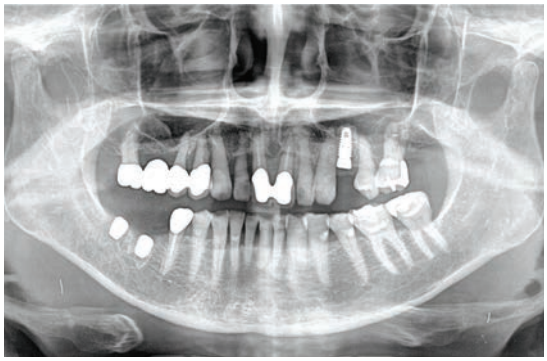


Fig. 4. Panoramic radiograph after the implant installation

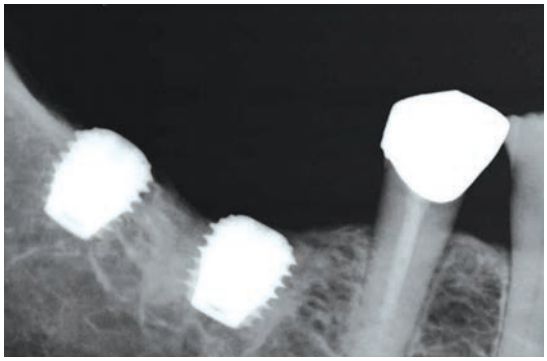


Fig. 5. Periapical radiograph 10 days after the implant installation

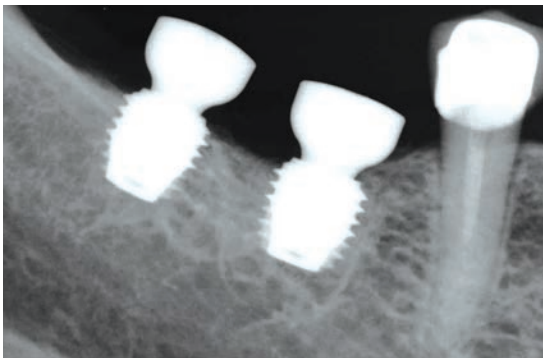


Fig. 6. Periapical radiograph after the second surgery. The second surgery was performed 3.5 months after the implant installation.

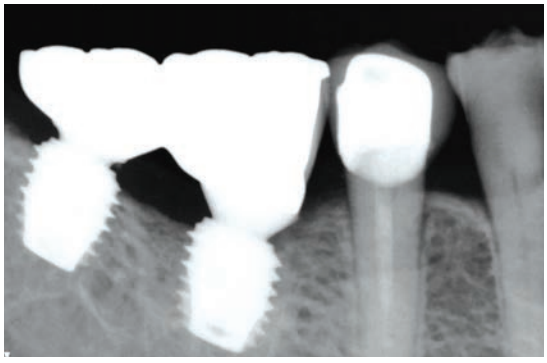


Fig. 7. Periapical radiograph three weeks after placement of the final prosthesis

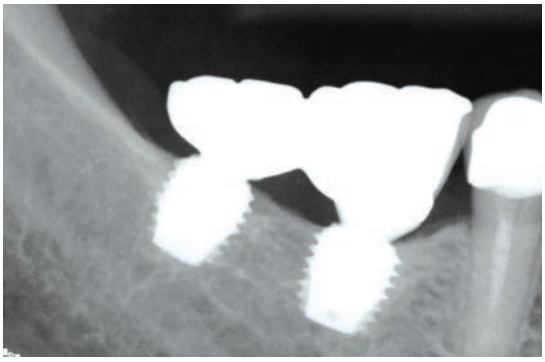


Fig. 8. Periapical radiograph 14 months after the placement of final prosthesis

Case | A case of a partial edentulous mandible : #36-37, 46-47 | Age : 58, Sex : F

4

Seoul National University Bundang Hospital
Professor
Kim,Young-Kyun
Yi, Yang-Jin

Short and Ultra-Wide implants (TSIII, GSII) were installed in the mandibular molar position on both sides

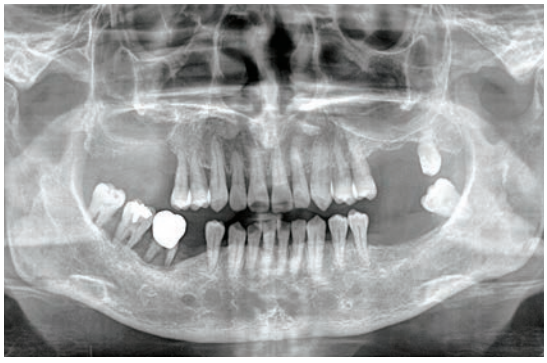


Fig. 1. Initial panoramic radiograph

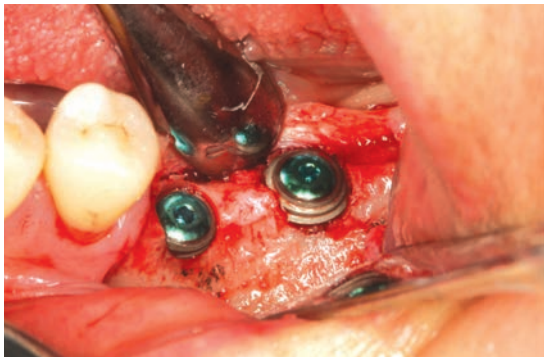


Fig. 2. Implants were installed in positions #36 and 37 (#36 : TSIII SA 4.5D/7L, #37: GSII Ultra-Wide 6D/6L). About 2mm of the thread was exposed on buccal side.

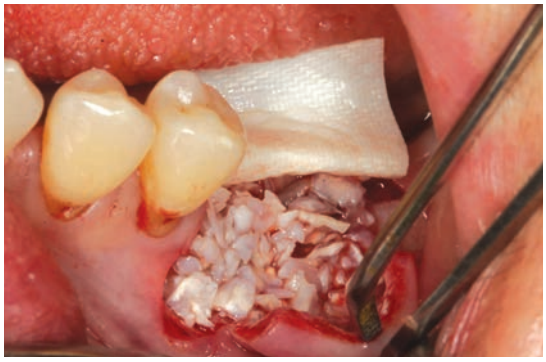


Fig. 3. Bone graft was performed by using autologous tooth bone chips (AutoBT chips : Korea Tooth bank Co, Seoul, Korea) made from extracted teeth from the mandibular right posterior region.

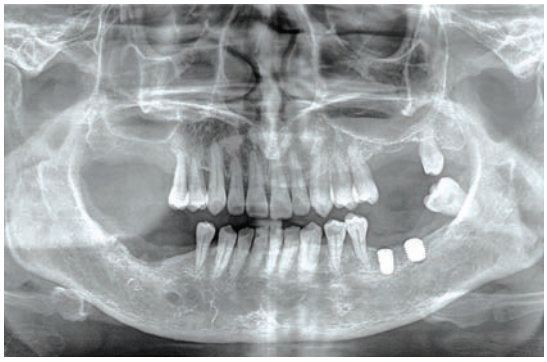


Fig. 4. Panoramic radiograph after the implant installation

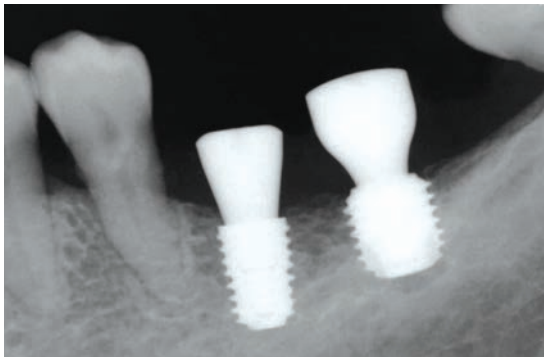


Fig. 5. Periapical radiograph after the second surgery.

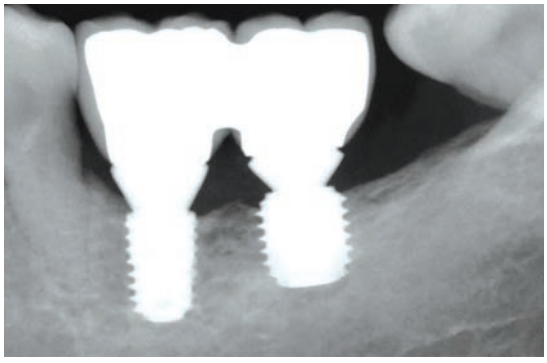


Fig. 6. Periapical radiograph one year after placing the final prosthesis

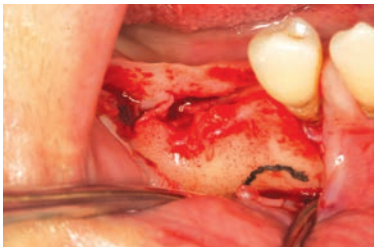


Fig. 7. Flap elevation performed on positions #45 ~ 47 for vertical ridge augmentation. Autogenous tooth bone graft chips (AutoBT chips) were produced from extracted teeth from positions #46, 47 and 48, seven weeks ahead of the grafting surgery.

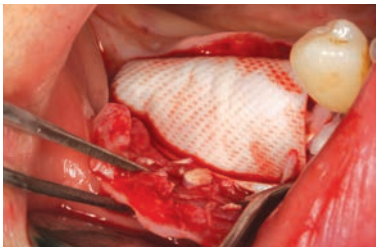


Fig. 8. Vertical ridge augmentation was performed by using autogenous tooth bone graft chips, and the area was covered with a resorbable collagen membrane (Ossix plus).

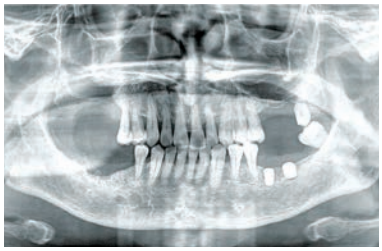


Fig. 9. A panoramic radiograph after a vertical ridge augmentation in the mandibular right molar.

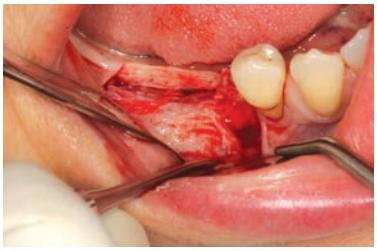


Fig. 10. A flap elevation was done six weeks after the bone graft for the implant installation. The bone healing was observed in fairly good condition.

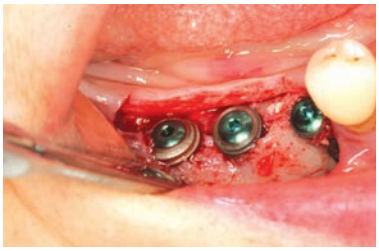


Fig. 11. Implants (#45 : TSIII SA, 4D/7L, #46 : TSIII SA 5D/7L, #47 : TSIII Ultra-Wide 6D/6L) were installed.

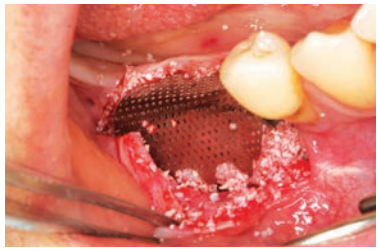


Fig. 12. Bone graft chips (Bio-Oss) were supplemented around the implant, and the area was covered with a titanium mesh.

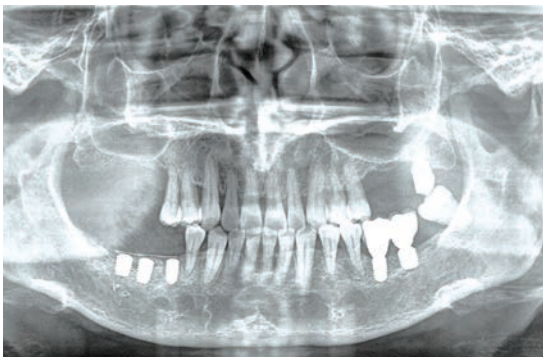


Fig. 13. Panoramic radiograph after implant installation

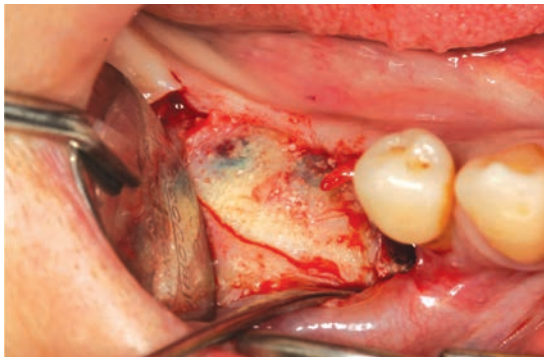


Fig. 14. The flap elevation was done three months after the implant installation to expose the implant

Fig. 15. Periapical radiograph after the second surgery

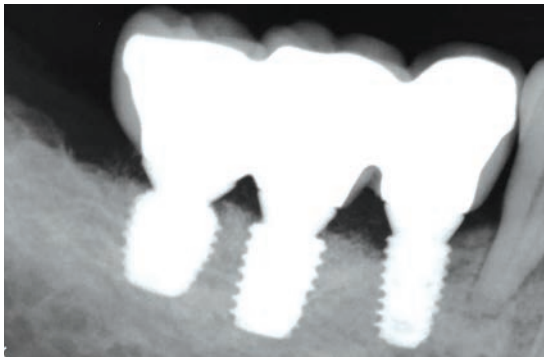


Fig. 16. Periapical radiograph six months after placing the final prosthesis

Case | Location : #47 | Age : 67, Sex : M

5

Seoul Dental Clinic

Director
Lee, Dae-Hee

A case of a GSIII Ultra-Wide installation five months after a bone graft in the mandibular second molar tooth by using an artificial bone graft

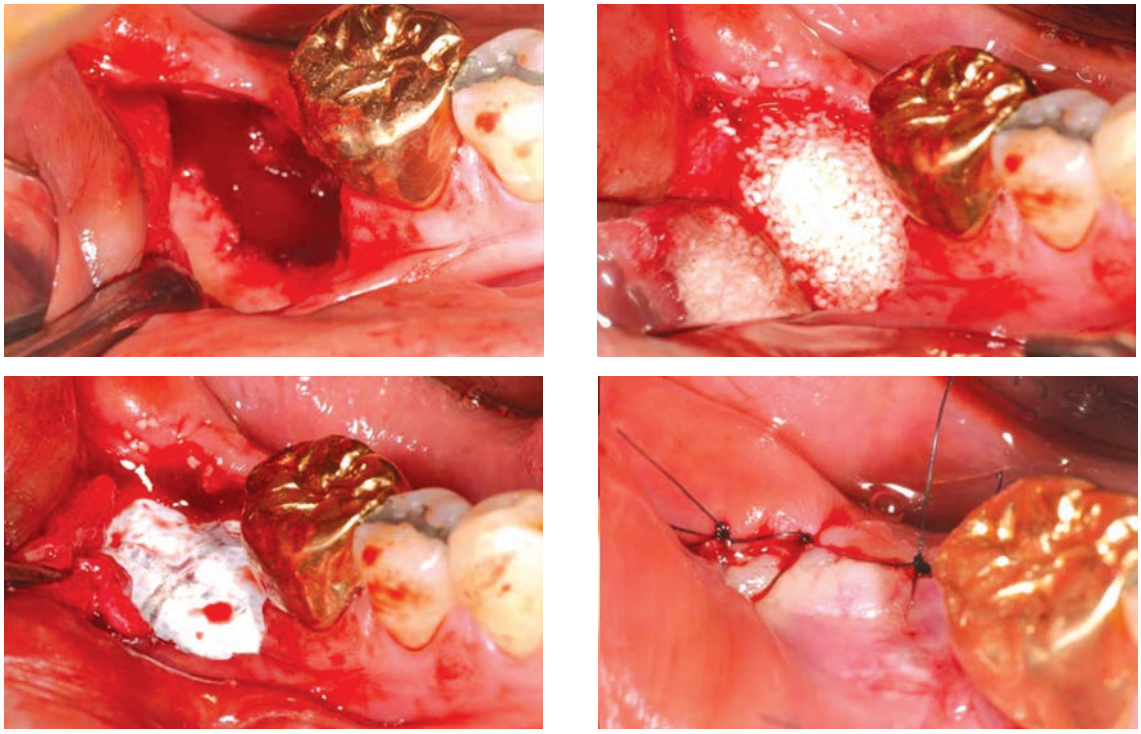
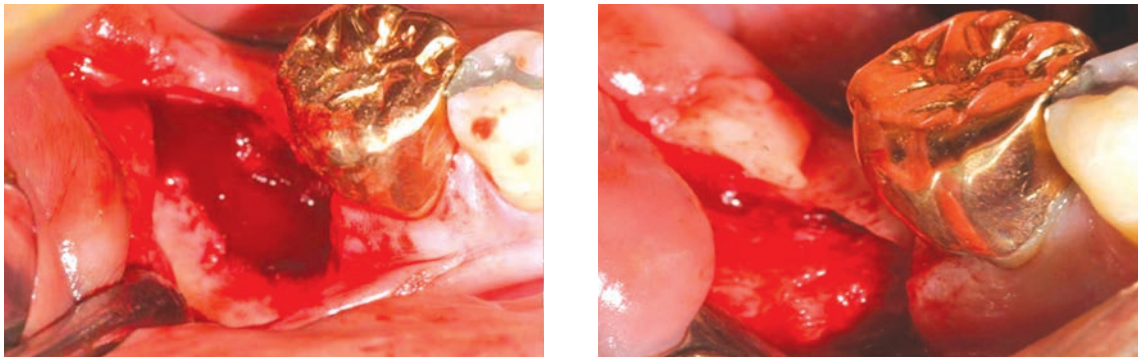


Fig. 1. Since the bone was not regenerated even one year after the extraction in the mandibular second molar tooth, guided bone regeneration (GBR) was performed by using synthetic bone.



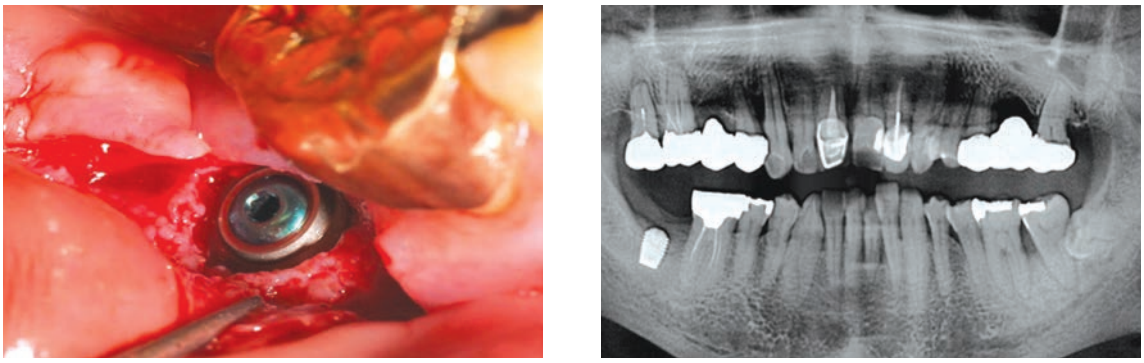


Fig. 2. A GSIII Ultra-Wide implant was installed four months later, after confirming the newly generated bone tissue.

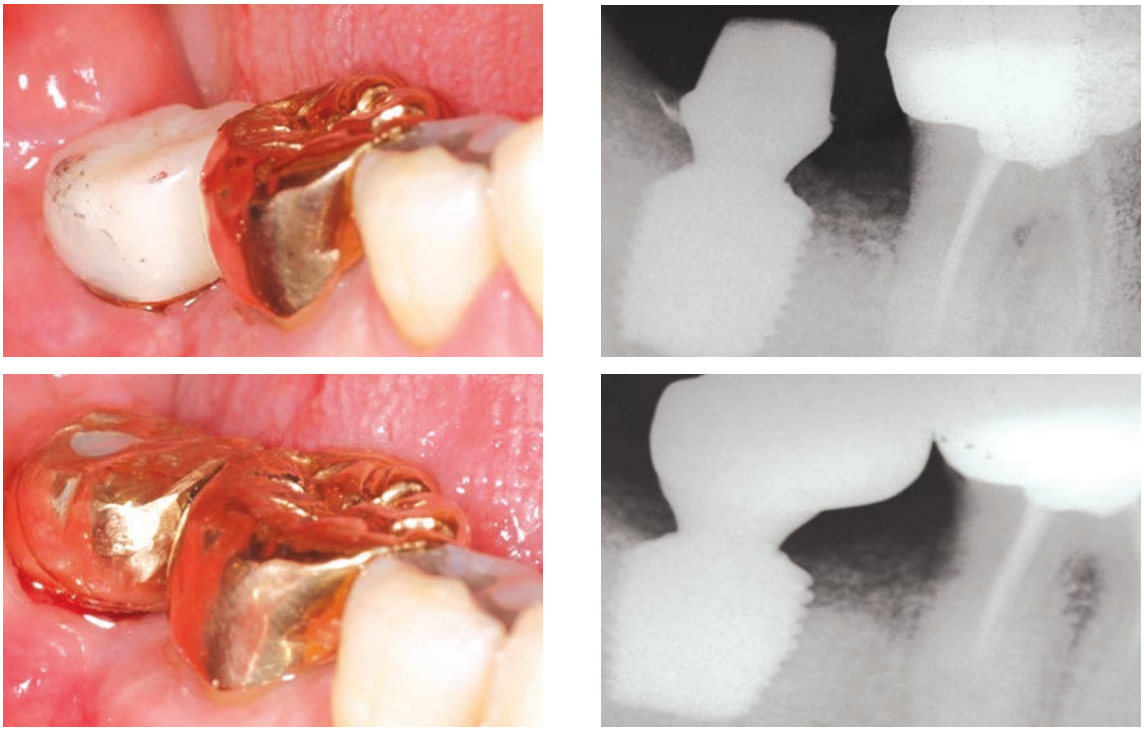


Fig. 3. A final prosthesis was placed after using a temporary prosthesis for a certain amount of period.

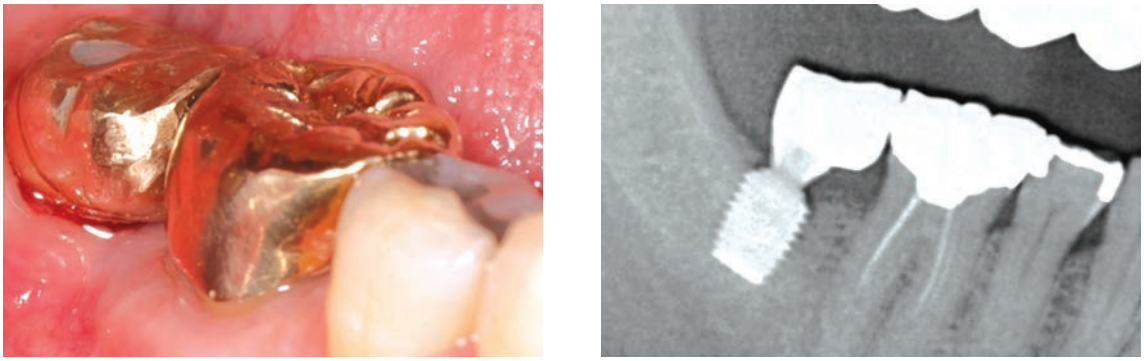


Fig. 4. A stable bone reaction was observed in this picture taken five years after the final prosthesis treatment.

Case 1 | Implant position : #47 | Age : 28, Sex : F

My Favorite Immediate Implantation Technique Using Osstem Implant TSIV SA

Acro Dental Clinic
Director
Oh, Sang -Yoon

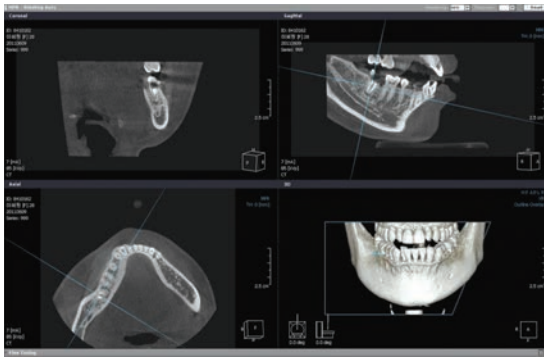


Fig. 1. A preop. X-ray (CT Coronal section View).

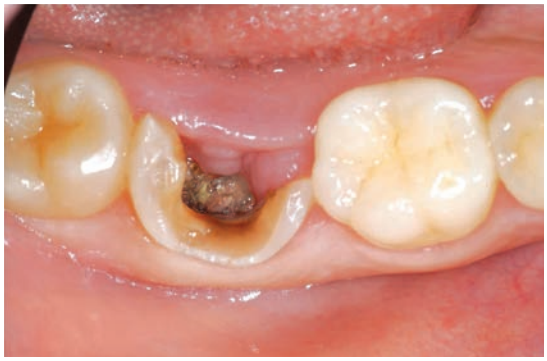
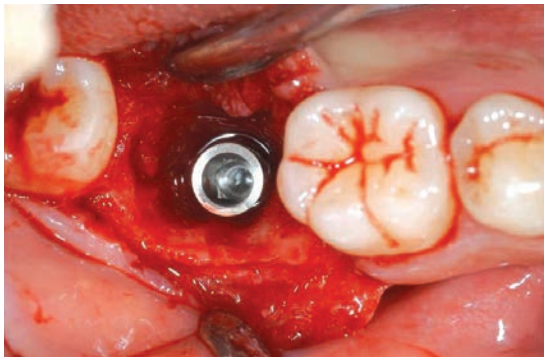


Fig. 2. Preoperative intraoral view (#47).



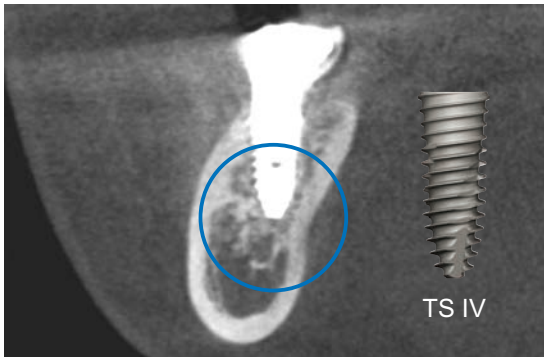
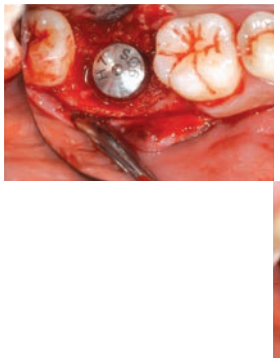


Fig. 3~4. Immediate implantation (TSIV ø5.0 x 11.5mm). Easy to initial stabilization by abrupt tapered design.
Excellent self tapping capacity by deep & sharp cutting edge.
Minimum trauma to the lingual concavity & inferior alveolar canal by pointed apex design.



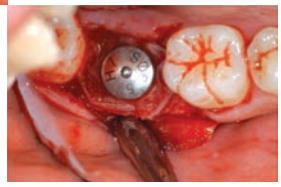
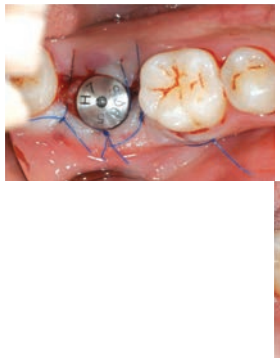


Fig. 5. Bone graft & healing abutment connection.
PRF for Surgical isolation.



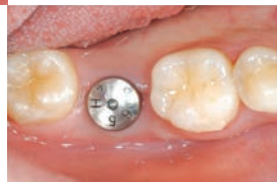


Fig. 6. Circular approximation.
Good healing ; Fast biological secondary stability by TS SA surface.

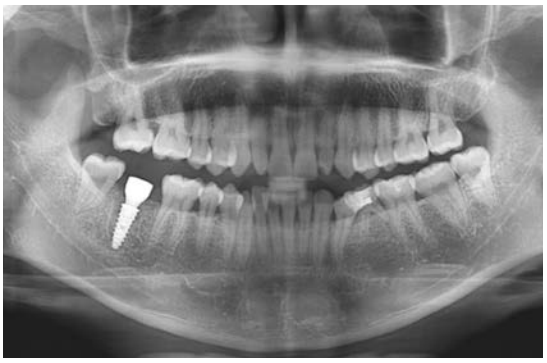


Fig. 7. Postoperative panoramic view.

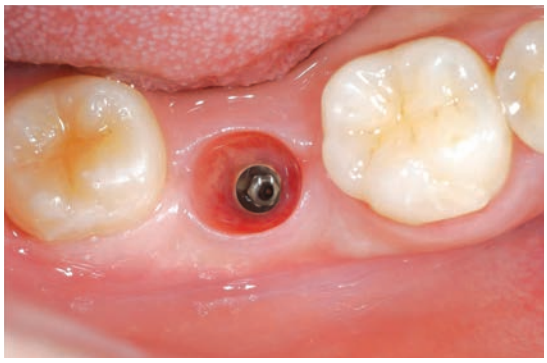


Fig. 8. 4 months later.
Tissue molding by healing abutment.

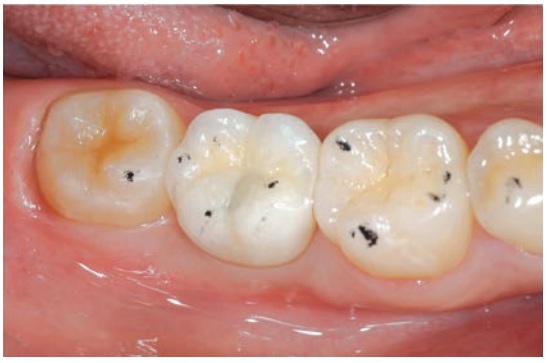


Fig. 9. Final prosthesis.
Harmonious gingival line & profile.

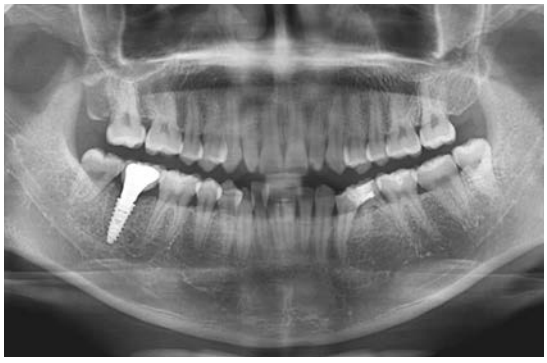


Fig. 10. Panoramic view after final prosthesis.

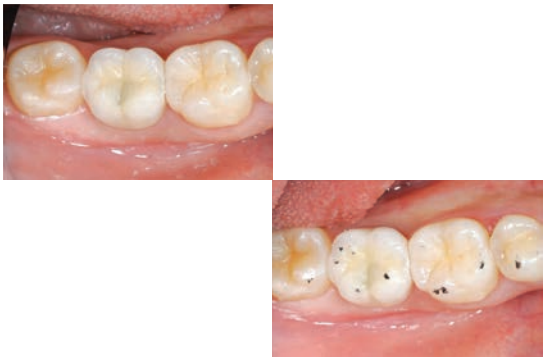


Fig. 11. 6 months later.
Maintain occlusal stability by no sinkdown.

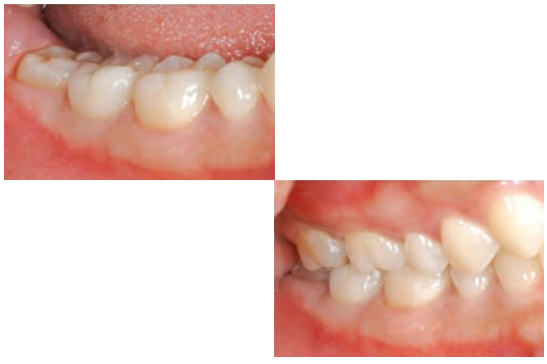
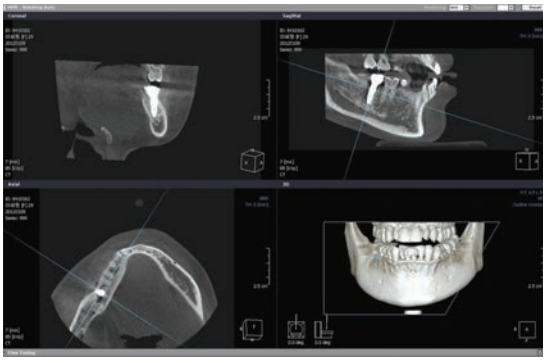


Fig. 12. 6 months later.
Natural gingival line & profile.



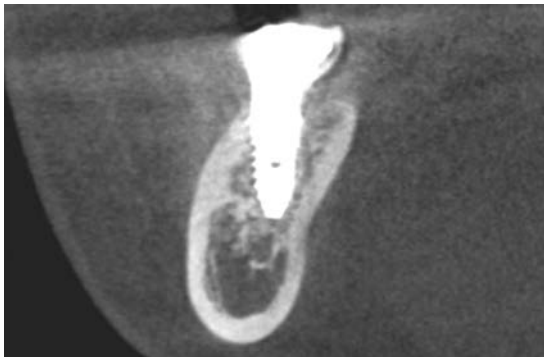


Fig. 13~14. 6 months later follow up CT (Coronal section view).

Case | Implant position : #11, #21 | Age : 51, Sex : M

2

Immediate Implant Placement of TSIV SA Fixtures after Extraction of Both Maxillary Central Incisores

Apsun Dental Clinic

Director
Cho, Yong-Seok

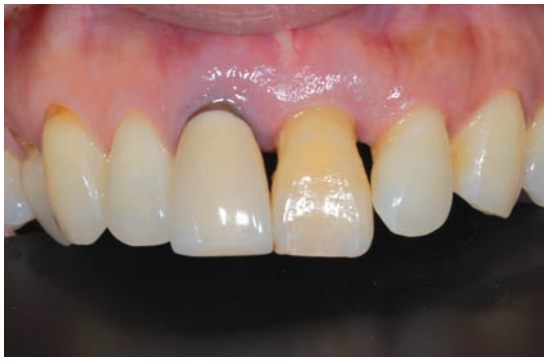


Fig. 1. 51 years old female visited my clinic for the mobility and esthetic problem of both maxillary central incisors.

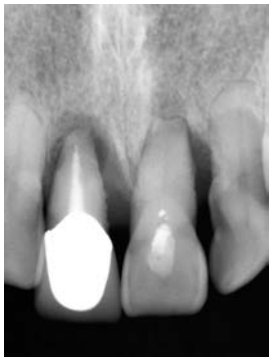
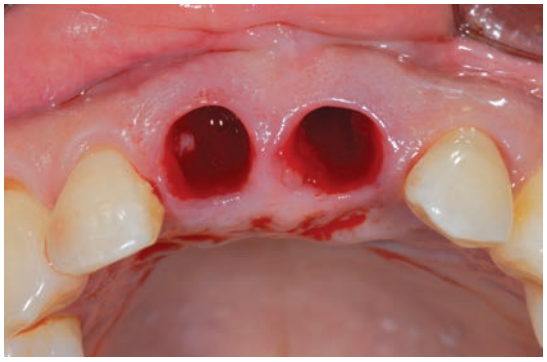


Fig. 2. In Standard X-ray view, both teeth received endodontic treatment before and involved in periodontitis with severe bone destruction. Immediate implantation after extraction of the both teeth was planned.



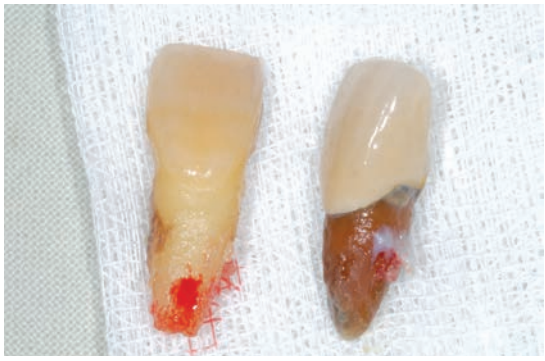


Fig. 3~4. After extraction of the teeth throughout curettage was performed. Loss of the labial bone plate was observed.

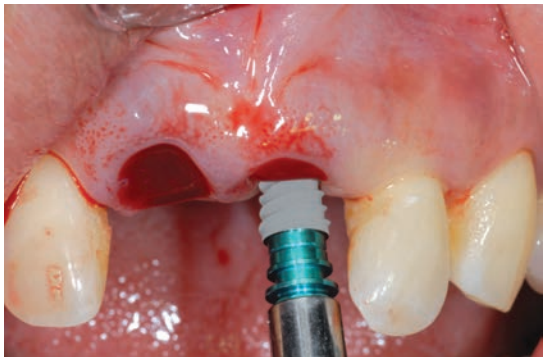


Fig. 5~6. After drilling at patatal side of the extraction sockets TSIV SA ⌀4.5x11.5mm were installed. Initial torque was over 40Ncm and ISQ value was 73/74 each.

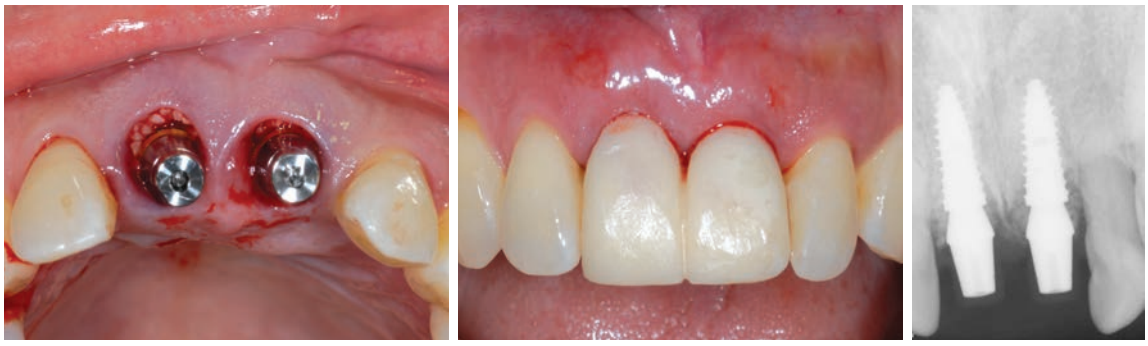


Fig. 7~9. Non functional immediate restoration was tried. Rigid abutments are connected on the fixtures with 30Ncm and allogenic bone graft material (SureOss 0.2cc+0.2cc) was grafts on labial bone defect. Temporary bridge was fabricated and delivered with out of occlusion. POP Standard X-ray shows well positioned TSIV SA fixtures.

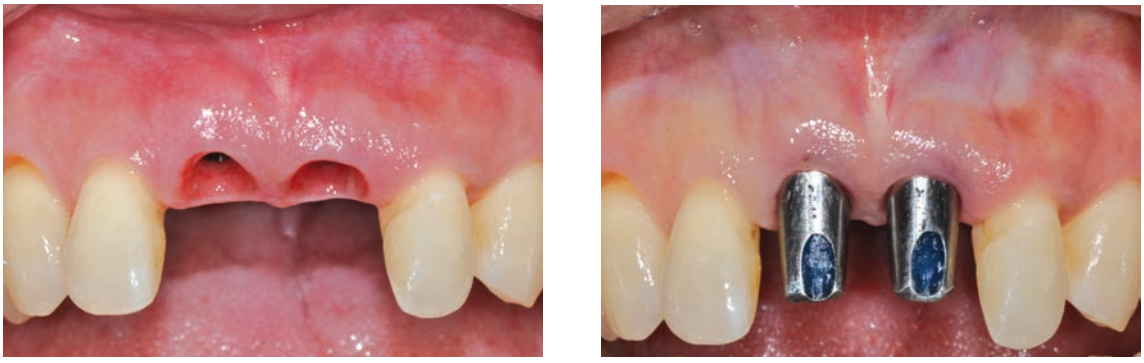


Fig. 10~11. 5 months after temporarization patient visited with good gingival health condition. After impression taking cementation type crowns are fabricated over customized abutments.

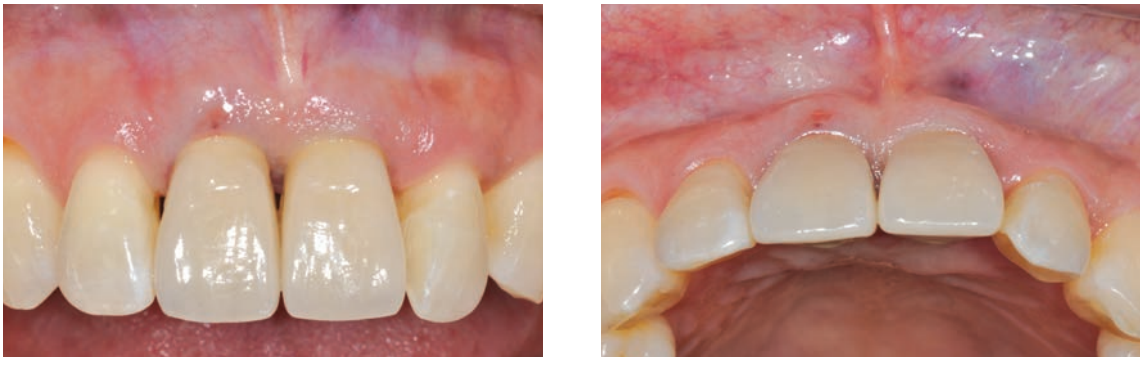


Fig. 12~13. Both crowns are delivered using a temporary cement. They showed harmonized crown and soft tissue.

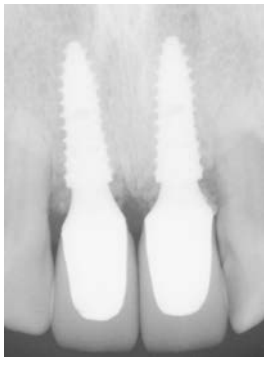


Fig. 14. Final Standard X-ray shows good osseointegration of the fixtures. However coronal bone remodeling is not finished yet.

Case | Location : #16, 17 | Age : 40, Sex : M

3

Seoul National University Bundang Hospital
Professor
Kim,Young-Kyun
Yi, Yang-Jin

Installation of TSIV SA implant at right maxillary molar tooth region

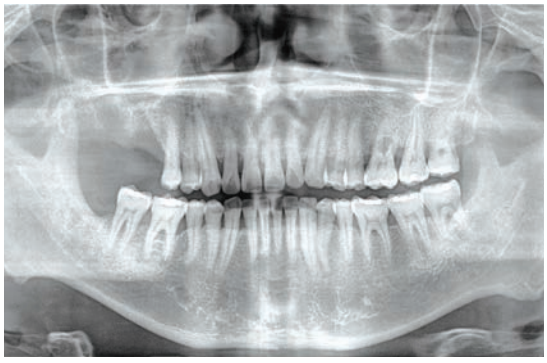


Fig. 1. Initial panoramic radiograph. Autogenous tooth bone graft chips (AutoBT chips) were produced from the extracted teeth from positions #16, 18 and 48, two months ahead of the grafting surgery.

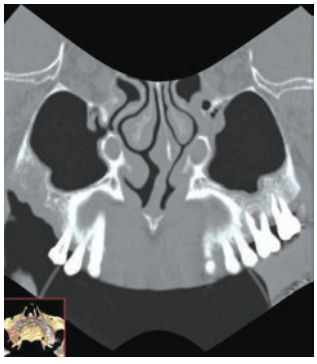


Fig. 2. Initial CT scan image

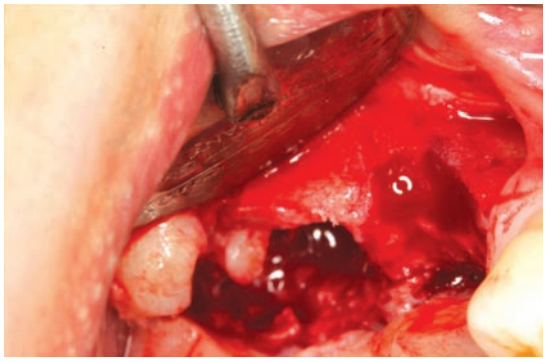


Fig. 3. A flap elevation was performed. Severe bone loss was observed in the area where the implant was to be installed.

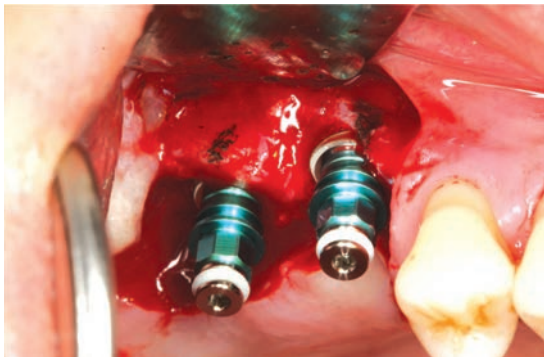


Fig. 4. After the implant installation (TSIV, #16 : 5D/11.5L, #17 : 5D/10L). A small amount of autogenous tooth bone chips were grafted during the maxillary sinus lift by using a crestal approach, and the implants were installed simultaneously. Primary stability measured by the Osstell Mentor (Integration Diagn osticsAB, Goteberg, Sweden) were 59 ISQ for position #16 and 62 ISQ for position #17, respectively.

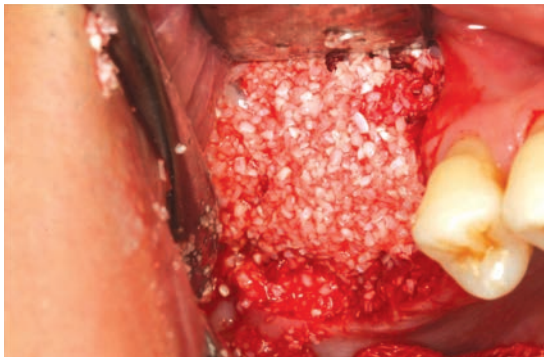


Fig. 5. After the bone graft around the implants using autogenous tooth bone chips. The wound was sutured after covering it with a resorbable collagen membrane (collagide).

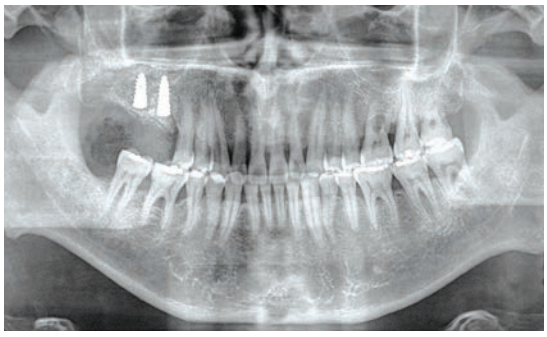


Fig. 6. Panoramic radiograph after implant installation

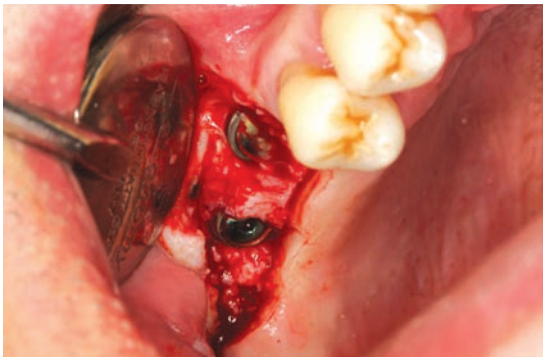


Fig. 7. The implant was exposed by the flap elevation after 3.5 months. Peri-implant bone defect healed well, and the secondary stability values of the implants measured by the Osstell Mentor were 63 ISQ for position #16 and 57 ISQ for position #17, respectively.

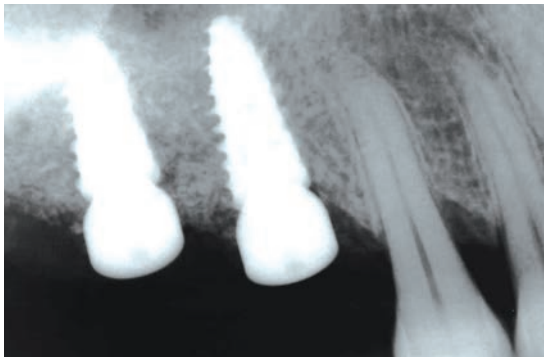


Fig. 8. Periapical radiograph after the second surgery

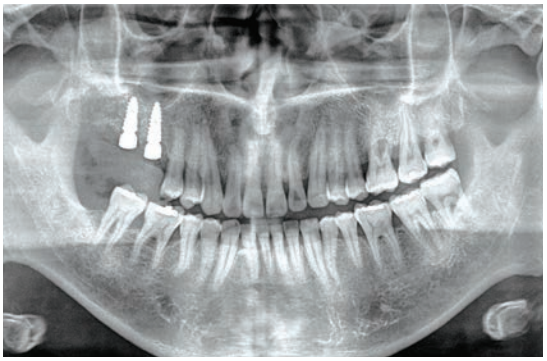


Fig. 9. Periapical panoramic radiograph after the second surgery

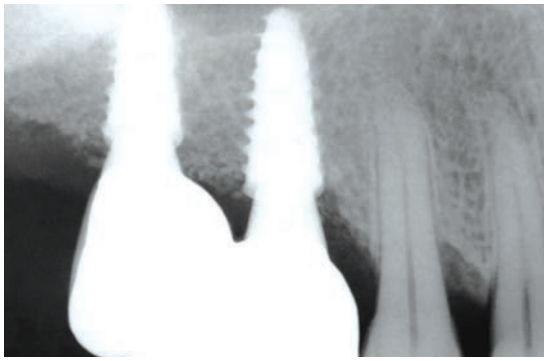


Fig. 10. Periapical radiograph 6 months after the final placement of the prosthesis

Case | Implant position: #35, #37 | Age:41, Sex:M

1

Yena Dental Clinic

Director
Yang, Choon-Mo

Non Submerged Placement of Osstem TSII SA Implant

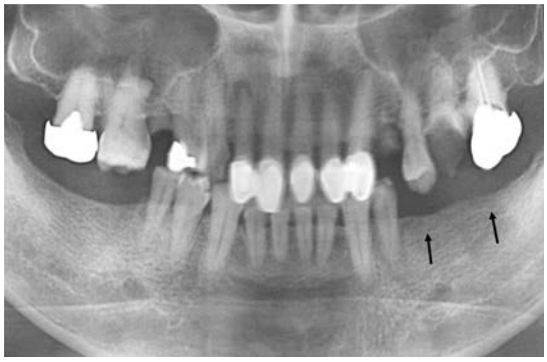


Fig. 1. A 41 year old male patient. Panoramic view prior to implant therapy in the lower left quadrant. Upper left premolar and molar teeth were extruded because of being free from occlusion for a long time.

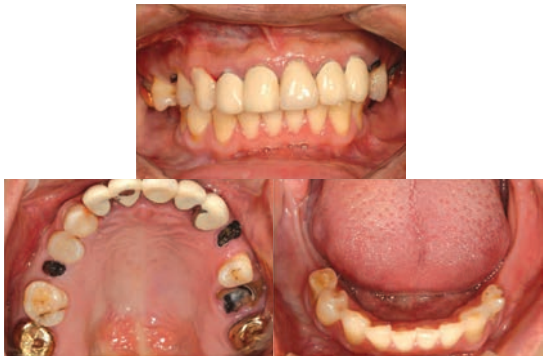


Fig. 2. Oral view of soft and hard tissue before treatment.

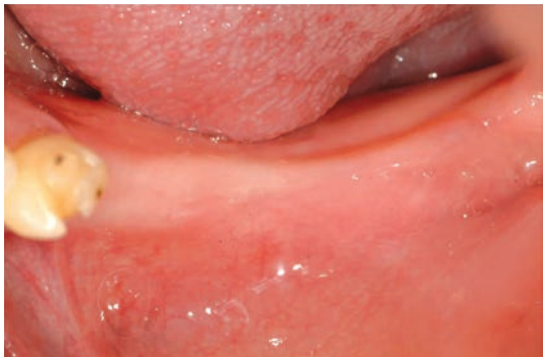


Fig. 3. View of surgical site. Minimal attached gingiva was observed in the molar region.

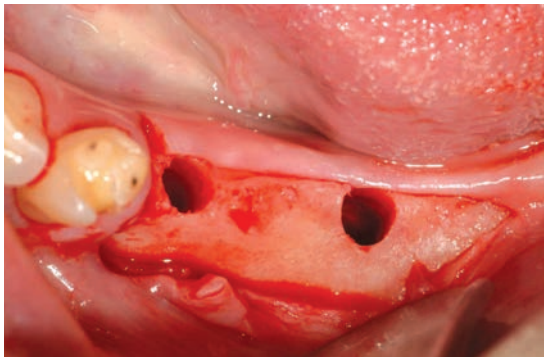


Fig. 4. Finished osteotomy. The bone density was evaluated as normal.

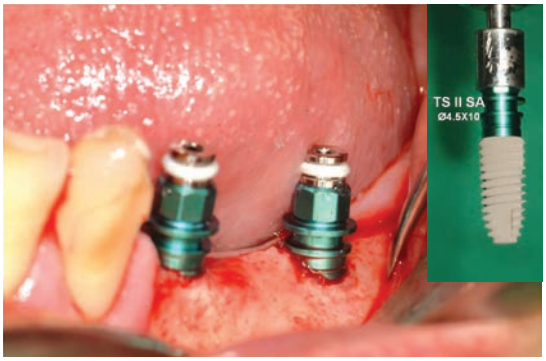


Fig. 5. Implant insertion. Msio-distal and bucco-lingual angulation of each fixture(TSII SA ø4.5X10mm) was evaluated.

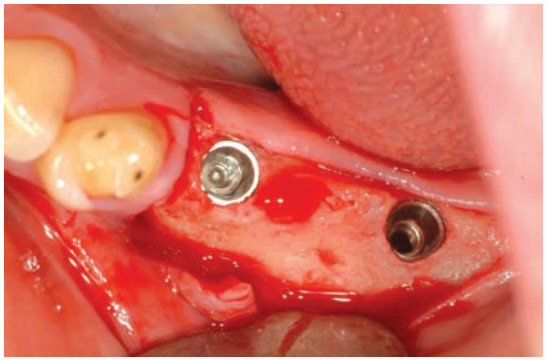


Fig. 6. Platform of each implant was located subcrestally.

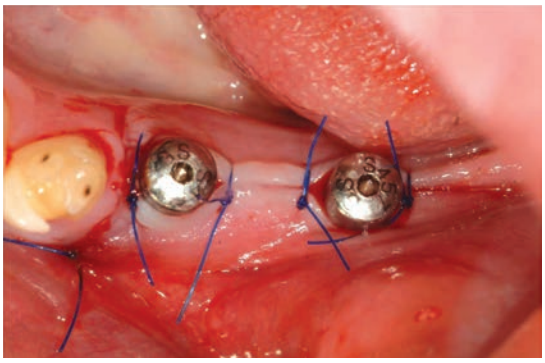


Fig. 7. The insertion-torque was 22Ncm to the site #35 and 18Ncm to the site #37 fixture by machine. The transmucosal healing abutments were connected.

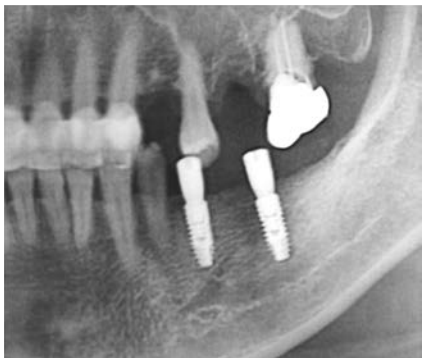


Fig. 8. Panoramic view of post-operative result.

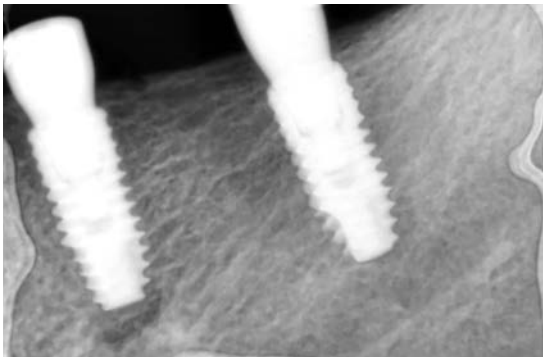


Fig. 9. Intra-oral periapical radiograph after implant placement.

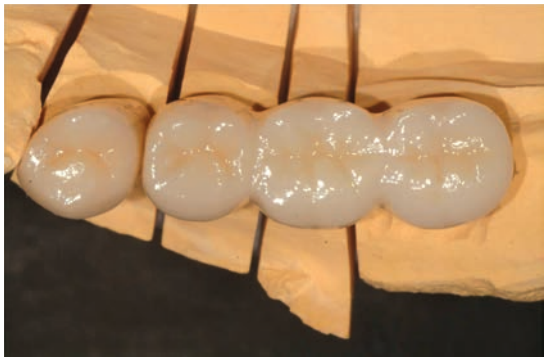
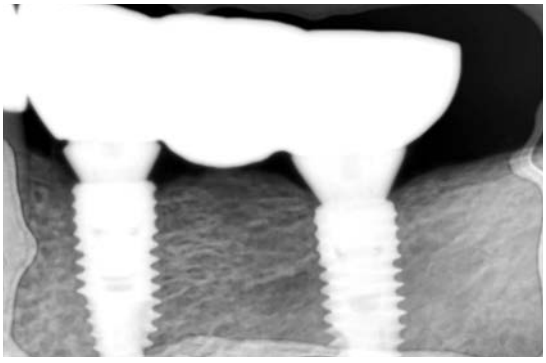


Fig. 10. All-zirconia bridge (Prettau zirconia of zirkonzahn) supported by two implants.



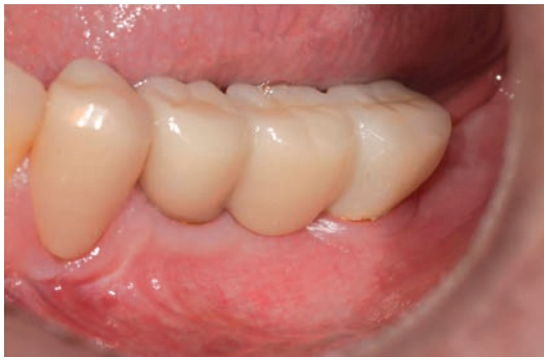


Fig. 11~12. Cement-retained fixed partial denture was delivered at 10weeks after implantation.

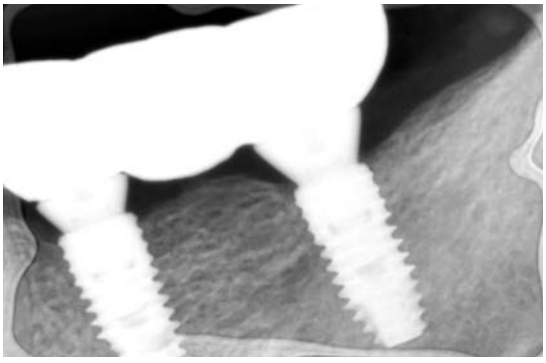


Fig. 13. Follow-up radiograph at 3 months after functional loading.

Case | Implant position: Multi. | Age:53, Sex:M

1

A Clinical Case of Osstem Implant Placement with Maxillary Sinus Augmentation by Lateral Window Technique

Namsang Dental Clinic

Director
Kim, Ki-Seong

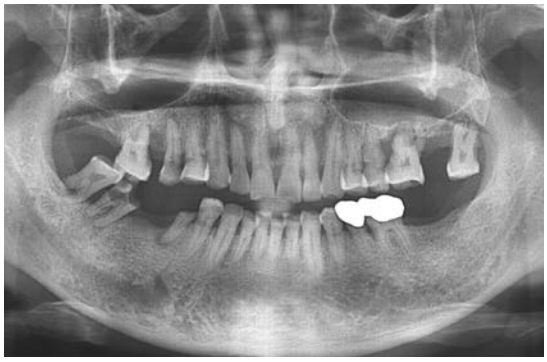


Fig. 1. Multiple teeth with deep caries and severe periodontitis were extracted.

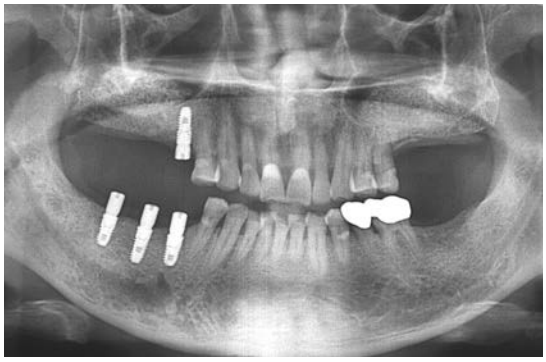
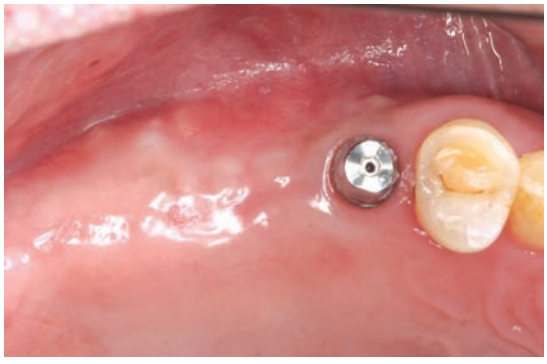


Fig. 2. TSIII SA fixtures were placed in #15, #45, #46, #47 missing area. Maxillary Sinus Graft procedure in Rt. & Lt. sides was done with lateral window technique.



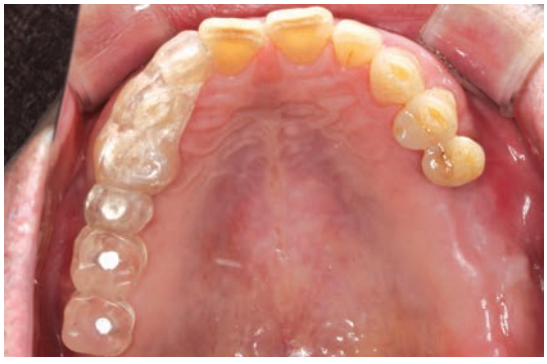


Fig. 3~4. At Four months after sinus graft procedure, SSII SA fixtures were planned to be placed in #16 and #17 missing area.

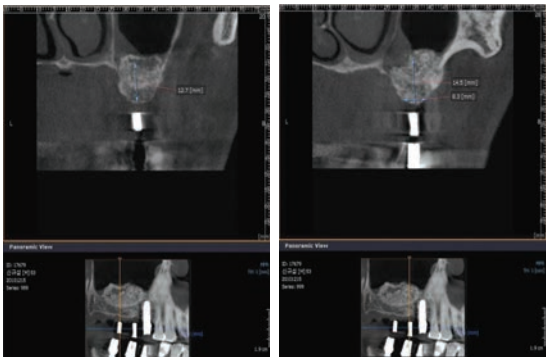


Fig. 5. Sufficient bone volume was acquired in both sides of sinus cavity.

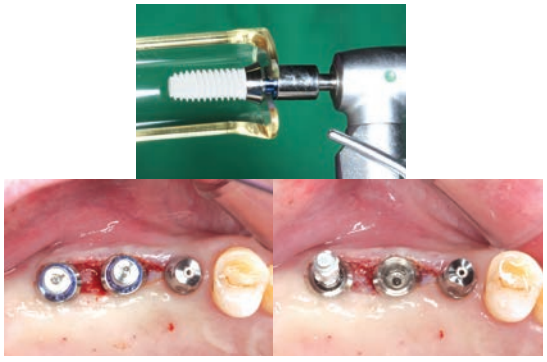


Fig. 6. SSII SA fixtures were placed with minimal flap incision.

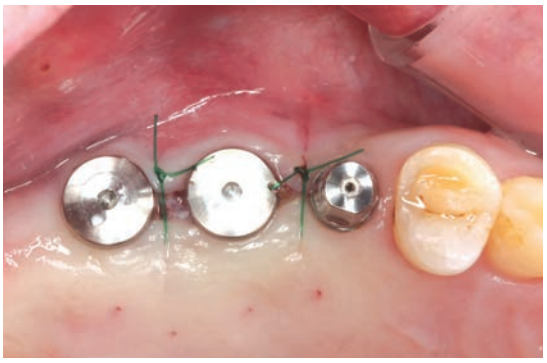
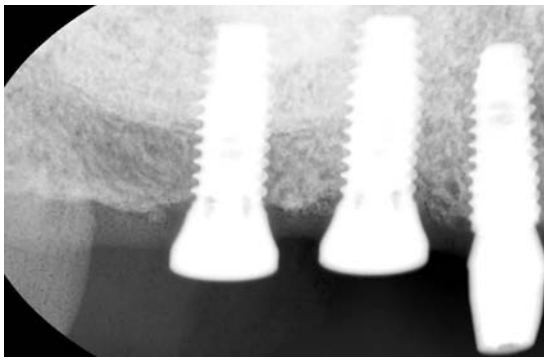



Fig. 7~8. Flap was sutured. Well-positioned SSII SA fixtures were shown in radiographic finding.

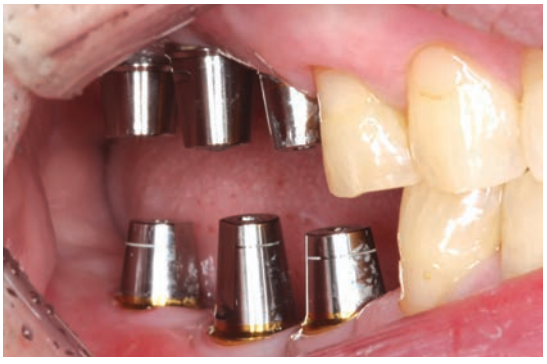
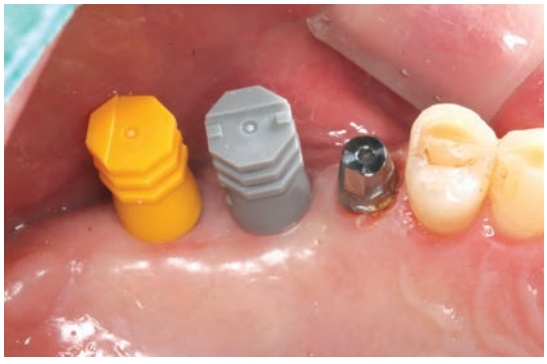



Fig. 9~10. Excellent solid abutments were connected with repeated 30Ncm tightening and an abutment level impression was made by using impression copings.

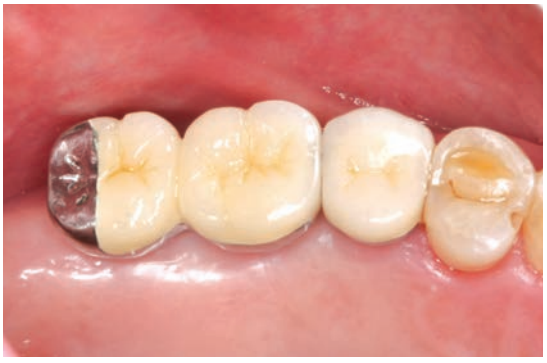
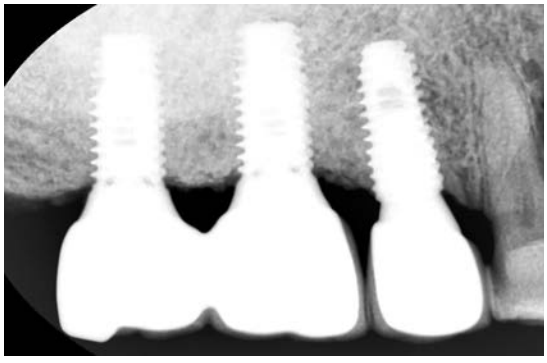



Fig. 11~12. Final treatment outcome at 8 months after the final crown placement.

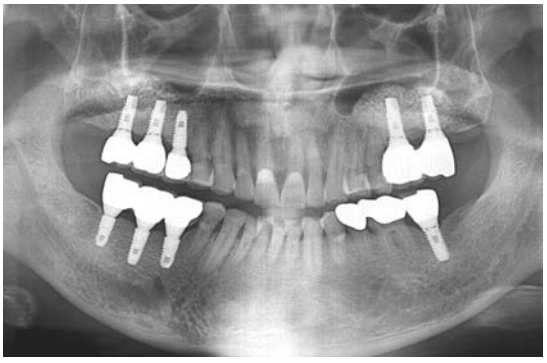


Fig. 13. Panoramic view at 12 months after the final crown placement. Bone level around placed SA fixtures was maintained stably.

Case | Implant position: #26,#27 | Age : 46, Sex : F

1

Seoul National University
Bundang Hospital
Professor
Kim, Young-Kyun

Immediate Loading Using TSIII HA Implants in Maxillary Posterior Area

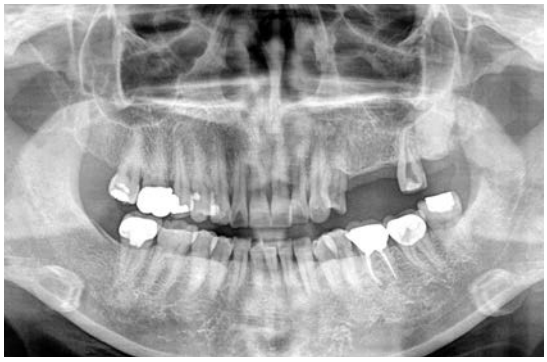


Fig. 1. Initial panoramic radiograph of 46-year old female patient. Left maxillary 2nd premolar and 1st molar were lost.

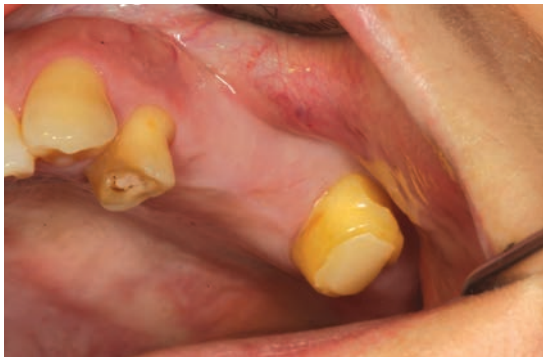


Fig. 2. Preoperative intraoral occlusal view.

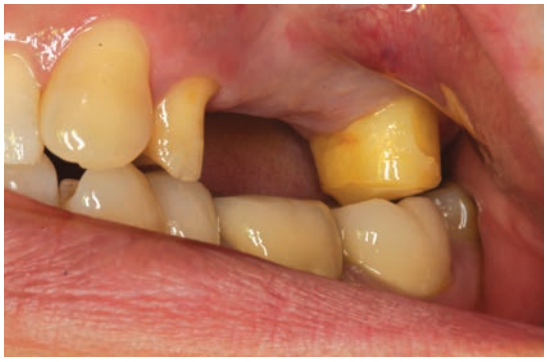


Fig. 3. Preoperative intraoral buccal view.

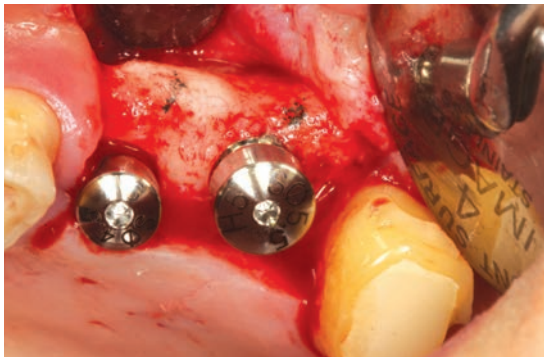


Fig. 4. Two Osstem TSIII HA implants (#25:4.5D/10L, #26:5D/10L) were installed.

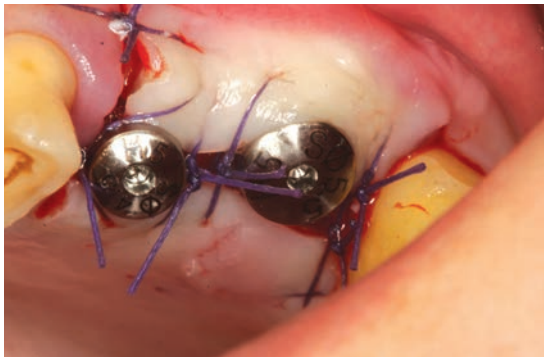


Fig. 5. Postoperative intraoral occlusal view.

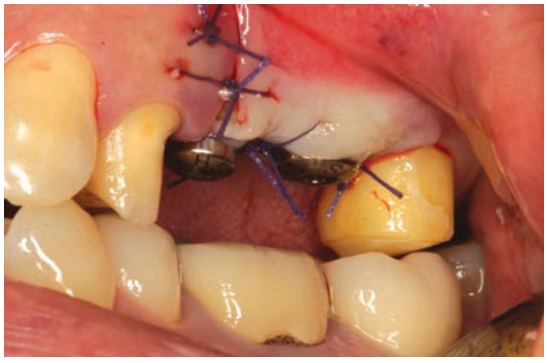


Fig. 6. Postoperative intraoral buccal view.

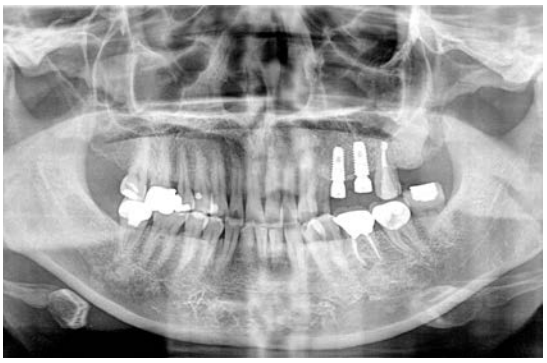


Fig. 7. Postoperative panoramic radiograph.

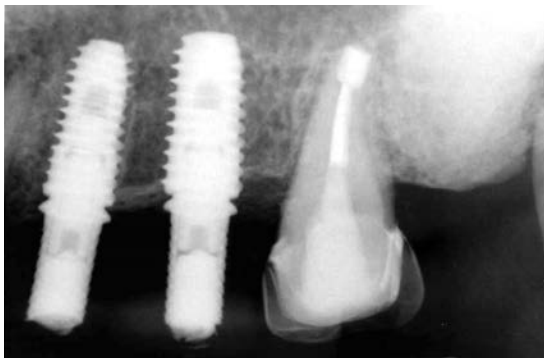


Fig. 8. Periapical radiograph 10 days after implant placement. Immediate loading was performed.

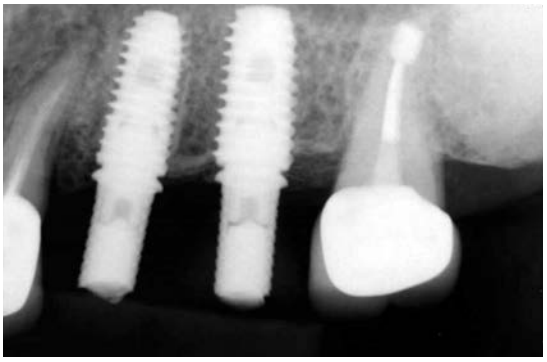


Fig. 9. Periapical radiograph 3 months after immediate loading.

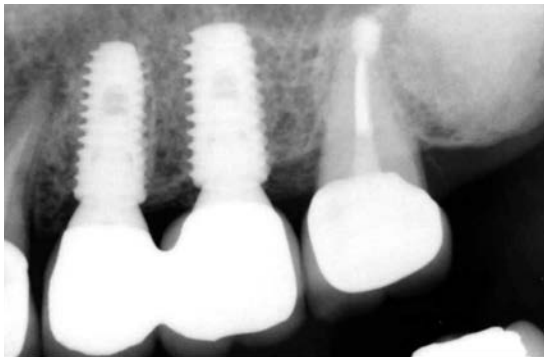


Fig. 9. Periapical radiograph 6 months after immediate loading. Final prosthesis was delivered.

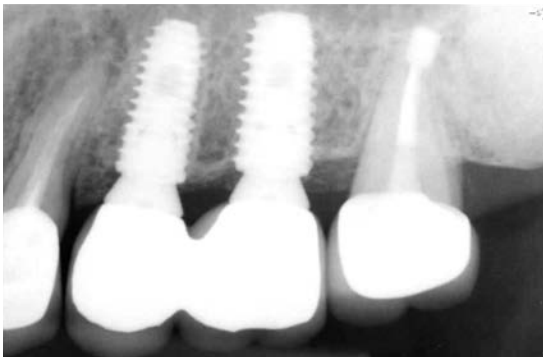


Fig. 11. Periapical radiograph 9 months after immediate loading.

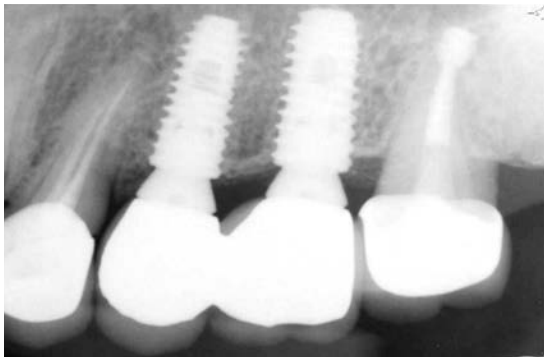


Fig. 11. Periapical radiograph 12 months after immediate loading. Crestal bone level was stable.

Case 2

Location: #25, 26

Age : 27, Sex : F

Seoul National University Bundang Hospital

Professor
Kim,Young-Kyun
Yi, Yang-Jin

Immediate loading was applied right after the implant installation, accompanied with a guided bone regeneration in the maxillary molar region.

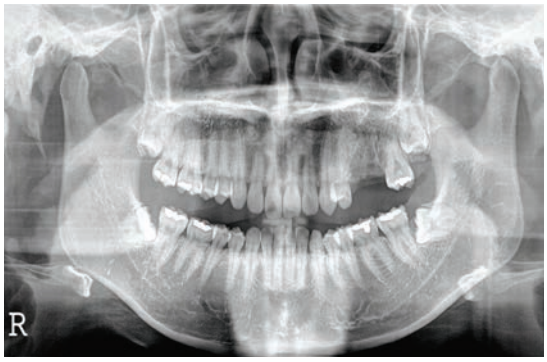


Fig. 1. Initial panoramic radiograph. The picture was taken one month after extracting teeth #25 and 26.

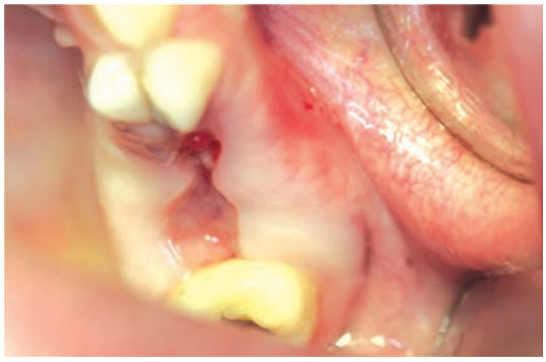


Fig. 2. Intra-oral view one month after the teeth extraction

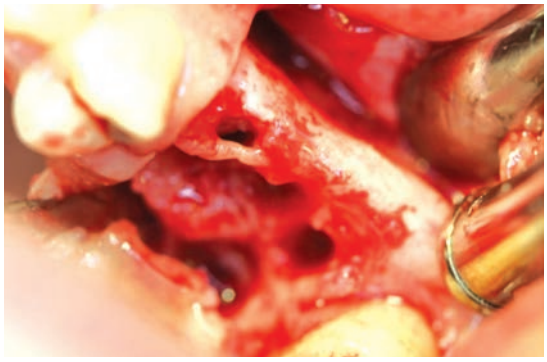


Fig. 3. After flap elevation

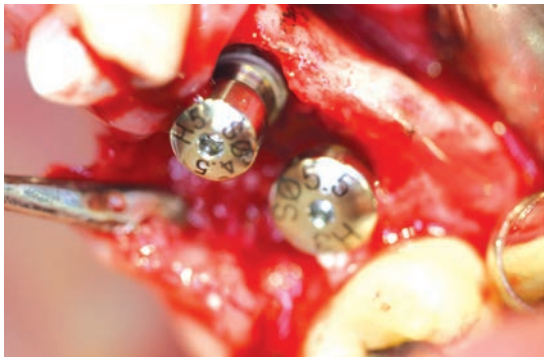


Fig. 4. Implants (TSIII HA, #25 : 4.5D/10L, #26 : 5D/10L) were installed and connected with healing abutment.

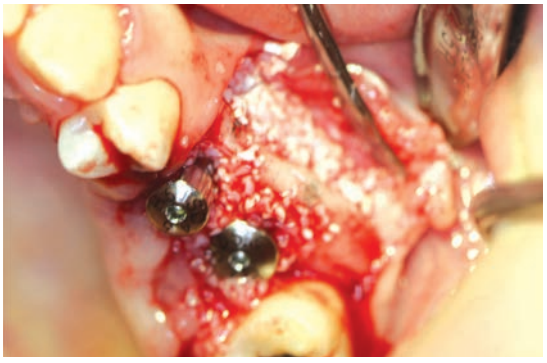


Fig. 5. Autogenous tooth bone chips made from patient's own extracted teeth were grafted in the perio-implant defects.

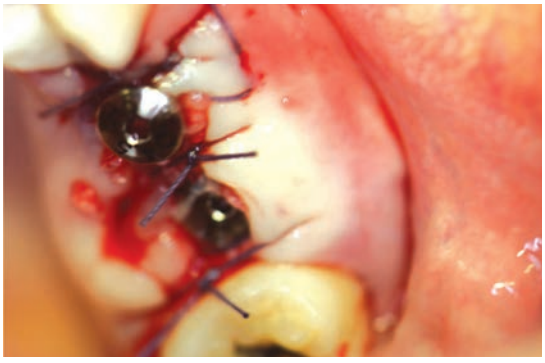


Fig. 6. The wound was sutured.

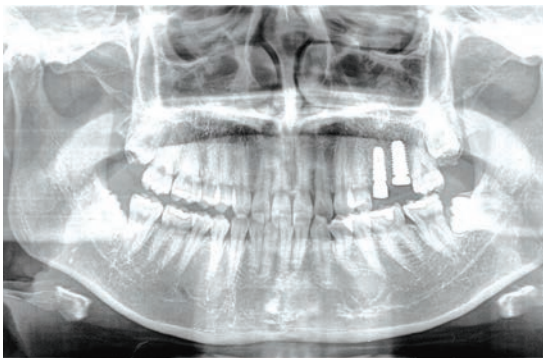


Fig. 7. Panoramic radiograph after the implant installation

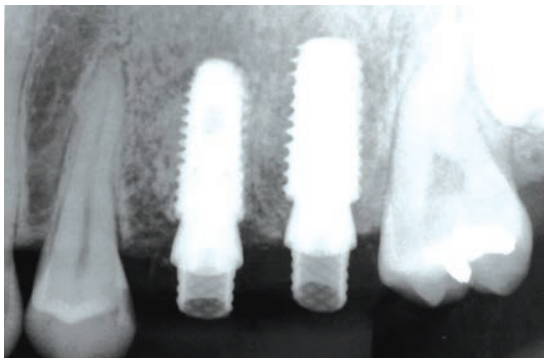


Fig. 8. Periapical radiograph two weeks after the immediate loading

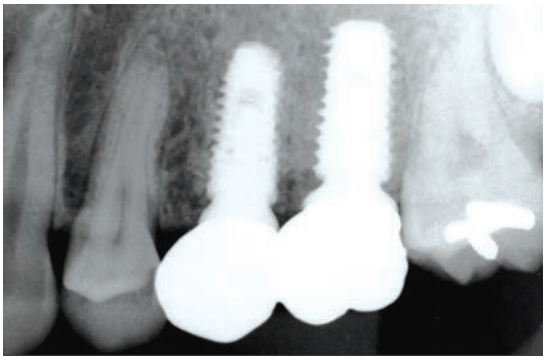


Fig. 9. Periapical radiograph one year after placing the final prosthesis, and 1 year and 6 months after immediate loading

Case | Implant location: #16 TS III HA 5.0 x10 mm | Age : 58, Sex : M

3

Seoul Dental Clinic

Director
Lee, Dae-Hee

Case of reconstruction by using TSIII HA implants after vertical ridge augmentation in maxillary right molar region.

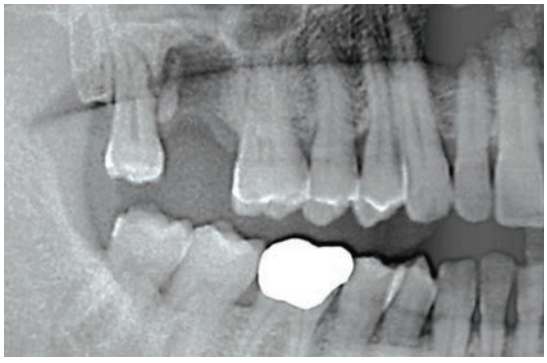


Fig. 1. A residual root was observed in the maxillary right first molar.

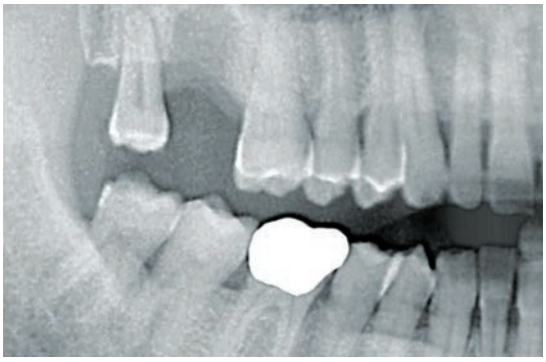


Fig. 2. No new bone generation was observed in the extraction socket even three months after removing the residual root.

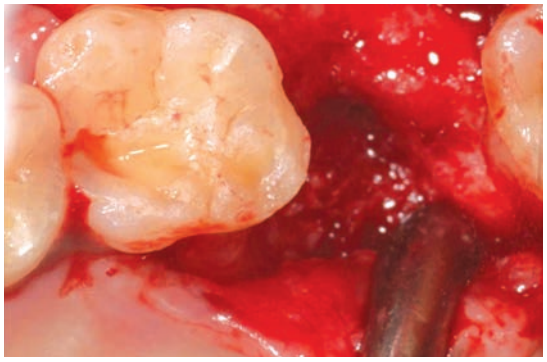


Fig. 3. Especially, the palatal side showed worse bone regeneration compared to other regions.

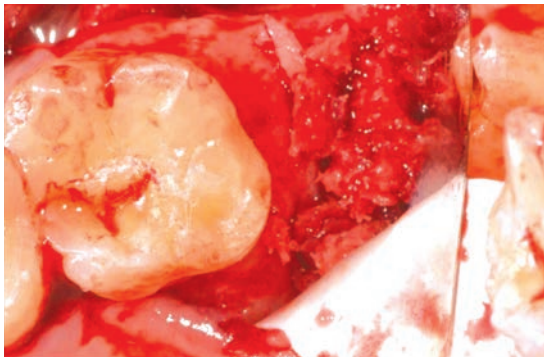


Fig. 4. The bone graft was performed using allogenic bone.

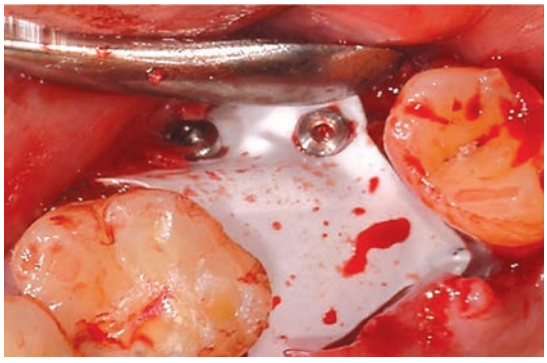


Fig. 5. Guided bone regeneration was performed by using Cytoplast membrane

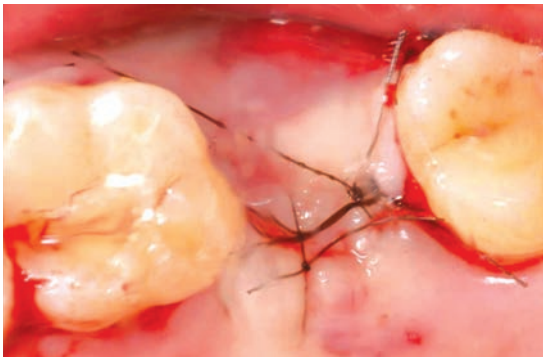


Fig. 6. The wound was sutured without tension.

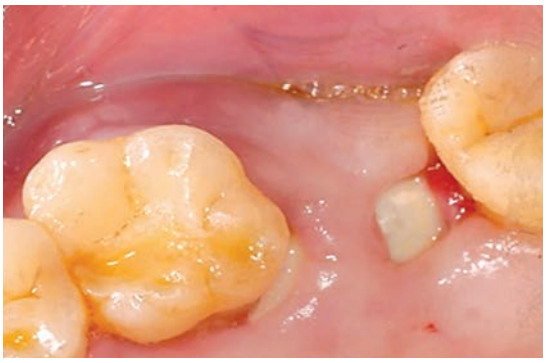


Fig. 7. The membrane was exposed partially after about three weeks.

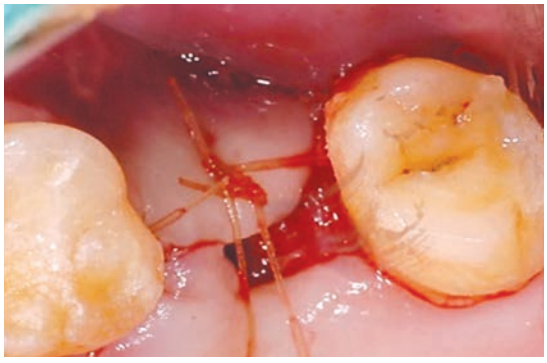


Fig. 8. According to an open membrane technique, the wound was stitched with a resorbable suture after removing the membrane.

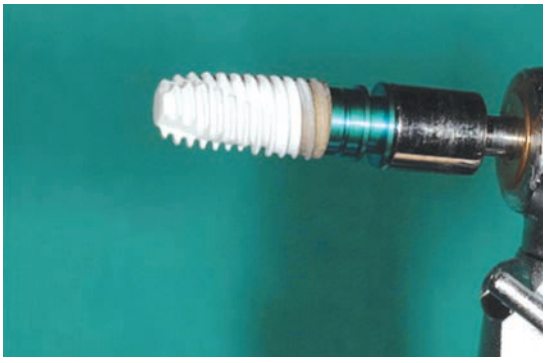


Fig. 9. Implant (TSIII HA 5.0x10mm) was installed after about four months.

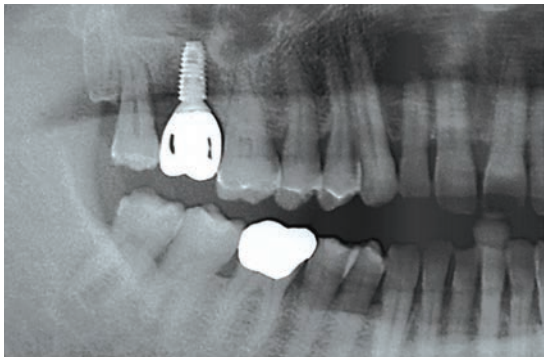


Fig. 10. The picture was taken after placing the final prosthesis.

Case | Location : # 26 | Age : 73, Sex : M

4

Seoul Dental Clinic

Director
Lee, Dae-Hee

Case of restoration TSIII HA implant installation accompanied with a sinus bone graft after removal of a ailing implant

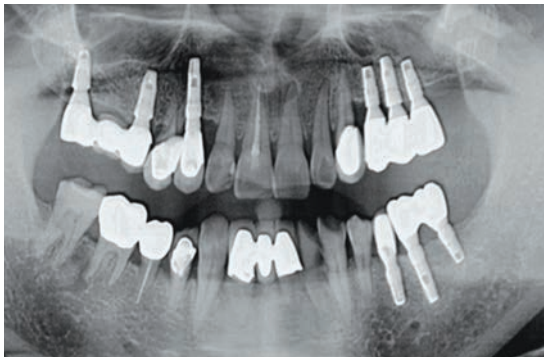


Fig. 1. Initial panoramic radiograph. Prosthetic treatment was performed with three implants about six years ago.

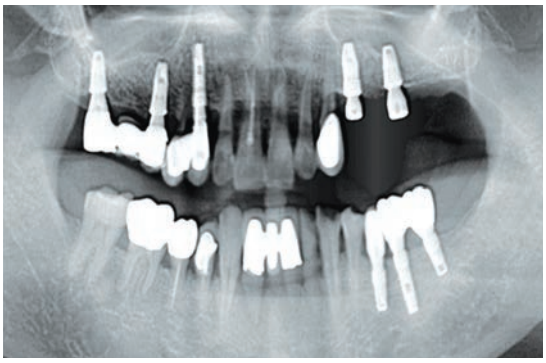


Fig. 2. The patient was complaining about block mobility around the bridge on the first visit. After all three implants were confirmed as having failed, they were removed. Two implants were installed after ensuring that there was no perforation on the sinus membrane.

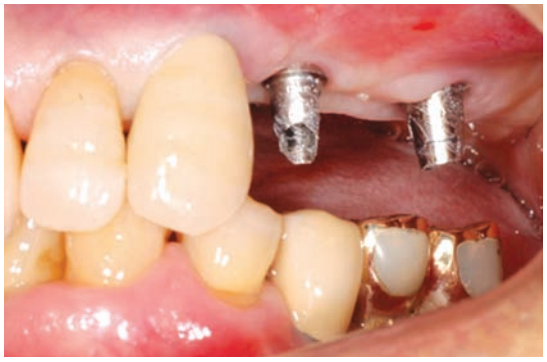


Fig. 3. Though a 3-init temporary bridge was applied by using two implants, it was removed due to the patient's complaint of soreness.

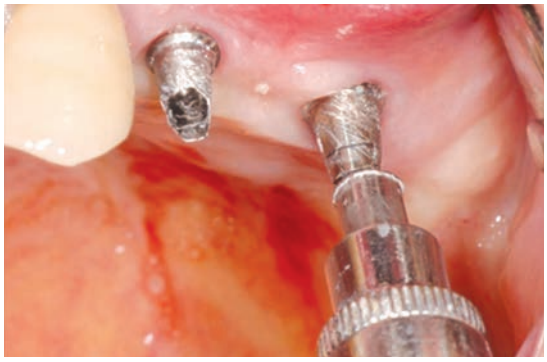


Fig. 4. A percussion test was performed in the suspicious area for a more definite diagnosis.

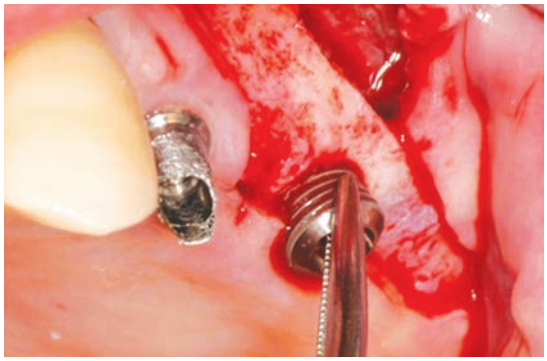


Fig. 5. The ailing fixture was removed and the lateral window was performed for the lateral approach.

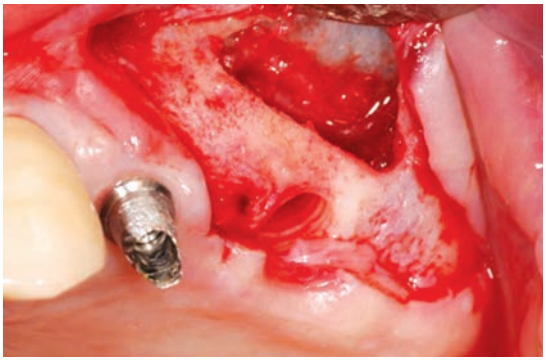


Fig. 6. The sinus membrane was detached.

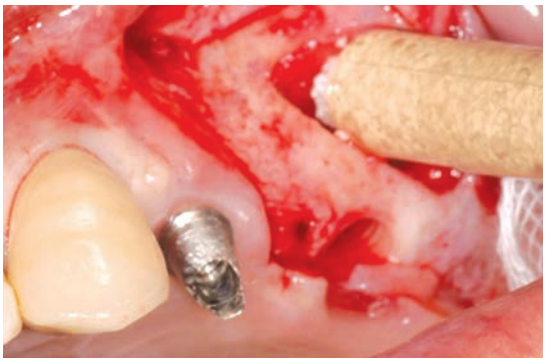


Fig. 7. A bone graft was performed in the lesion made by the detached sinus membrane.

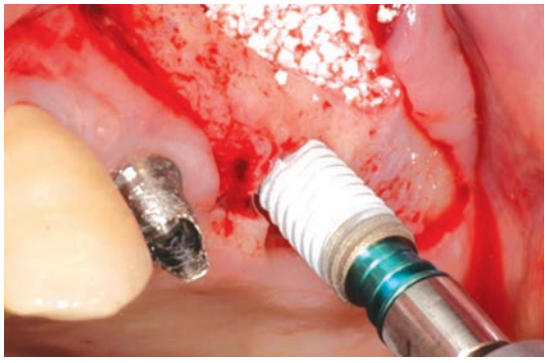


Fig. 8. TSIII HA 4.5x10mm implant was installed in position #26.

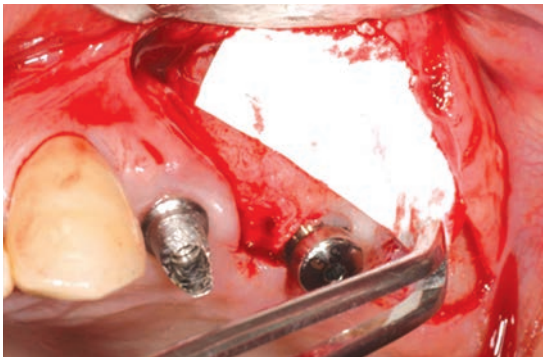


Fig. 9. The implant was installed using a single stage method, and the lateral window was closed with collagen membrane.

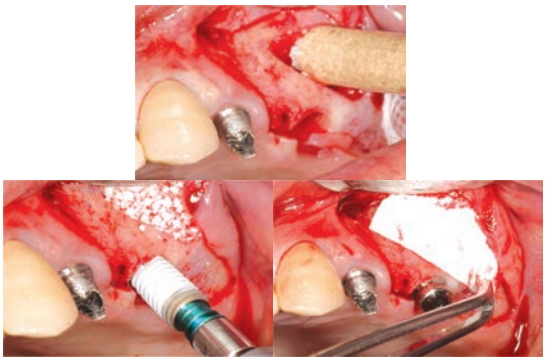


Fig. 10. A TSIII HA implant was installed, performing bone graft in the maxillary sinus widened buccolingually.

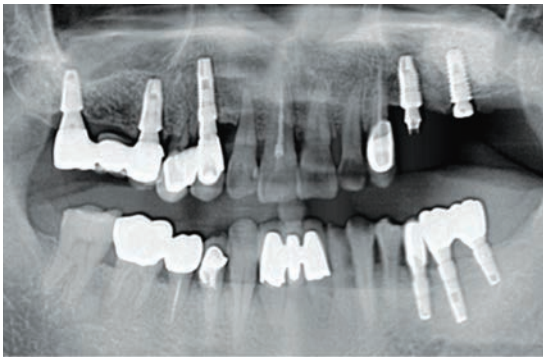


Fig. 11. This radiograph was right after the TSIII HA implant installation and procedure on the sinus.

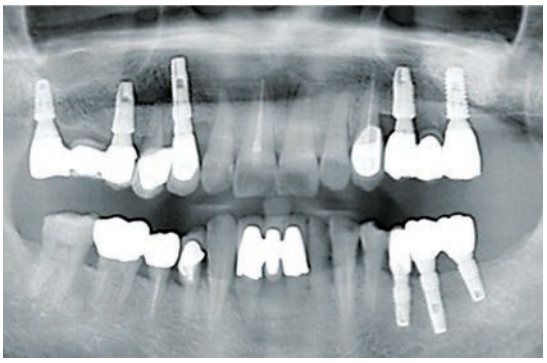


Fig. 12. This radiograph was taken right after placing the final prosthesis about four months later.

Case | Location : # 16 | Age : 65, Sex : M

5

Seoul Dental Clinic

Director
Lee, Dae-Hee

A case of reconstruction using a TSIII HA implant after the ridge augmentation with allogenic bone block in the maxillary right molar region.

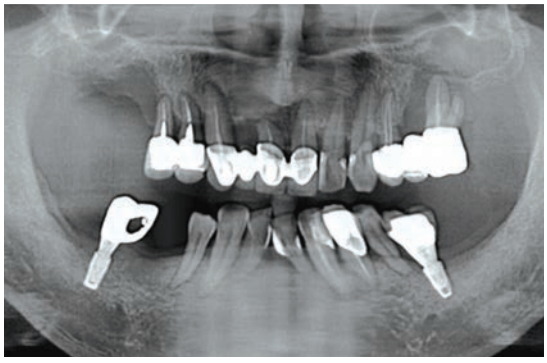


Fig. 1. This patient was transferred for a vertical bone graft in the maxillary right molar region.

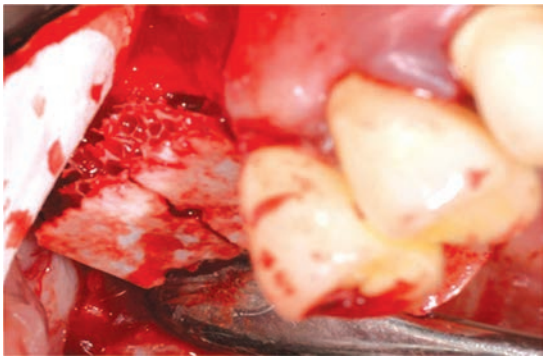


Fig. 2. A bone graft was performed by using an allogenic bone block, but it was broken during the fixing procedure using a GBR screw due to a thin cortical part.

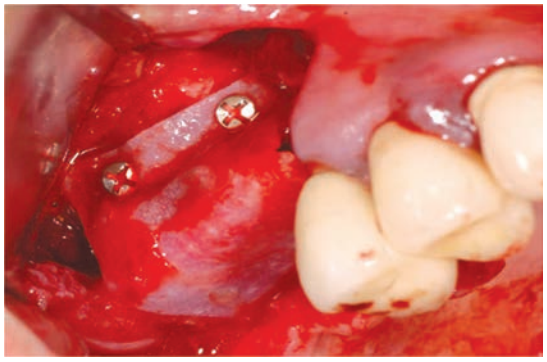


Fig. 3. The grafted block was fixed with collagen membrane and GBR pin, and Bellafuse allogeneic bone was inserted on top of the graft because thin cortical bone layer could cause massive bone resorption.

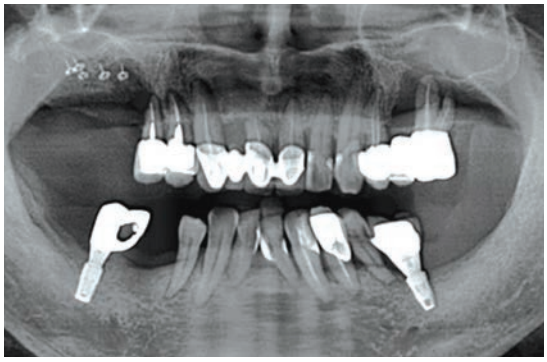


Fig. 4. Radiograph after allogeneic block bone graft.

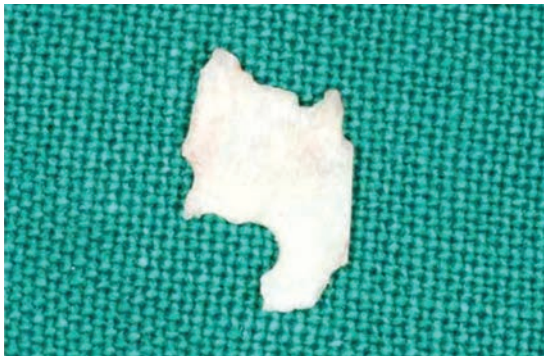


Fig. 5. The Bellafuse allogeneic bone was necrotized about 5 months later.

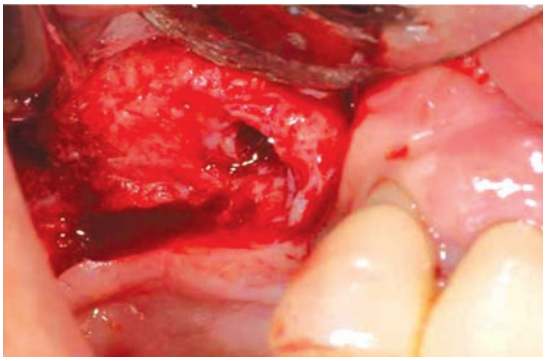


Fig. 6. However, the allogenic bone block on the bottom was taken fairly well without any presence of bone absorption.

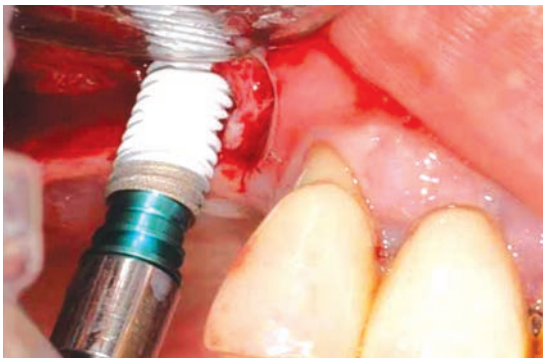


Fig. 7. TSIII HA implant (5.0x10mm) was installed in position #16.

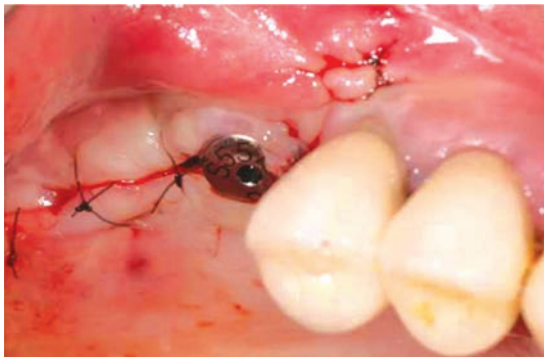


Fig. 8. The picture shows the installed implant by using a single stage procedure.

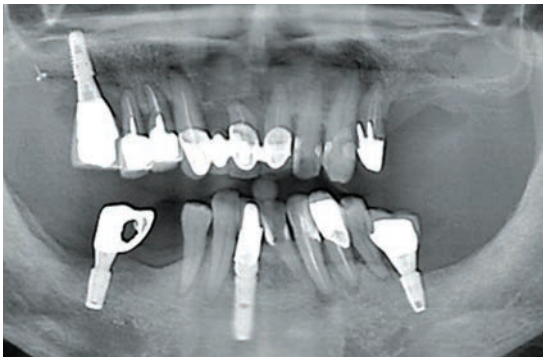


Fig. 9. The picture was taken after placing the final prosthesis about three months later.

Case 1 | Implant position: #26, #27 | Age : 64, Sex : F

Sinus Lift Using the CAS-KIT and Implantation of the TSIII HA Fixtures at Lt Maxillary Molars

Apsun Dental Clinic
Director
Cho, Yong-Seok

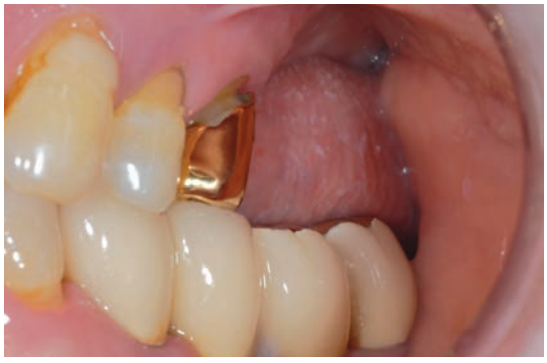


Fig. 1. 64 years old female visited my clinic to receive implants. She extracted #27 3 months ago for the mobility of the tooth after bridge cutting. Excessive occlusal clearance due to vertical bone loss was observed.

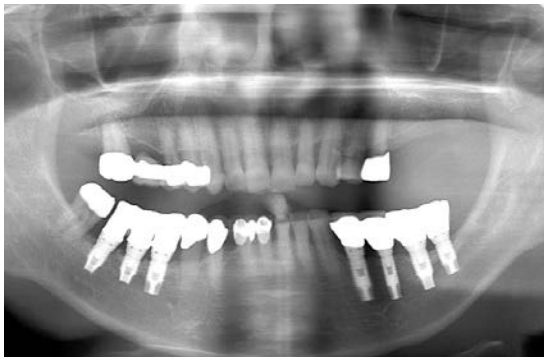


Fig. 2. In Panoramic view, resibual alveolar bone heights of #26, 27 are not clear and bone density seems very poor.

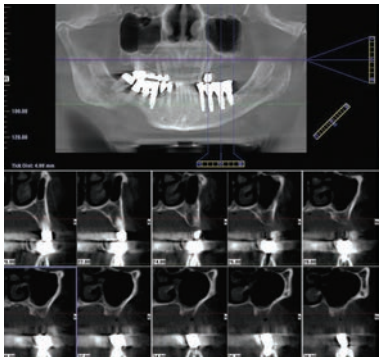


Fig. 3. In Conebeam CT view, it is difficult to measure the remaining bone height because of unclear alveolar bone crest. The sinus shows in healthy condition.

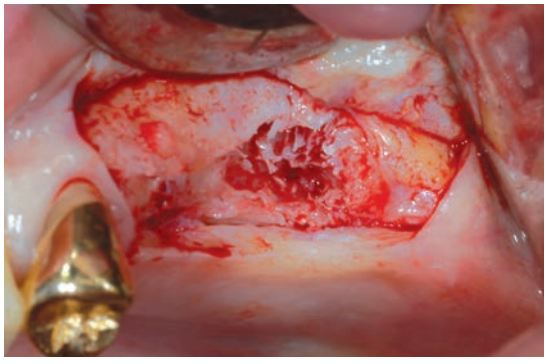


Fig. 4. Bone exposed after elevation of the mucoperiosteal flap. Bone healing of #27 site which involved in periodontitis looks very poor even 3months after extraction.

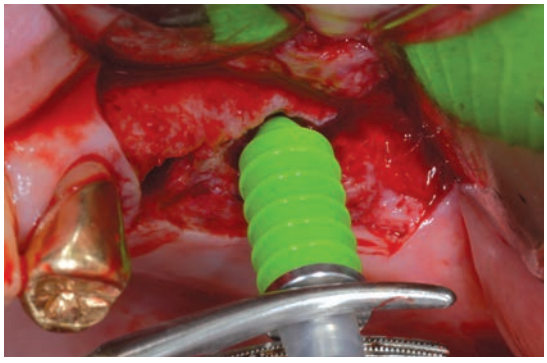


Fig. 5. The remaining bone height of #26 was sufficient and #27 was not. Sinus lift procedure was performed at #27 site using the CAS-KIT. Hydraulic membrane lifting procedure was done after penetration of the sinus floor.

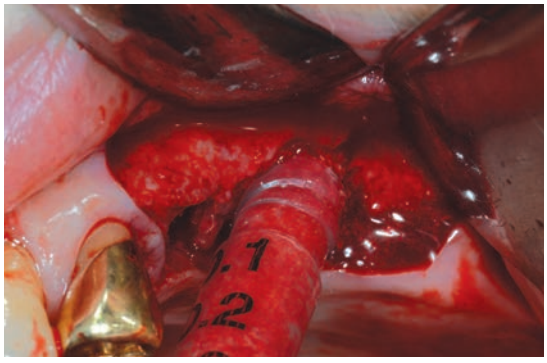


Fig. 6. Allogenic bone substitute (SureOss 0.5cc) was grafted.

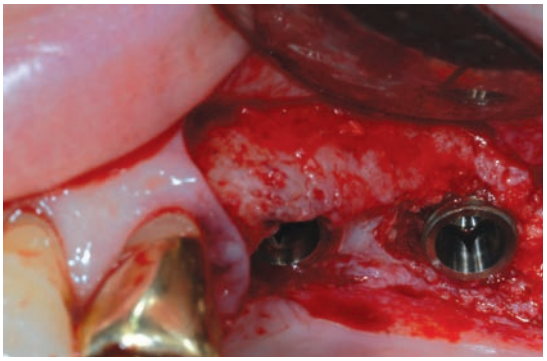


Fig. 7. After bone graft TSIII HA ⌀4.5x10.0mm fixtures were installed. Because of poor bone quality insertion torques were under 10Ncm, and ISQ value was measured as 56/58 and 48/55 each.

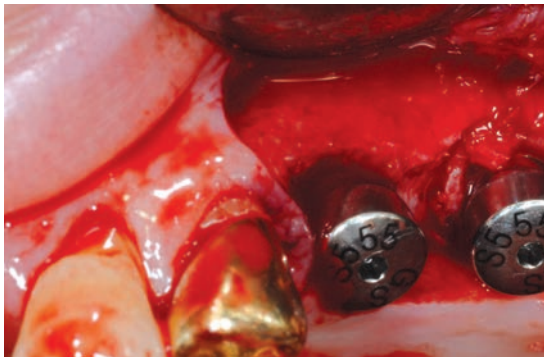


Fig. 8. After minor autogenic bone graft around #27i bone defect 1-stage surgery was done by connecting healing abutments.

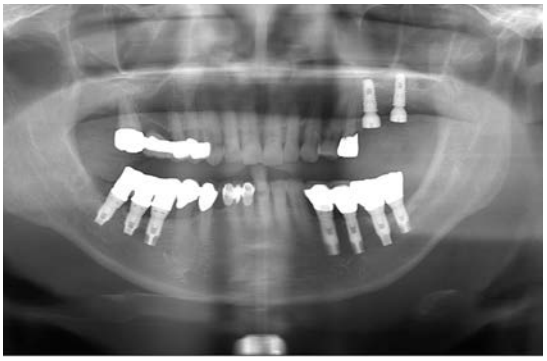


Fig. 9. POP Panoramic view shows well positioned #26i, 27i. Well defined dome shaped bone grafting is seen at the apex of #27i.

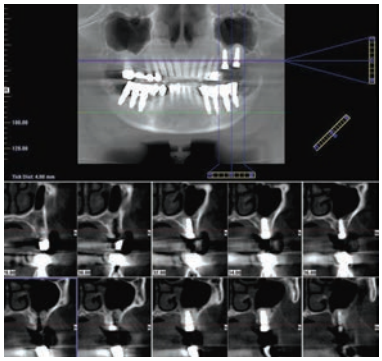


Fig. 10. POP CT shows successful sinus bone grafting of #27i using the CAS-KIT without membrane perforation.

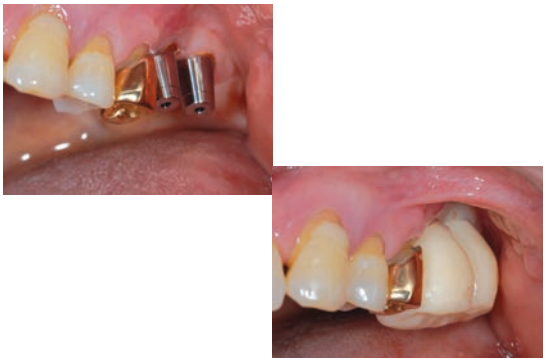


Fig. 11~12. he rigid abutments are connected 6 months after operation and the temporary bridge was delivered.

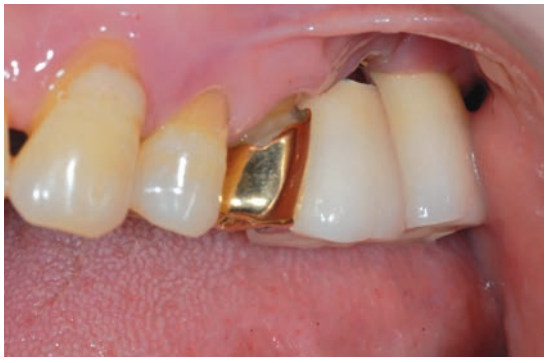


Fig. 13. Final restoration was delivered 7 months after operation.

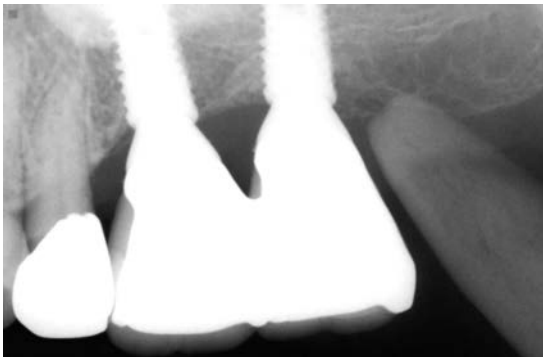


Fig. 14. Standard X-ray view after cementation of the final bridge.

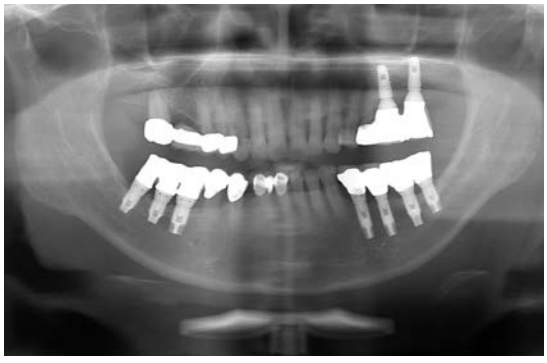
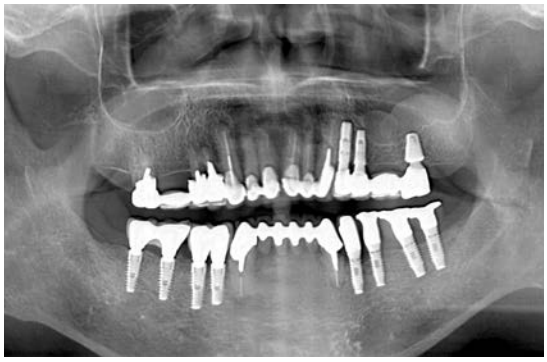


Fig. 15. The Panoramic view shows sinus floor remodeling of the #27i.

Case 2 | Implant position: #26 | Age:66, Sex:M

Use of GSIII short implant instead of sinus surgery

Seoul Dental Clinic
Director
Lee, Dae-Hee



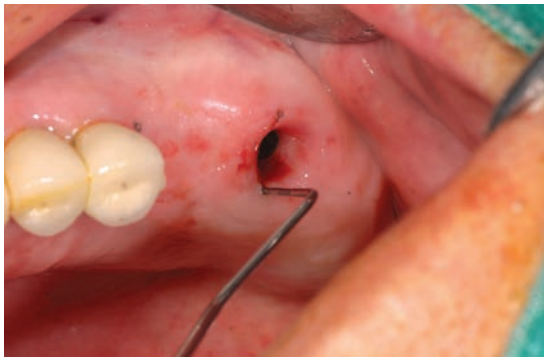


Fig. 1~2. This patient had suffered from cerebral stroke and its complications.
His chief complaint was food packing under the pontic side of left upper implant-supported bridge area.

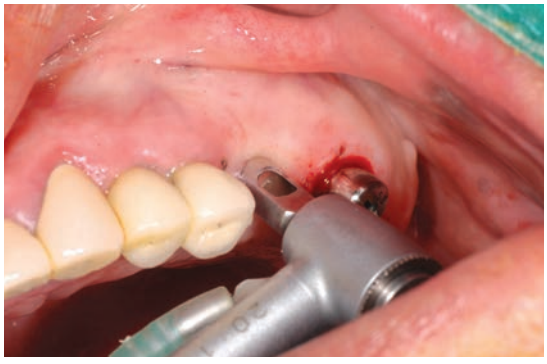


Fig. 3. Flapless surgery was done for the patient's convenience.

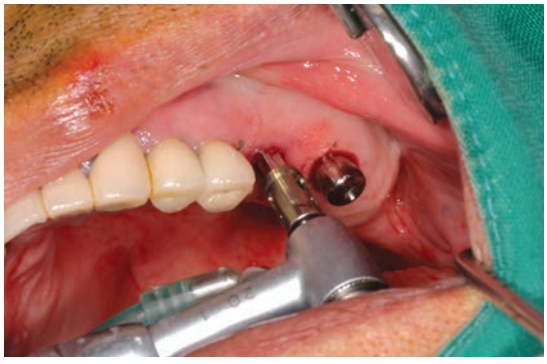


Fig. 4. CAS drill of Osstem was used to shaving the sinus floor for bi-cortical engagement of fixture.

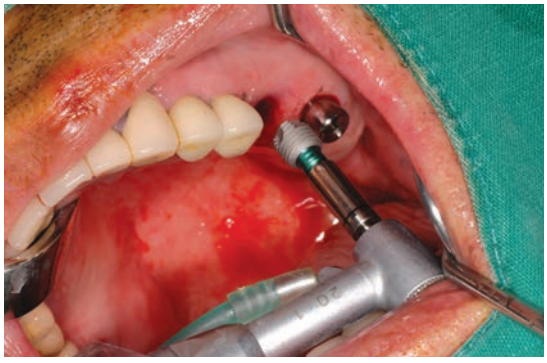


Fig. 5. 6mm short GSIII fixture was installed.

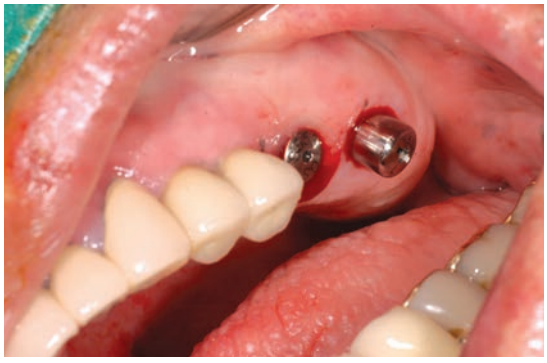


Fig. 6. Healing abutment was fastened and suture was not practiced.

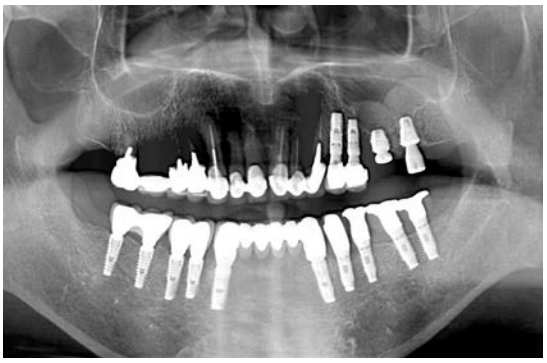


Fig. 7. Fixture was successfully engaged not to touch the thickened sinus membrane.

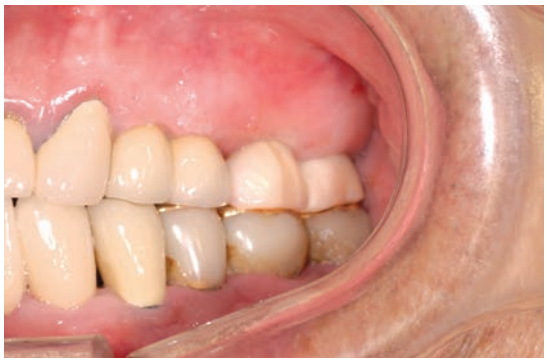


Fig. 8. After the period of provisional restoration.

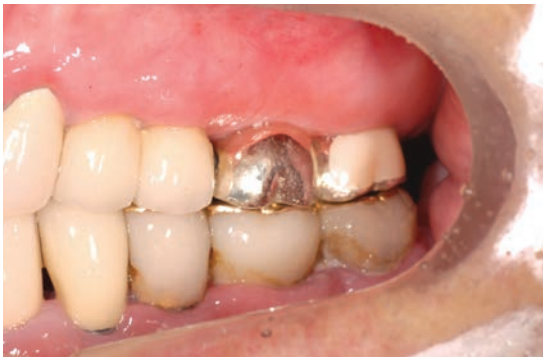


Fig. 9. Gold bridgework was delivered. Plaque control was poor due to the hemiparalysis of right side from stroke.

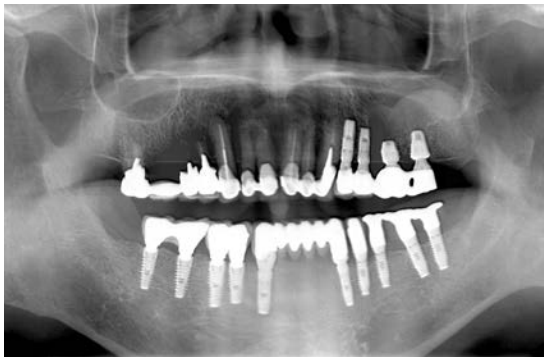


Fig. 10. This picture shows the final appearance after bridgework.

Case | Location: #24, 27 | Age:56, Sex:M

1

Left maxillary sinus bone graft using LAS-KIT and simultaneous Implant placement

Apsun Dental Clinic

Director

Cho, Yong-Seok

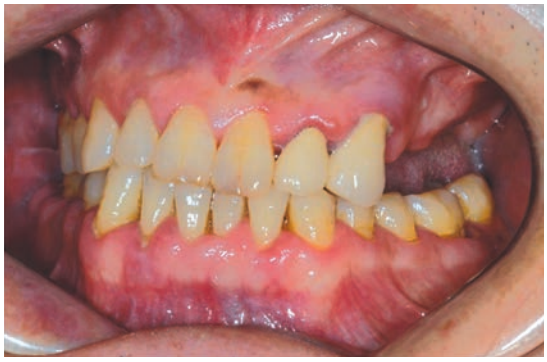


Fig. 1. 56 years old male patient visited to place the implant at missing site of #24, 25, 26, 27

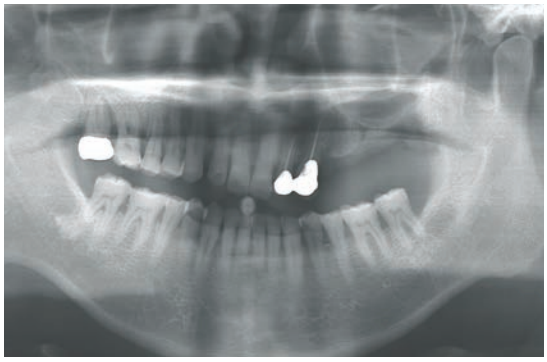


Fig. 2. Preoperative panoramic view shows remaining bone height of the left maxillary sinus about 3.0 mm

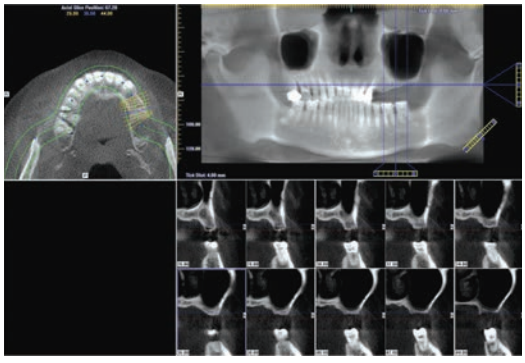


Fig. 3. Preoperative CT view shows remaining bone height about 2.0 to 3.0mm and relatively thick lateral sinus wall.

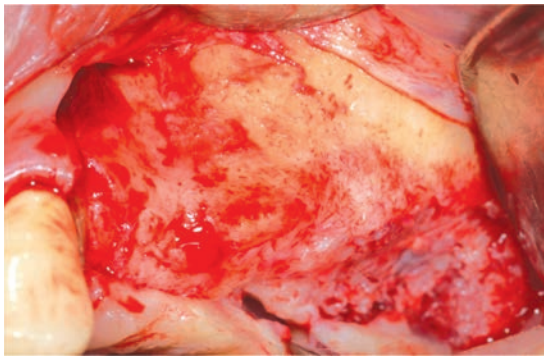
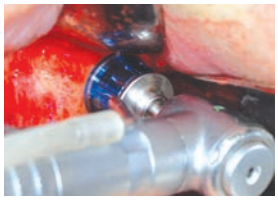


Fig. 4. Lateral wall of the left maxillary sinus was exposed after mucoperiosteal flap elevation

ø 7.0mm Core drill with 1.5mm stopper



ø 7.0mm Core drill with 2.0mm stopper

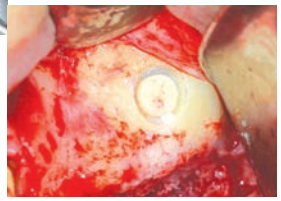


Fig. 5. Grind the lateral sinus wall using the ø 7.0mm LAS Core drill with 1.5mm stopper but sinus membrane was not exposed. After using ø 7.0mm Core drill with 2.0mm stopper sinus membrane was showed through.

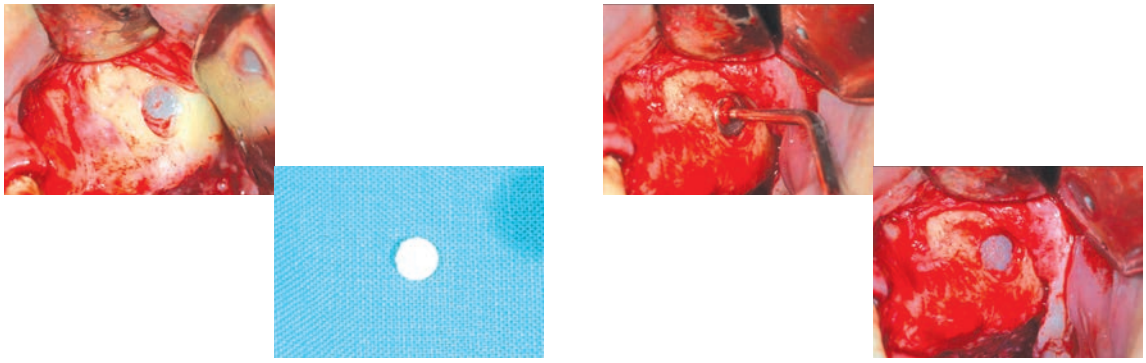


Fig. 6. Bone core was detached and sinus membrane was elevated using the membrane separator and elevator

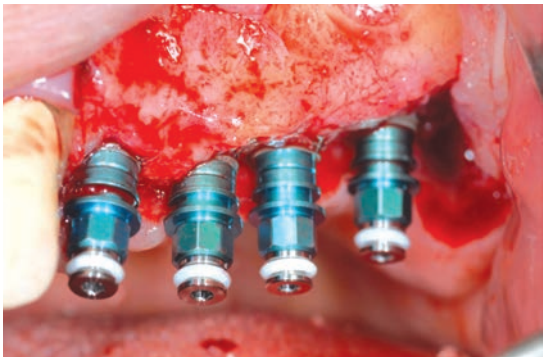


Fig. 7. After bone graft TSIII SA 4.5x10.0mm and 4.5x10.0mm fixtures were installed

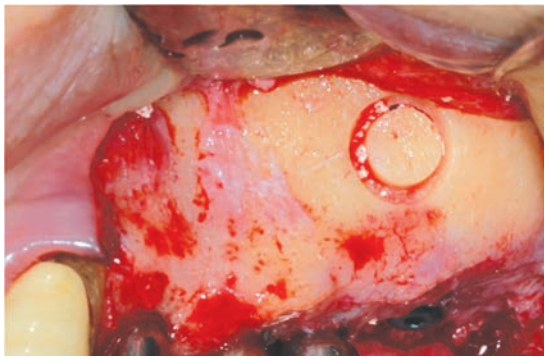


Fig. 8. Bone core was repositioned

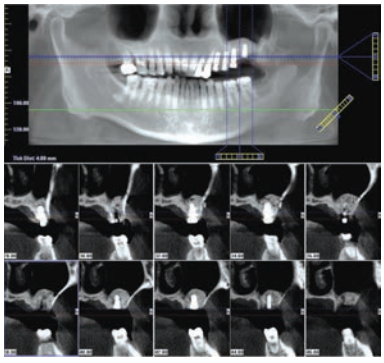


Fig. 9. POP CT view shows successful sinus bone graft

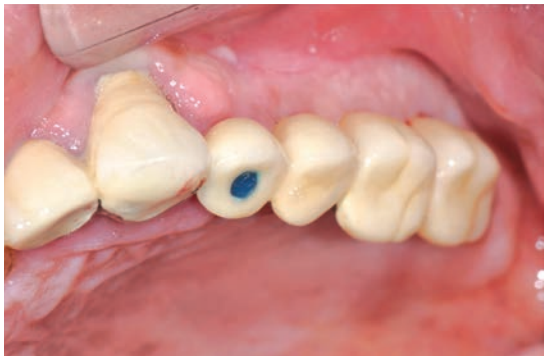


Fig. 10. Bridge was delivered 6 months after the implant installation

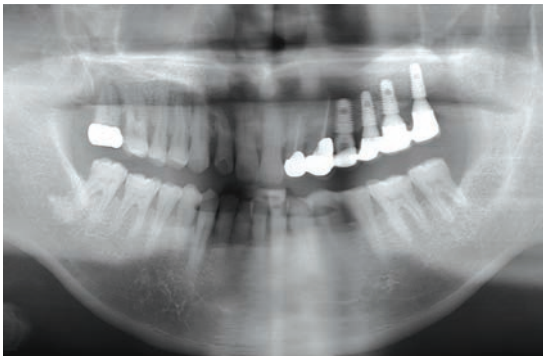


Fig. 11. Panoramic view after the bridge delivery

Case | Location: #16, 17 | Age:57, Sex:F

2

Right sinus bone graft using LAS-KIT and simultaneous implant placement

Apsun Dental Clinic

Director
Cho, Yong-Seok

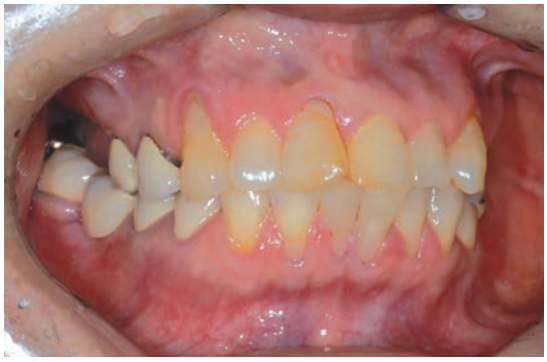


Fig. 1. 57 years old female patient visited to place the implant at missing site of #16, 17

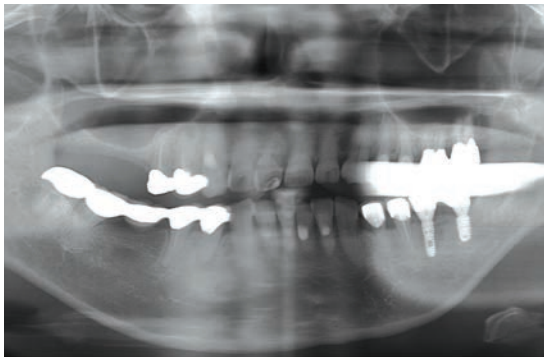


Fig. 2. Preoperative panoramic view shows remaining bone height of the right maxillary sinus about 2.0 mm

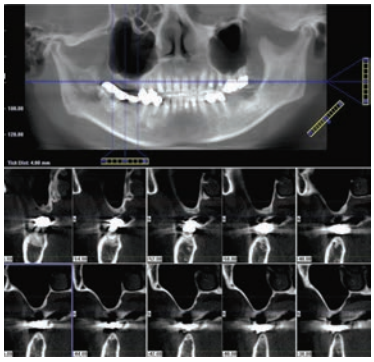


Fig. 3. Preoperative CT view shows remaining bone height about 1.0 to 20mm and thin lateral sinus wall.

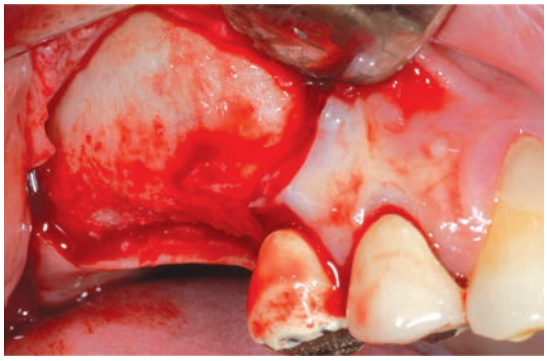


Fig. 4. Lateral wall of the right maxillary sinus was exposed after mucoperiosteal flap elevation

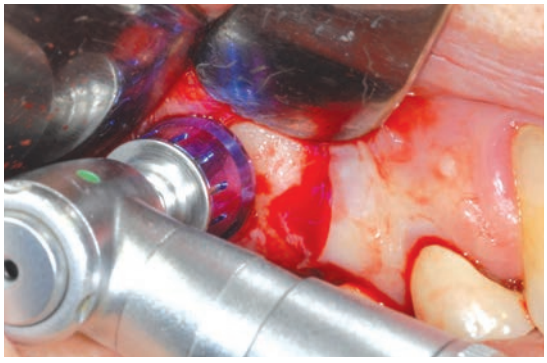


Fig. 5. Grind the lateral sinus wall using the ø7.0mm LAS Core drill with 1.0mm stopper .

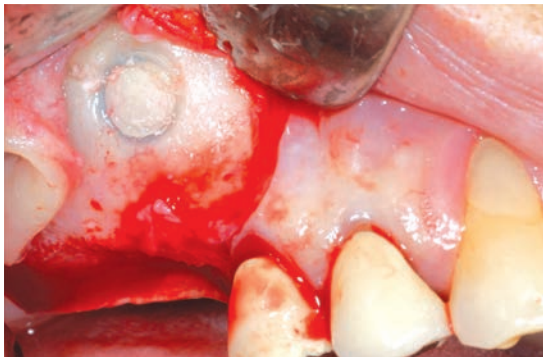


Fig. 6. After using ø7.0mm Core drill with 1.0mm stopper sinus membrane was showed through.

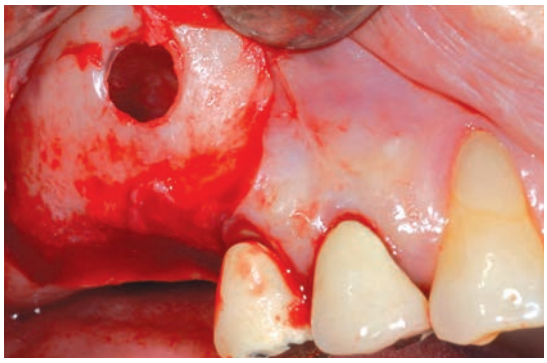


Fig. 7. Bone core was detached and sinus membrane was elevated using the membrane separator and elevator

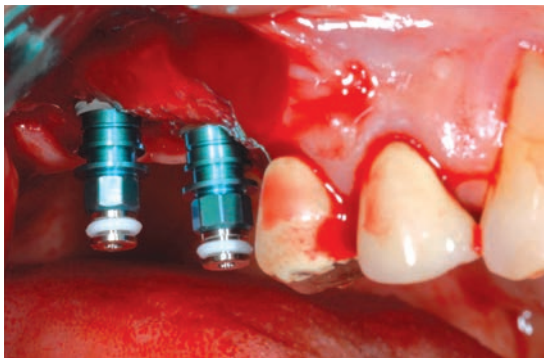


Fig. 8. After bone graft TSIII SA 4.5x10.0mm fixtures were installed

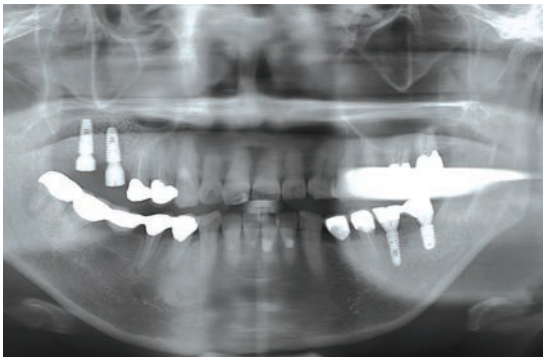


Fig. 9. POP Panoramic view shows successful sinus bone graft

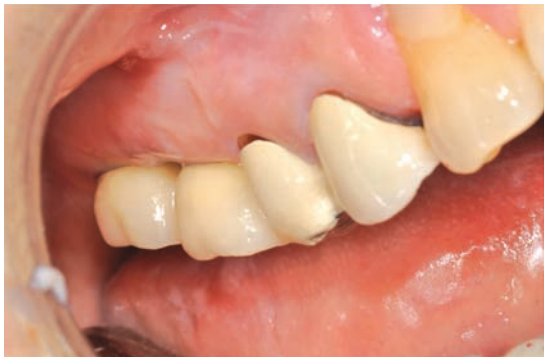


Fig. 10. Bridge was delivered 8 months after the implant installation

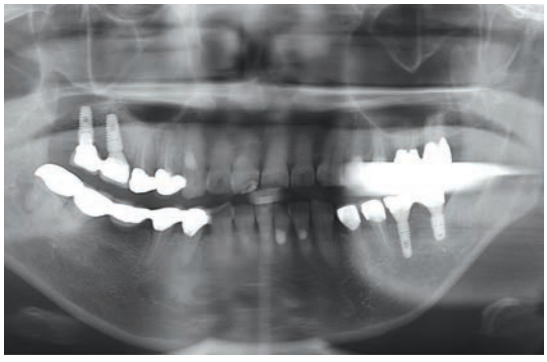


Fig. 9. Panoramic view after the bridge delivery

Case | Implant position: #33, 43 | Age:72, Sex:M

1

Seoul National University Bundang Hospital

Professor
Kim,Young-Kyun
Yi, Yang-Jin

Overdenture Treatment Using Two MS Port Implants in the Severely Atrophic Mandible

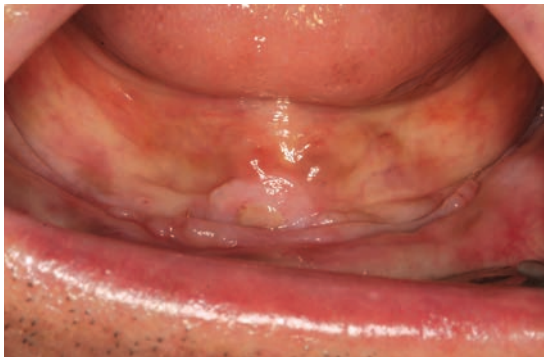


Fig. 1. Initial intra-oral view. Since long-term use of the complete denture caused repeated ulcerative lesions on the oral floor and the patient was complaining of pressure pains on mental foramen on both sides when wearing the denture, it was very hard to apply routine treatment for the complete denture.

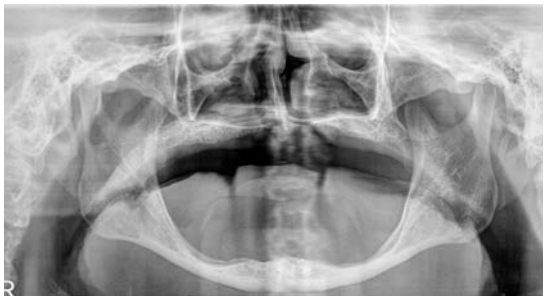


Fig. 2. Initial panoramic radiograph. Severe mandibular atrophy was observed and the mental foramen was located close to the alveolar crest. Since there was a risk of a mandibular bone fracture during the implant installation and the patient's general health condition was poor, it was considered that guided bone regeneration or installation of an implant with a common diameter size would not be appropriate in this case. Therefore, we planned to apply an overdenture after installing two mini implants in order to minimize complications.

Fig. 3. An MS port implant with diameter of 2.5mm and length of 8.5mm

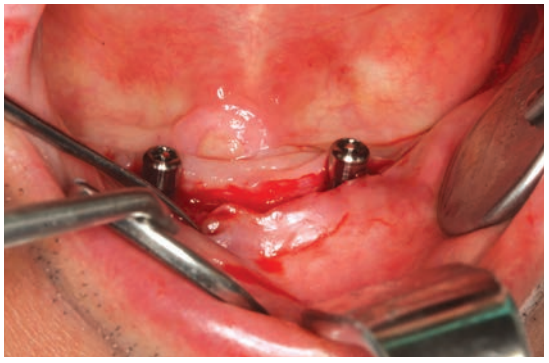


Fig. 4. Two MS port implants were installed by using the minimal invasive approach.

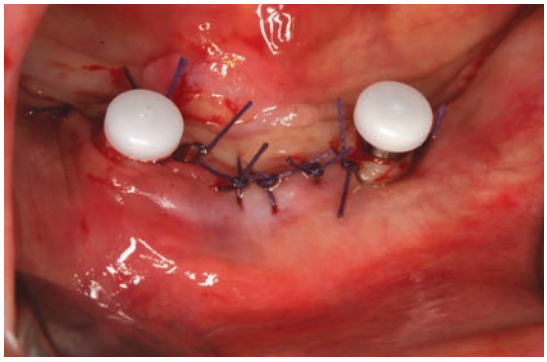


Fig. 5. The wound was sutured after covering it with a cap.

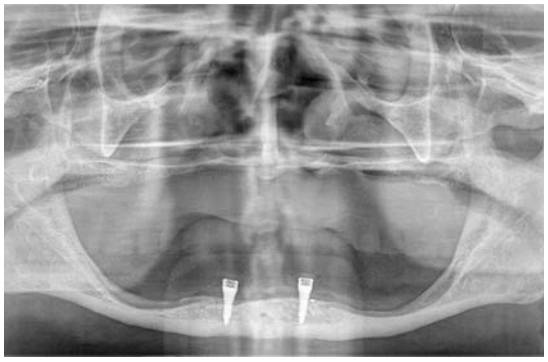


Fig. 6. Panoramic radiograph after the implant installation

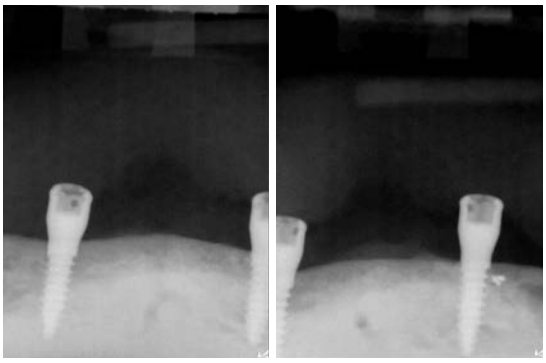


Fig. 7. Periapical radiograph 2 weeks after the implant installation

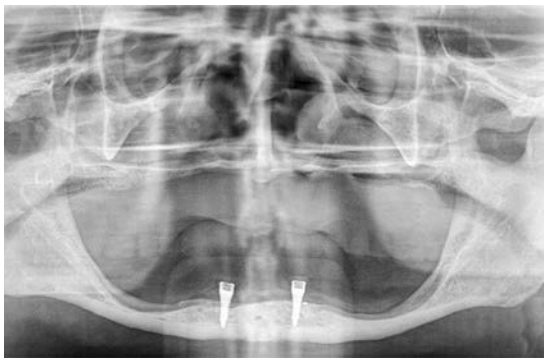


Fig. 8. Panoramic radiograph 2 months after the implant installation

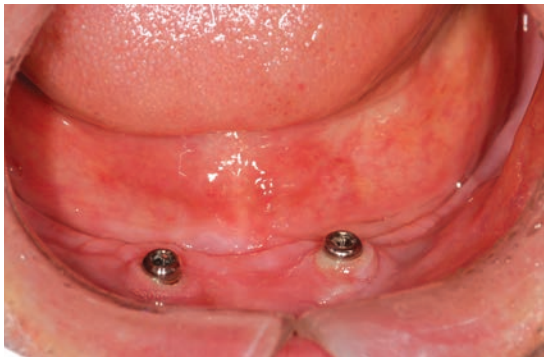


Fig. 9. Intra-oral view after functional use of the overdenture for five months

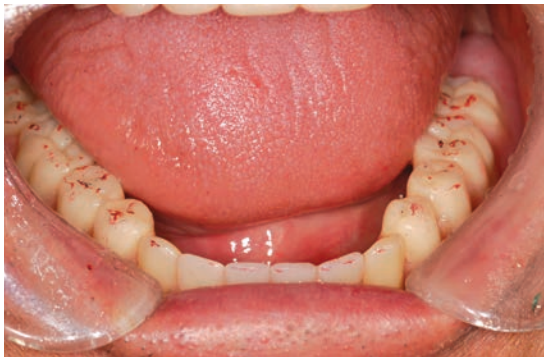
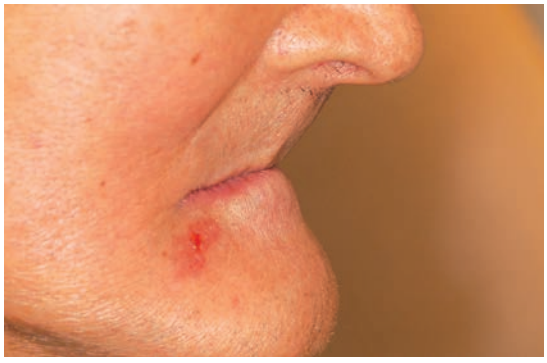


Fig. 10. Intraoral view of the overdenture 5 months of functional use.



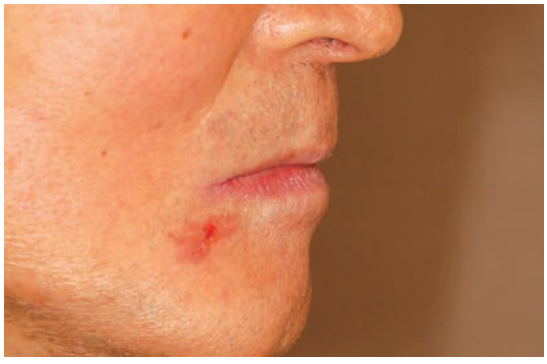


Fig. 11. Lateral view before and after placing the overdenture

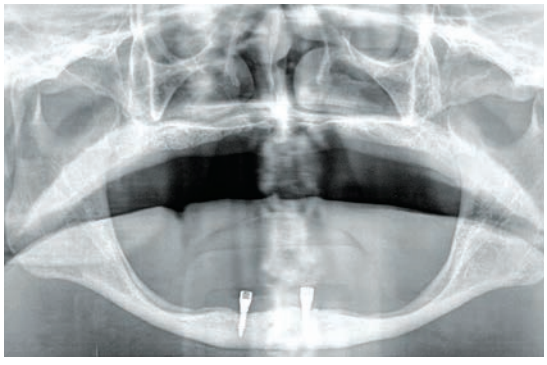


Fig. 12. Panoramic radiograph 1 year and 6 months after placing the overdenture

Case | Location: #41 | Age:41, Sex:M

2

A case of an MS implant installed right after extracting the mandibular central incisors that broken in an injury

Apsun Dental Clinic

Director
Cho, Yong-Seok

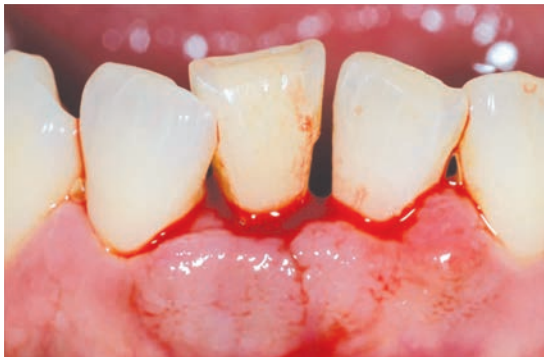


Fig. 1. 41 years old male patient visited for mobility of #41 after trauma

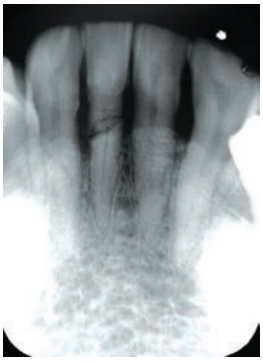


Fig. 2. Standard X-ray view showed fractured #41

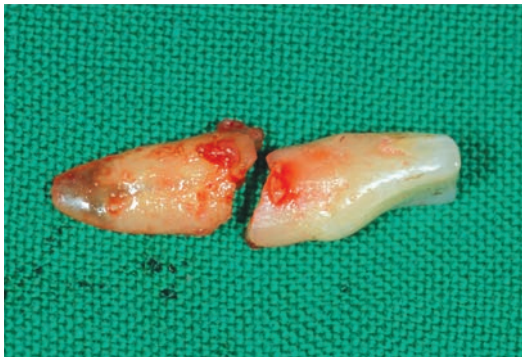


Fig. 3. Extraction of #41

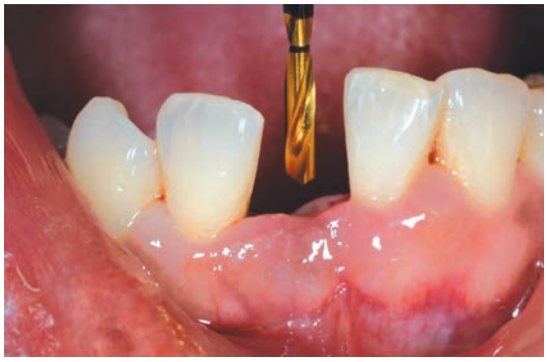


Fig. 4. Using ø 2.3 twist drill implant site was enlarged

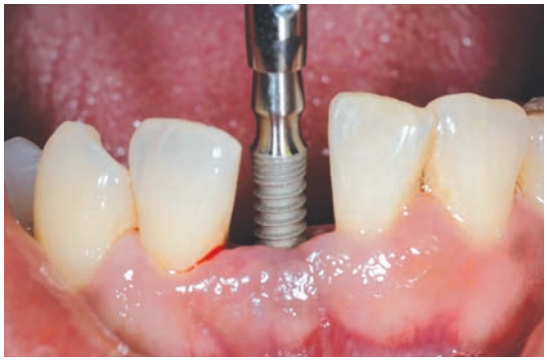


Fig. 5. After drilling MS 3.0x13mm fixture was installed

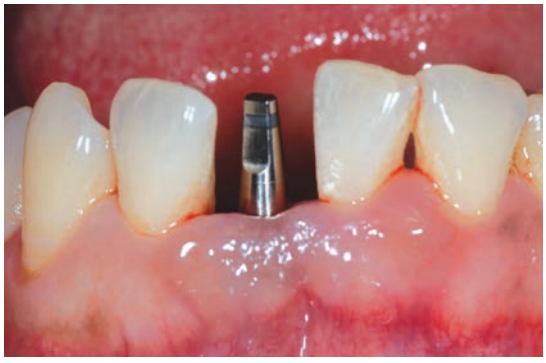


Fig. 6. Insertion torque was about 30 Ncm

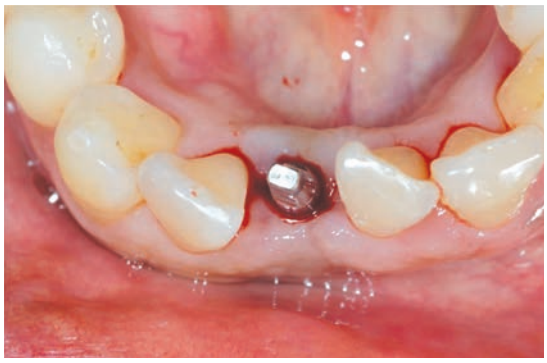


Fig. 7. In occlusal view abutment of the MS fixture was positioned obliquely considering crowding of adjacent teeth

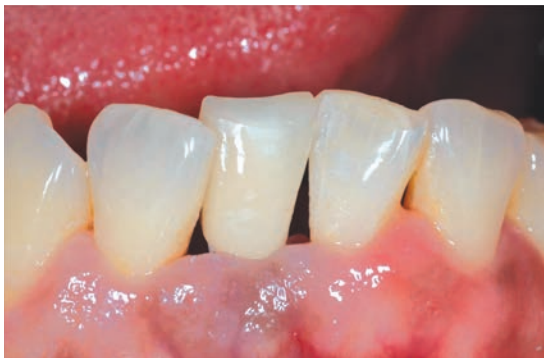


Fig. 8. Immediate after implant installation temporary crownd was fabricated using a temporary cap and delivered

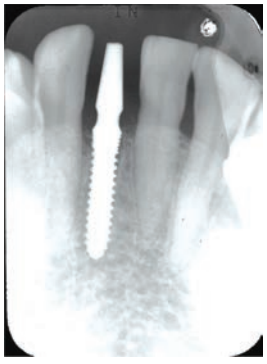


Fig. 9. POP Standard X-ray view showed good position of MS implant

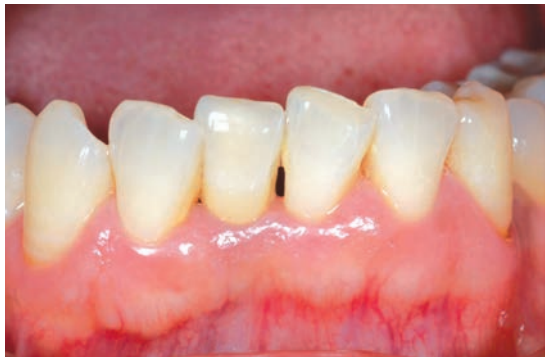


Fig. 10. Clinical photo of 4 years after crown delivery

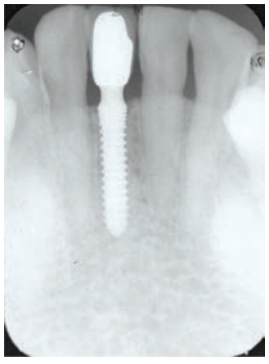


Fig. 11. Standard X-ray of 4 years after crown delivery

Case | Location: #41 | Age:51, Sex:F

3

Apsun Dental Clinic

Director
Cho, Yong-Seok

MS implants were installed immediately after extracting both the lower central incisors affected by periodontal disease

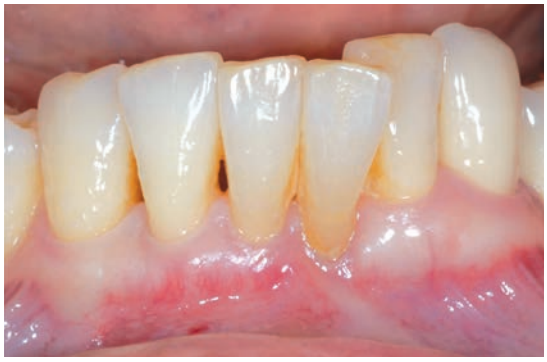


Fig. 1. 51 years old female patient visited for mobility and gingival recession of #31. The degree of mobility were grade 3 in #31 and gerade 1 in #41

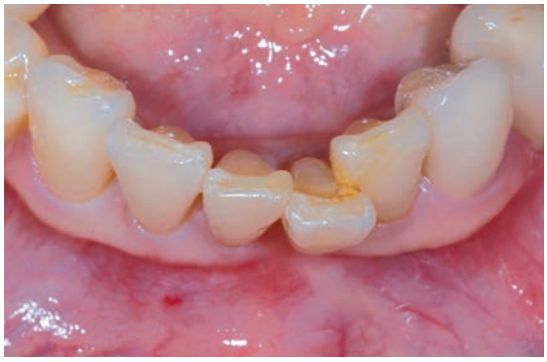


Fig. 2. In Occlusal view #31 was labially protruded

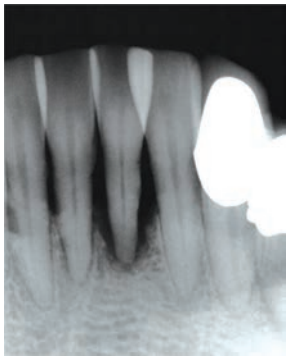


Fig. 3. Standard X-ray view showed severe alveolar bone reposition of #31.and moderate bone reposition of #41

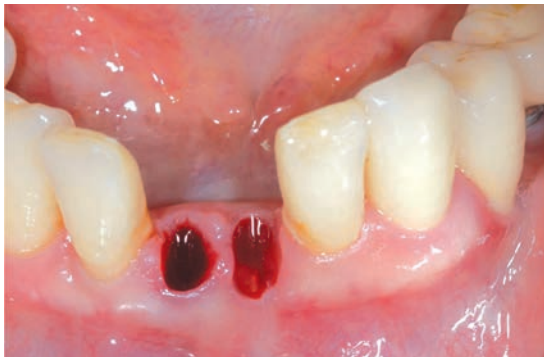


Fig. 4. Both #31 and #41 were extracted. Using ø 1.8 twist drill #41 implant site was enlarged

Fig. 5. After drilling MS 2.5x13mm fixture was installed at #41

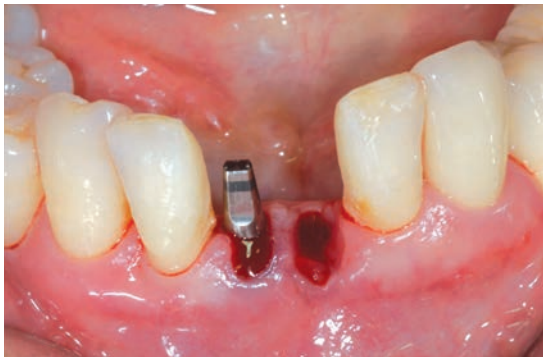


Fig. 6. Controlled depth of the fixture

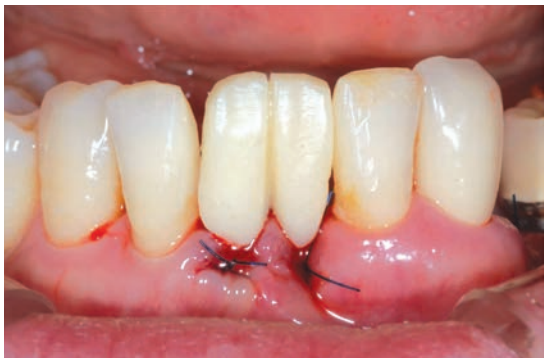


Fig. 7. Immediate after implant installation temporary bridge was fabricated using temporary caps and delivered

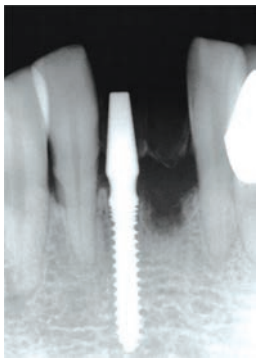


Fig. 8. POP Standard X-ray view shows good position of MS implant

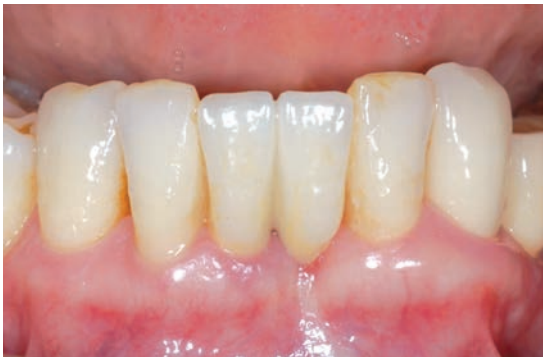


Fig. 9. Clinical photo of 4 months after bridge delivery

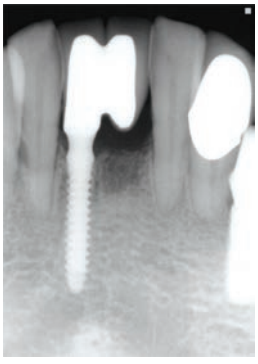


Fig. 10. Standard X-ray of 4 months after bridge delivery

Case 1 | Location : multiple, maxilla and mandible | Age : 54, Sex : M

Full-mouth reconstruction by using a GSIII implant I

Seoul Dental Clinic
Director
Lee, Dae-Hee

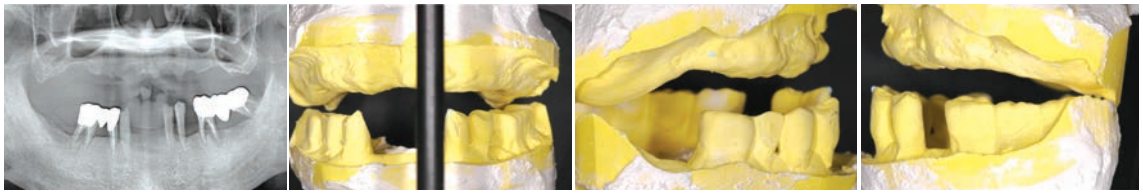


Fig. 1. The patient with a completely edentulous maxilla and partially edentulous mandible asked for a fixed-type complete prosthesis supported by an implant.

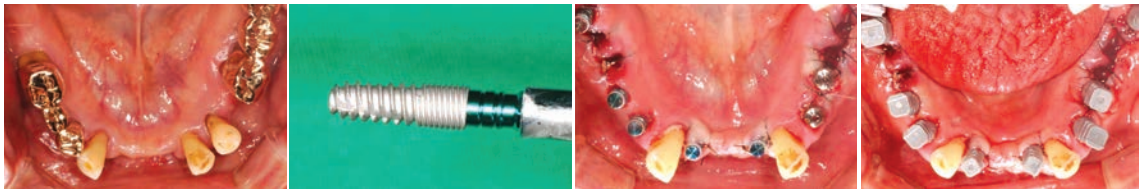


Fig. 2. The GSIII implant was installed right after extracting the teeth and immediate loading was applied simultaneously.

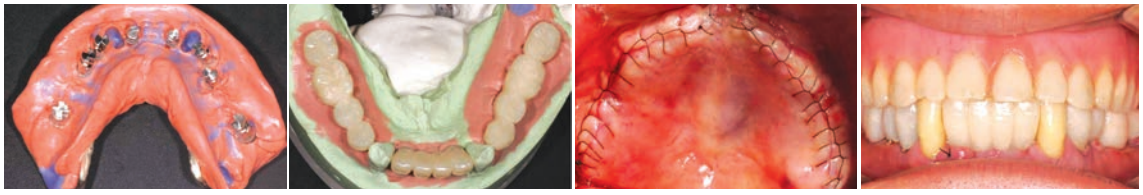


Fig. 3. Full-mouth implant installation was performed in the mandible on the day of placing temporary fixed-type prosthesis in the maxilla.

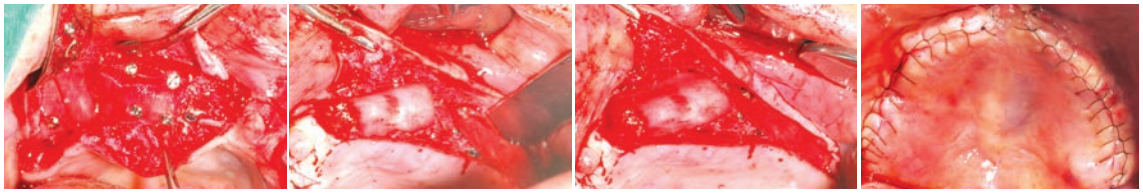


Fig. 4. A sinus lift and overall bone graft were performed at the same time.

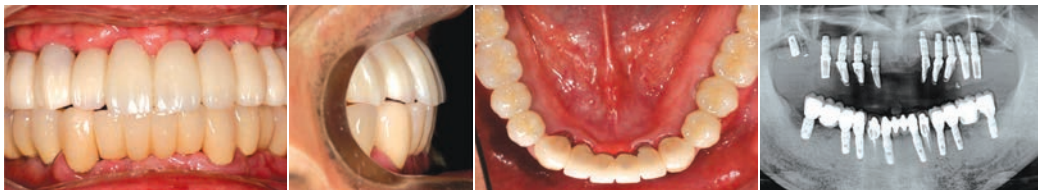


Fig. 5. This picture was taken after finishing the prosthetic treatment in the mandible and placing temporary teeth in the maxilla.

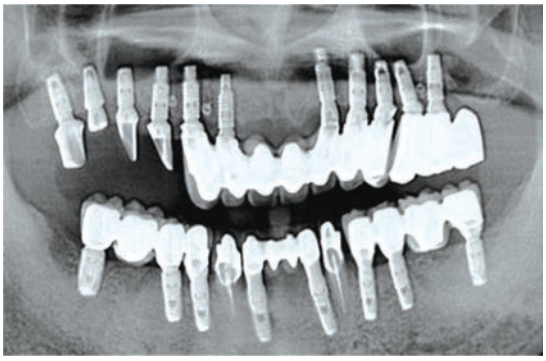


Fig. 6. One more implant was installed additionally in the right side of the maxilla while placing the temporary teeth.

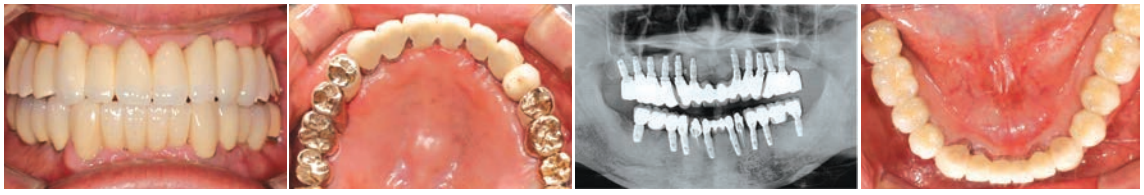


Fig. 7. After placing the final prosthesis

Case | Location : multiple, maxilla and mandible | Age : 66, Sex : F

2

Full-mouth reconstruction by using a GSIII implant II

Seoul Ace Dental Clinic
Director
Park, Hwee-Woong

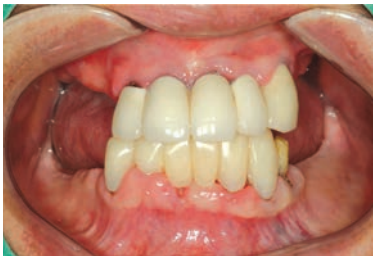


Fig. 1. Initial condition. There was mobility in the posterior region of the maxilla and mandible as well as severe resorption of the alveolar ridge in the edentulous region.

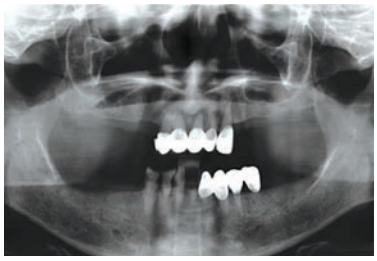


Fig. 2. Initial panoramic radiograph

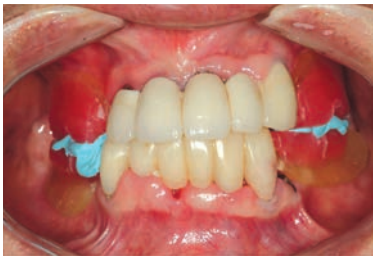


Fig. 3. An intermaxillary jaw relation was taken for mounting a diagnostic model of the maxilla and mandible.

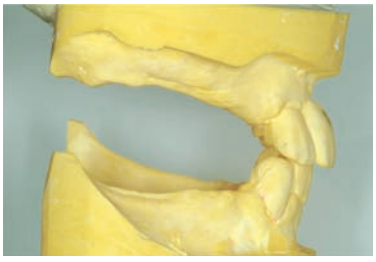


Fig. 4. Mounted models of the maxilla and mandible showed severe vertical and horizontal bone resorption in the molar region.

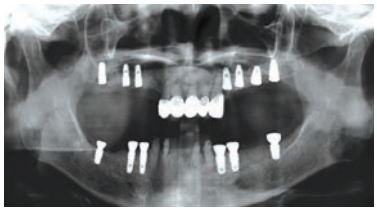


Fig. 5. Implants were installed in the molar region after extracting the premolar teeth showing poor prognosis. A sinus lift and bone graft were performed in the maxilla by using a crestal approach with simultaneous installation of GSIII implants, and healing abutment was connected using a single stage method after the implant installation in the mandible. Periodontal treatment and a root canal treatment were performed in the posterior resin of the mandible and maxilla during the healing period for the osseointegration.

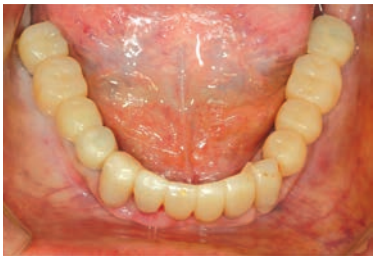


Fig. 6. Transfer abutment was connected to the mandibular molar region two months after the implant installation and a temporary prosthesis was installed.

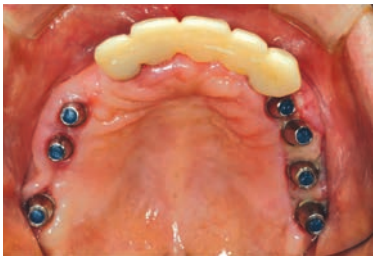


Fig. 7. Transfer abutment was connected to the maxillary molar region four months after the implant installation and a temporary prosthesis was installed.

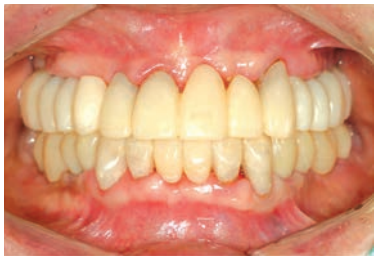


Fig. 8. After placing the temporary fixed prosthesis in the maxilla and mandible, an occlusal balance was established.

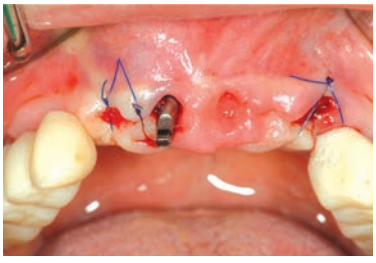


Fig. 9. MS implants were installed immediately after extracting the upper central incisors affected by periodontal disease so that the installed implants could support the temporary fixed prosthesis.

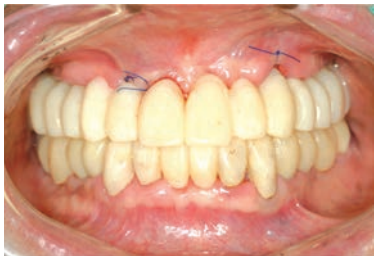


Fig. 10. Used, temporary natural abutment teeth were fixed in MS implant after adjustment with the cross-arch splinting to the molar region.

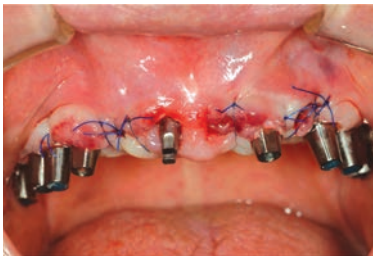


Fig. 11. Two GS III implants were installed additionally after extracting the posterior teeth and the soft tissue healed.

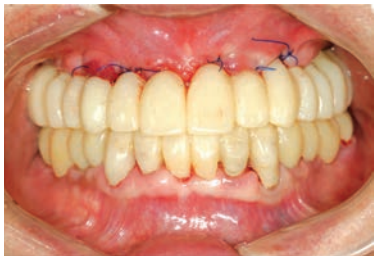


Fig. 12. Since the immediate loading was applied by connecting transfer abutment to a newly installed implant in the maxillary posterior region, the patient was able to keep using the temporary fixe prosthesis.

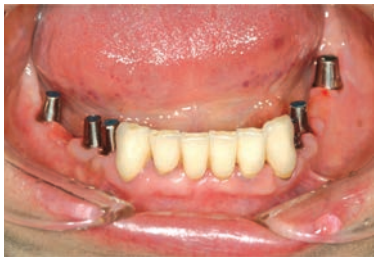


Fig. 13. Fixed prostheses were made by using natural teeth taken from the maxillary posterior part and transfer abutment was applied in the molar region.

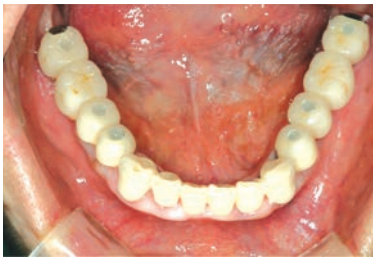


Fig. 14. After placing the final prosthesis in the mandible.

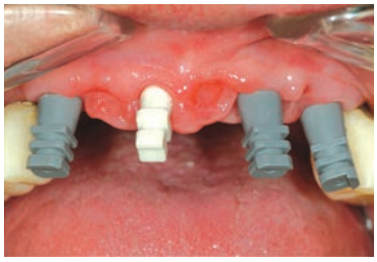


Fig. 15. An impression was taken from the maxillary posterior region by using plastic impression coping.

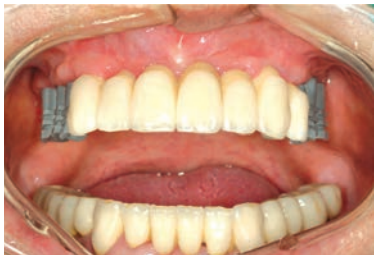


Fig. 16. An impression of the molar region was taken with the prosthesis placed in the maxillary posterior part.

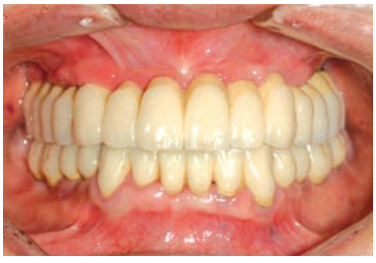


Fig. 17. After placing the final prosthesis

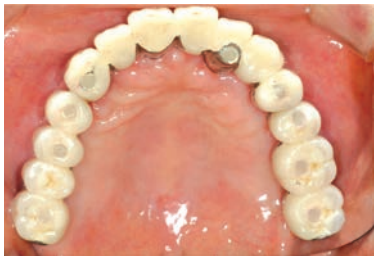


Fig. 18. Prostheses for the maxilla were made into three segments for the posterior part and two molar parts.

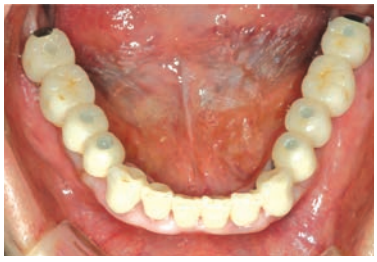


Fig. 19. Mandibular posterior teeth was used as abutment after the periodontal and root canal treatment without extractions. Conserved natural teeth would prevent resorption of the alveolar ridge, which may occur after tooth extraction, and help the patient sense proprioception during mastication.

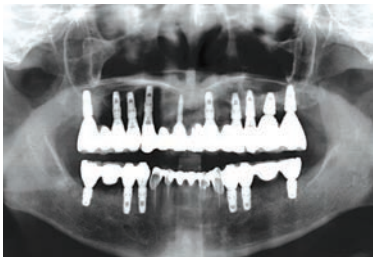


Fig. 20. Panoramic radiograph after placing the final prostheses

Case | Location: #45, 46 | Age:40, Sex:M

1

Chungbuk National University Hospital
Professor
Kim, Kyeong-won

Delayed installation of an implant after extraction of the lower molar teeth followed by a ramal block bone graft in the mandibular posterior region

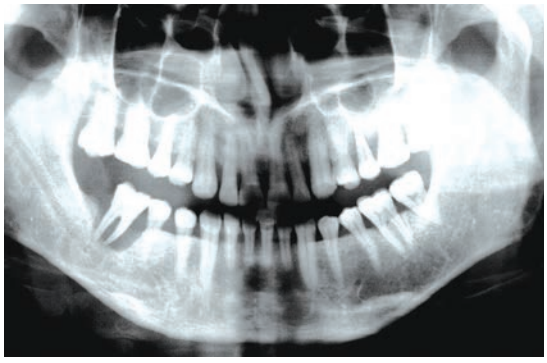


Fig. 1. Initial panoramic radiograph. Severe bone loss was observed in position #47.

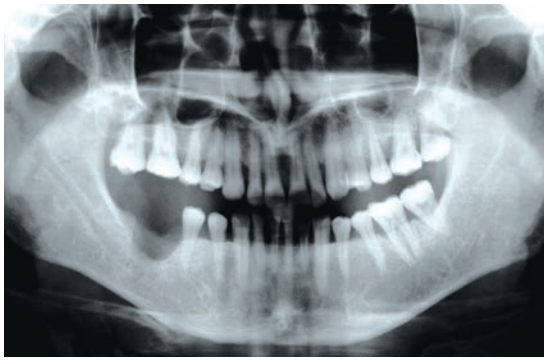


Fig. 2. Panoramic radiograph after extraction of tooth #47

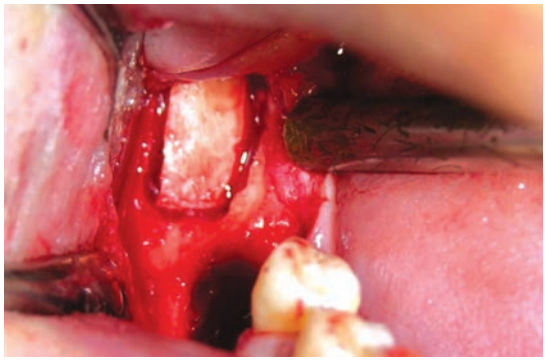


Fig. 3. Taking ramal block bone

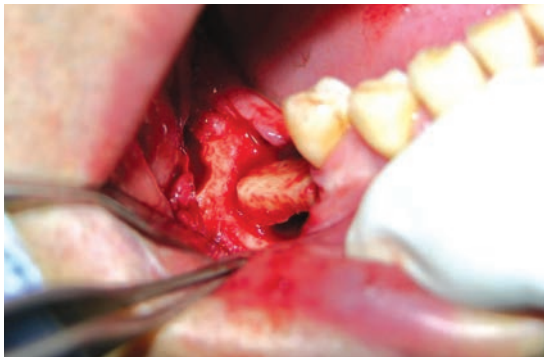


Fig. 4. Ramal block bone applied to a bony defect area.

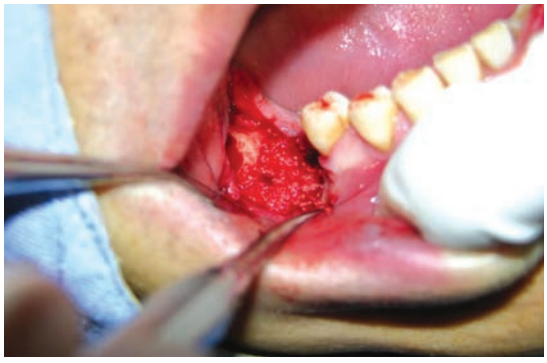


Fig. 5. β-TCP was grafted around the block bone.

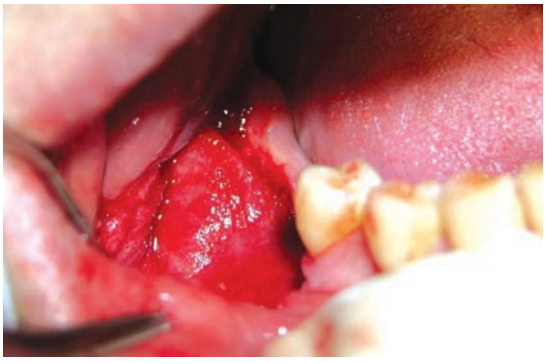


Fig. 6. After covering with resorbable collagen membrane (Lyoplant)

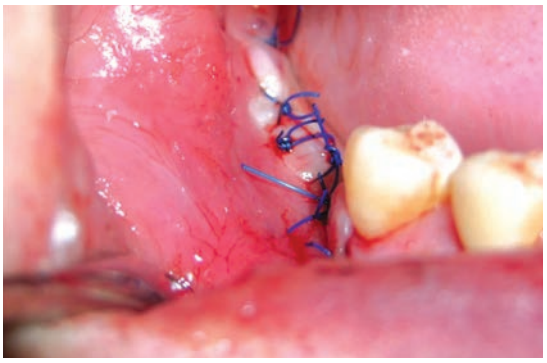


Fig. 7. After suturing the wound

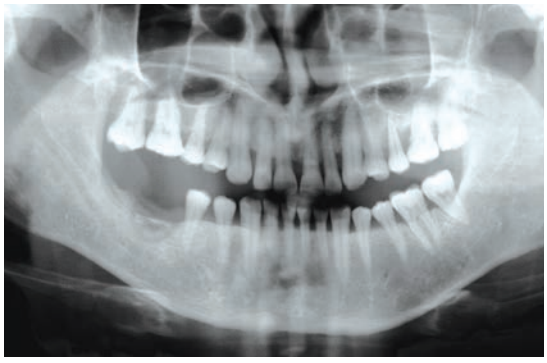


Fig. 8. Panoramic radiograph 5.5 months after a bone graft

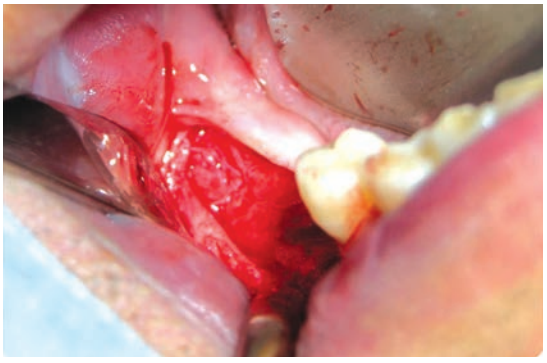


Fig. 9. A flap elevation was performed 5.5 months after a bone graft. Fairly good bone healing was observed.

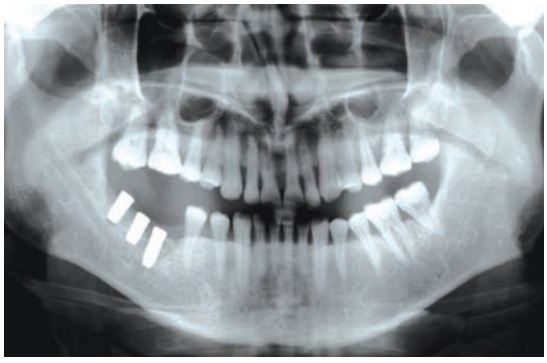


Fig. 10. Panoramic radiograph after the implant installation. Two HSII implants with a size of 5.0x6mm and one with a size of 5.0x8.5mm were installed.

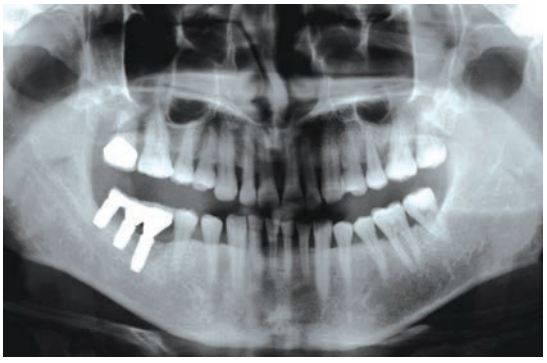


Fig. 11. Panoramic radiograph one year after placing the final prostheses

Case | Location: #11, 21, 33, 31, 42 | Age:32, Sex:F

1

Chungbuk National University Hospital

Professor

Kim, Kyeong-won

Installation of a TSIII SA in the upper anterior position and an MS implant in the lower anterior position

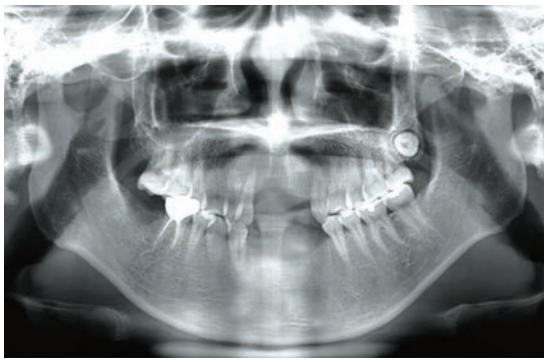


Fig. 1. Initial panoramic radiograph Initial intra-oral view

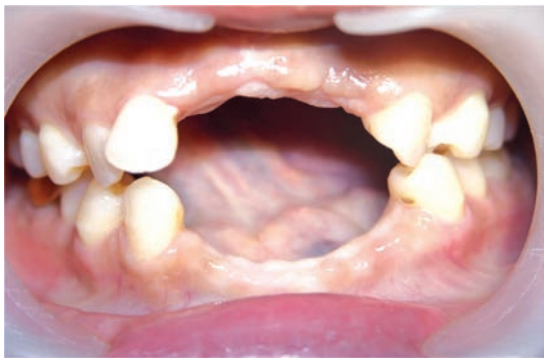


Fig. 2. Since the patient bite the oral airway too hard in the intensive care unit under coma state, loss of anterior teeth was accompanied with severe destruction and resorption of the alveolar bone in the maxilla and mandible.

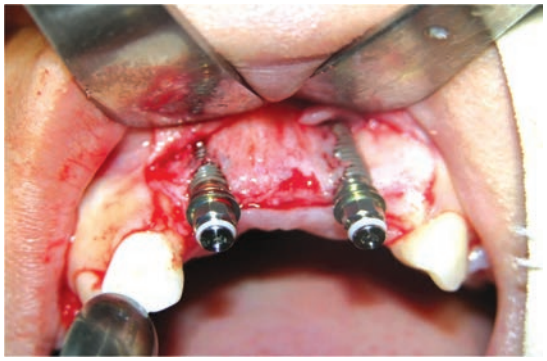


Fig. 3. Though TSIII implant(3.5x13mm) was installed, more than half of the total length of the fixture was exposed due to severe alveolar bone resorption in the maxillary anterior part.

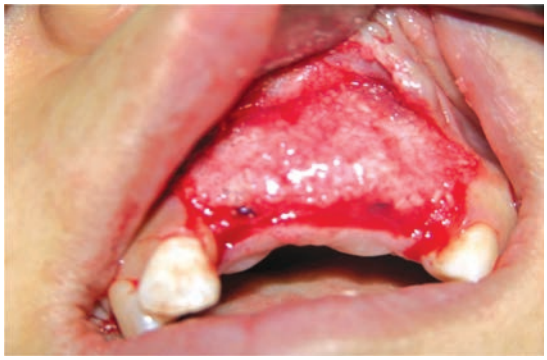


Fig. 4. Allogeneic bone graft was performed in the dehiscence defect, and bone particles were fixed by using fibrin glue (Beriplast).

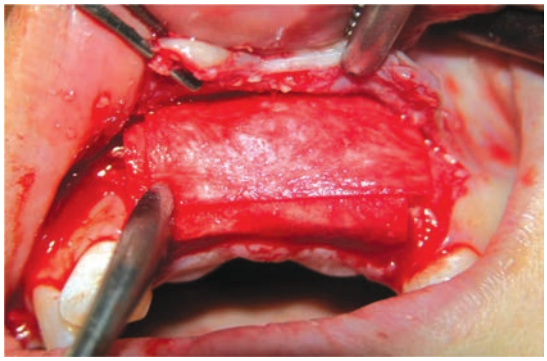


Fig. 5. The bone graft area was covered with resorbable collagen membrane in a double layer and fixed with a tissue adhesive (Beriplast).

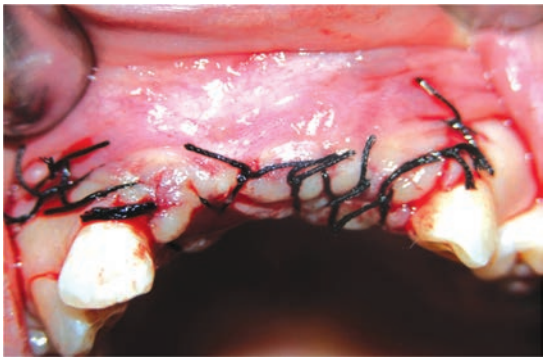


Fig. 6. After suturing the lesion

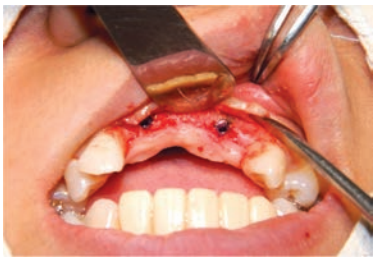


Fig. 7. The implant was exposed four months after surgery. Bone regeneration around the implant was observed to be fairly good.

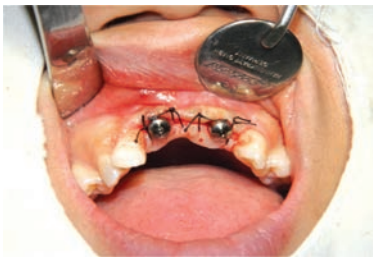


Fig. 8. The wound was sutured after applying a healing abutment.

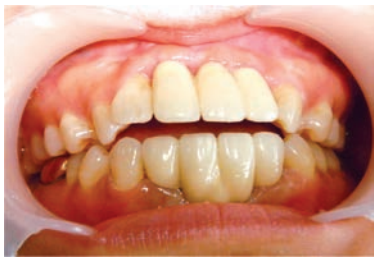


Fig. 9. Intra-oral view seven months after placing the final prosthesis

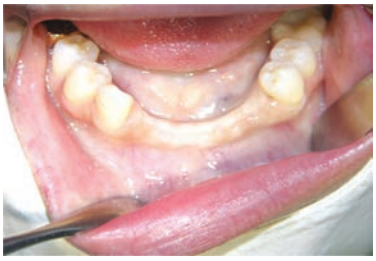


Fig. 10. Initial intra-oral view of the mandible

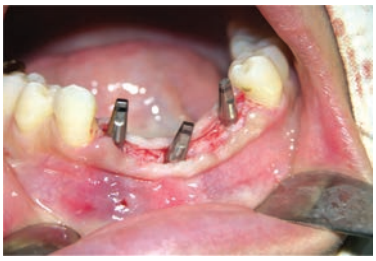


Fig. 11. Three MS implants (2.5D, 13L) were installed due to the narrow bucco-lingual width of the alveolar bone.

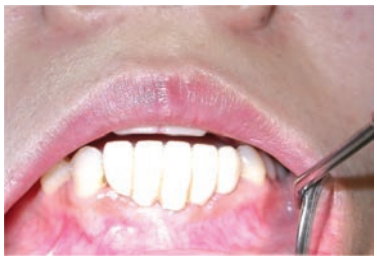


Fig. 12. After placing the temporary prosthesis

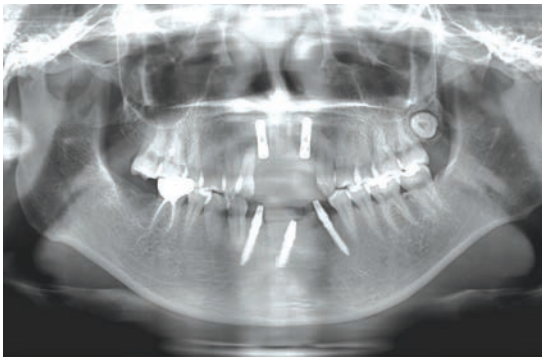


Fig. 13. Panoramic radiograph after an implant installation in the maxilla and mandible

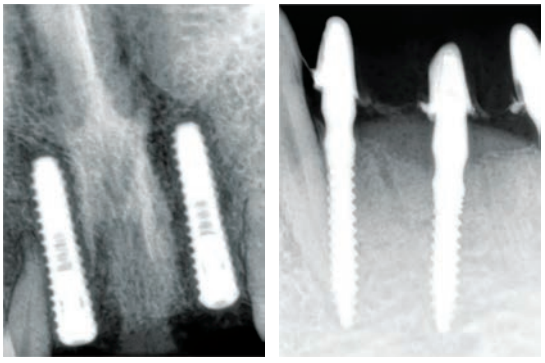


Fig. 14. Panoramic and periapical radiograph two months after the implant installation

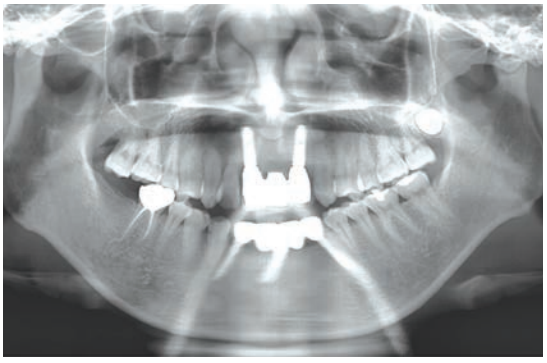


Fig. 15. Panoramic radiograph 13 months after placing the final prosthesis in the maxilla and mandible

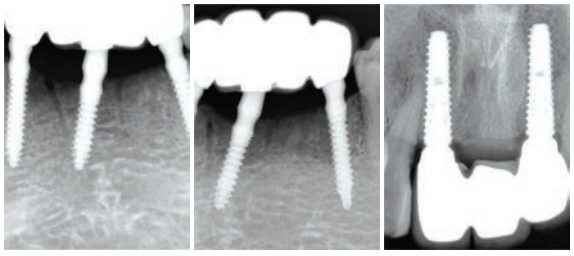


Fig. 16. Periapical radiograph 13 months after placing the final prosthesis in the maxilla and mandible

2013

Osstem Implant System

VII Osstem Implant Related Paper

OSSTEM IMPLANT

(SCI and/or PubMed Registered Paper)

Kim YK, Yun PY. Use of a buccinator musculomucosal flap in implant surgery: a case report. Int J Periodontics Restorative Dent. 2012;32(6):699-703.

Primary wound closure is difficult in the posterior mandible when insufficient soft tissue is available. Primary wound closure using a buccinator musculomucosal flap after implant placement and guided bone regeneration was performed in a patient with an atrophic alveolar ridge in the posterior mandible. Implants were placed at the bone level of neighboring teeth to protect the inferior alveolar nerve, and exposed threads were covered using guided bone regeneration. A posterior-based buccinator musculomucosal flap was raised and placed over the alveolar crest, which resulted in a satisfactory clinical outcome.

Jeong MA, Kim SG, Kim YK, Oh HK, Cho YS, Kim WC, Oh JS. A multicenter prospective study in type IV bone of a single type of implant. Implant Dent. 2012;21(4):330-4.

PURPOSE : To analyze the success and survival rates of the Osstem GSII (Osstem, Busan, Korea) implant in type IV bone.

MATERIALS : A prospective, multicenter (5 centers) study was conducted by examining the relationship between implant success and survival rates, and several patient and surgical parameters. The implants were placed in 82 patients who visited several nationwide dental hospitals and clinics between 2007 and 2008, followed by clinical and radiographic analyses.

RESULTS : In type IV bone, the implant success and survival rates were 93.23% and 95.83%, respectively. The maxillary premolar and mandibular anterior tooth areas showed success rates of 100%. The most widely used implant diameter and length was 5.0 and 13 mm, respectively, but the diameter and length had no effect on success rates. However, success rates appeared to decrease with age.

CONCLUSIONS : The results indicated that the Osstem GSII implant is highly effective in poor-quality type IV bone.

Kim SG, Yun PY, Park HS, Shim JS, Hwang JW, Kim YK. Effect of loading time on the survival rate of anodic oxidized implants: prospective multicenter study. J Adv Prosthodont. 2012;4(1):18-23.

PURPOSE : The purpose of this prospective study was to evaluate the effect of early loading on survival rate or clinical parameter of anodic oxidized implants during the 12-month postloading period.

MATERIALS AND METHODS : Total 69 implants were placed in 42 patients. Anodic oxidized implants (GSII, Osstem Cor., Busan, Korea) placed on the posterior mandibles were divided into two groups, according to their prosthetic loading times: test group (2 to 6 weeks), and control group (3 to 4 months). The implant survival rates were determined during one-year postloading period and analyzed by Kaplan-Meier method. The radiographic peri-implant bone loss and periodontal parameters were also evaluated and statistically analyzed by unpaired t-test.

RESULTS : Total 69 implants were placed in 42 patients. The cumulative postloading implant survival rates were 88.89% in test group, compared to 100% in control group ($P < .05$). Periimplant marginal bone loss (T: 0.27±0.54 mm, C: 0.40±0.55 mm) and periodontal parameters showed no significant difference between the groups ($P > .05$).

CONCLUSION : Within the limitation of the present study, implant survival was affected by early loading on the anodic oxidized implants placed on posterior mandibles during one-year follow-up. Early implant loading did not influence peri-implant marginal bone loss, and periodontal parameters.

Kim YK, Kim SG, Kim JH, Yi YJ, Yun PY. Prospective study of tapered resorbable blasting media surface implant stability in the maxillary posterior area. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2012 Feb 28. 2012;114(1):e19-24.

OBJECTIVES : The purpose of this study was to evaluate the stability of tapered resorbable blasting media surface implants in the posterior maxilla.

STUDY DESIGN : From September 2008 through January 2010, 20 patients (9 men, 11 women) who were treated with tapered GSIII implants at Seoul National University Bundang Hospital were identified. Thirty-eight implants (14 premolar and 24 molar) were placed in maxillary posterior areas.

RESULTS : The patients' mean age was 52.1 years, and the mean follow-up period was 12.6 months after final prosthesis delivery. The implant length was 11.8±1.4 mm with a diameter of 4.6±0.5 mm. The 1-year survival rate was 97.4%, and the success rate was 94.7%. The implant stability quotient value at implant placement was 63.6 and 74.4 at the second surgery, which indicated a significant difference. There was no significant difference in crestal bone loss according to implant diameter or length or sinus bone graft.

CONCLUSIONS : This study showed the favorable clinical outcome of tapered implants that were placed in the maxillary posterior area.

Eom TG, Jeon GR, Jeong CM, Kim YK, Kim SG, Cho IH, Cho YS, Oh JS. Experimental study of bone response to hydroxyapatite coating implants: Bone-implant contact and removal torque test. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012; 114(4):411-8.

OBJECTIVE : The objective of this study was to evaluate the early osseointegration of hydroxyapatite (HA)-coated implant.

STUDY DESIGN : Twelve adult male miniature pigs were used in this study. The removal torque of implants placed in the tibia of miniature pigs was measured. For implants placed in the mandible, histomorphometric evaluation was performed for the evaluation of the bone-implant contact (BIC) ratio.

RESULTS : After 4, 8, and 12 weeks, removal torque values were increased. Among the 3 groups, the HA-coated group showed the highest values ($P < .05$). At 4 and 8 weeks, the BIC ratio of HA was significantly higher than that of resorbable blast medium or sand blasted with alumina and acid etched ($P < .05$).

CONCLUSIONS : It was concluded that HA-coated implants are relatively favorable in early loading stages.

Hong J, Lim YJ, Park SO. Quantitative biomechanical analysis of the influence of the cortical bone and implant length on primary stability. Clin Oral Implants Res. 2011 Sep 29. doi: 10.1111/j.1600-0501.2011.02285.x.

AIM : The aim of the study was to investigate the influence of cortical bone and increasing implant fixture length on primary stability. Further investigation considered the correlation between the presence of cortical bone at the marginal bone and implant stability measured by insertion torque (IT) and resonance frequency analysis (RFA), as well as implant length, were determined.

MATERIALS AND METHODS : Two different types of polyurethane bone models were compared. (Group 1: with cortical and cancellous bone; Group 2: with cancellous bone only). A total of 60 external type implants (ø4.1, OSSTEM®, US II) with different lengths (7, 10, and 13 mm) were used. IT was recorded automatically by a computer which was connected to the Implant fixture installation device during the placement. RFA was conducted to quantify the primary implant stability quotient (ISQ). All two measurements were repeated 10 times for each group.

RESULTS : All these differences were statistically significant between the two groups ($P < 0.001$) and intragroups ($P < 0.001$). Upon comparing the IT, cortical bone appears to have a greater influence on implant stability than implant lengths, whereas the RFA value strongly affects implant length rather than the presence of the crestal cortical bone.

CONCLUSIONS : The quantitative biomechanical evaluations clearly demonstrated that primary implant stability seems to be influenced by the presence of a cortical plate and total surface area of the implant fixture appears to be the decisive determinant for ISQ value.

Jeong SM, Choi BH, Kim JH, Xuan F, Lee DH, Mo DY, Lee CU. A 1-year prospective clinical study of soft tissue conditions and marginal bone changes around dental implants after flapless implant surgery. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;111:41-46.

BACKGROUND : Despite several reports on the clinical outcomes of flapless implant surgery, limited information exists regarding the clinical conditions after flapless implant surgery.

OBJECTIVE: The objective of this study was to evaluate the soft tissue conditions and marginal bone changes around dental implants 1 year after flapless implant surgery.

STUDY DESIGN: For the study, 432 implants were placed in 241 patients by using a flapless 1-stage procedure. In these patients, peri-implant soft tissue conditions and radiographic marginal bone changes were evaluated 1 year after surgery.

RESULTS : Within the limitation of the present study, implant survival was affected by early loading on the anodic oxidNone of the implants were lost during follow-up, giving a success rate of 100%. The mean probing depth was 2.1 mm (SD 0.7), and the average bleeding on probing index was 0.1 (SD 0.3). The average gingival index score was 0.1 (SD 0.3), and the mean marginal bone loss was 0.3 mm (SD 0.4 mm; range 0.0-1.1 mm). Ten implants exhibited bone loss of 〉 1.0 mm, whereas 125 implants experienced no bone loss at all.

CONCLUSION : The results of this study demonstrate that flapless implant surgery is a predictable procedure. In addition, it is advantageous for preserving crestal bone and mucosal health surrounding dental implants.

Kim YK, Kim SG, Park JY, Yi YJ, Bae JH. Comparison of clinical outcomes of sinus bone graft with simultaneous implant placement: 4-month and 6-month final prosthetic loading. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2011;111(2):164-9.

OBJECTIVES : The aim of this study was to compare the survival rate and surrounding tissue condition of sinus bone grafts with simultaneous implant placement between 4-month and 6-month occlusal loading after implantation.

STUDY DESIGN : Twenty-seven patients (61 implants) who were treated with sinus bone grafts (sinus lateral approach) and simultaneous Osstem GSII implant placement from July 2007 to June 2008 were included in this study. Of these patients, 14 (31 implants) were in the 4-month loading group, and 13 (30 implants) were in the 6-month loading group. We investigated the implantation type (submerged or nonsubmerged), sinus membrane perforation, type of prosthesis, opposed tooth type, primary and secondary stability of implants, and crestal bone loss around implant and surrounding tissue conditions.

RESULTS : The amounts of crestal bone-loss at the final recall time (12.56±5.95 mo after loading) of the 4-month and 6-month loading groups were 0.19±0.33 mm and 0.39±0.86 mm, respectively. However, the difference between groups was not statistically significant (P = .211). The width of keratinized mucosa, gingival index, plaque index, and pocket depth of the 4-month and 6-month loading groups were 2.50±1.69 mm and 1.73±1.40 mm (P = .081), 0.72±0.83 and 0.59±0.69 (P = .671), 1.11±0.96 and 0.76±0.79 (P = .226), 3.56±0.98 mm and 3.65±1.06 mm (P = .758), respectively. The primary stabilities of implants in the 4-month and 6-month loading groups were 61.96±12.84 and 56.06±15.55 (P = .120), and the secondary stabilities were 71.85±6.80 and 66.51±11.28 (P = .026), respectively. The secondary stability of the 4-month group was significantly higher than that of the 6-month group. There was no statistical difference (P 〉 .05) between the 4-month and 6-month loading groups regarding the implantation type (submerged or nonsubmerged), sinus membrane perforation, type of prosthesis, or opposed tooth type. In the 4-month and 6-month groups, all of the implants survived until the final recall time.

CONCLUSIONS : For the cases in which the residual bone was 〉3 mm and primary implant stability could be obtained, we conclude that loading is possible 4 months after the sinus bone graft and simultaneous implant placement.

Pae A, Kim SS, Kim HS, Woo YH. Osteoblast-like cell attachment and proliferation on turned, blasted, and anodized titanium surfaces. Int J Oral Maxillofac Implants. 2011;26(3):475-81.

PURPOSE : The purpose of this study was to investigate the cellular activities of MG63 osteoblast-like cells on modified titanium surfaces.

MATERIALS AND METHODS : MG63 osteoblast-like cells were cultured on titanium disks (n = 20 in each group) with turned, resorbable blast media (RBM)-treated, or anodized surfaces. The surfaces of commercially available implants of Osstem (Osstem Implant) were reproduced for the titanium disks. The morphology of cells cultured on these disks was examined using scanning electron microscopy. X-ray photoelectron spectroscopy (XPS) was employed for the analysis of surface chemistry. Specimens were also evaluated with an initial cell adhesion assay to compare initial adhesion, with a methyl tetrazol sulfate (MTS) assay to compare the proliferation ability, and with an alkaline phosphatase (ALP) assay to compare the differentiation ability. Statistical significance of the differences was determined using the Kruskal-Wallis test for the cell adhesion assay and analysis of variance for the MTS and ALP assays.

RESULTS : Attached cells with more defined lamellopodia and flattened morphology were observed on the anodized and RBM surfaces than on the turned surfaces. The titanium surfaces were all oxidized as titanium oxide and polluted by carbon determinants, as determined by XPS. Anodized titanium surfaces exhibited calcium and phosphorus peaks. Initial cell attachment activity, cell proliferation activity, and ALP activity were higher on the anodized surfaces than on the other surfaces. Cell differentiation on the anodized surfaces at culture day 10 was significantly higher (P 〈 .05) than on the other surfaces.

CONCLUSIONS : Surface treatment by anodization may improve initial attachment of cells, proliferation ability, and differentiation activity, which play important roles in providing better osseointegration of implants. More rapid and stronger osseointegration of implants may make it possible to offer the best anchorage and shorten the healing time required prior to functional loading.

Lee DH, Choi BH, DDS, Jeong SM, Xuan F, Kim HR. Effects of Flapless Implant Surgery on Soft Tissue Profiles: A Prospective Clinical Study. Clin Implant Dent Relat Res 2011;13(4):324-9.

BACKGROUND: Flapless implant surgery has been suggested as a suitable treatment modality for the preservation of soft tissue after implant placement.

PURPOSE: The purpose of this study was to determine the extent of soft tissue profile changes around implants after flapless implant surgery. Materials and Methods: A total of 44 patients received 76 implants using a flapless implant procedure. The marginal level of the peri-implant soft tissue was evaluated using dental casts 1 week, 1 month, and 4 months after implant placement.

RESULTS : The mean soft tissue levels around implants showed 0.7±0.3 mm of coronal growth 1 week after surgery. At 1 month, the levels were 0.2±0.2 mm coronal growth and at 4 months, the values were 0.0±0.3 mm. Soft tissue profiles assessed 4 months after flapless implant placement were similar to profiles assessed immediately before implant placement.

CONCLUSION : Flapless implant surgery is advantageous for preserving mucosal form surrounding dental implants.

KEY WORDS: dental implant, flapless, minimal invasive, peri-implant tissue

Park JC, Kim HD, Kim SM, Kim MJ, Lee JH. A Comparison of Implant Stability Quotients Measured Using Magnetic Resonance Frequency Analysis from Two Directions: Prospective Clinical Study during the Initial Healing Period. Clin Oral Implants Res. 2010;21(6): 591-7.

OBJECTIVES : Given that the orientation of the transducer (mesiodistal or buccolingual) affects the data obtained from a piezoelectric resonance frequency analysis (RFA), this study evaluated whether it is necessary to use measurements taken in two different directions (mesiodistal and buccolingual) when using magnetic RFA to assess changes in the stiffness of dental implants.

MATERIALS AND METHODS : A prospective clinical trial was completed, in a total of 53 patients, on 71 non-submerged dental implants that were inserted to replace the unilateral loss of mandibular molars. All of the implants were of the same diameter (4.1 mm), length (10 mm), and collar height (2.8 mm). The implant stability quotient (ISQ) was measured during the surgical procedure, and at 4 and 10 weeks after surgery. Measurements were taken twice in each

DIRECYION : in the buccolingual direction from the buccal side and in the mesiodistal direction from the mesial side. The average of two measurements in each direction was regarded as the representative ISQ of that direction. The higher and lower values of the two ISQs (buccolingual and mesiodistal) were also classified separately. In addition, the variation in ISQ was quantified by subtracting the lower value from the higher value, and the implants were classified into two groups according to this variation: one with ISQ variation of 3 or more and the other with a variation of 〈 3.

RESULTS : There were no differences between the two ISQs when measured from different directions, but there were significant differences between the higher and lower values of the ISQs at each measurement point. A significant difference was also observed between the two ISQ variation groups in the pattern of change of the lower value for the period from immediately after surgery to 10 weeks after surgery.

CONCLUSION : Acquisition of two directional measurements and classification of the higher and lower values of the two directional ISQs may allow clinicians to detect patterns of change in ISQ that would not be identified if only one directional measurement were made.

KEY WORDS: implant stability quotient, Mentort, prospective clinical study, resonance frequency analysis

Jo SH, Kim KI, Seo JM, Song KY, Park JM, Ahn SG. Effect of impression coping and implant angulation on the accuracy of implant impressions: an in vitro study. J Adv Prosthodont. 2010;2(4):128-33.

PURPOSE : The purpose of this study was to compare the accuracy of the implant master cast according to the type (pick-up, transfer) and the length (long, short) of the impression copings.

MATERIALS AND METHODS : The metal master cast was fabricated with three internal connection type implant analogs (Osstem GSIII analog), embedded parallel and with 10° of mesial angulation to the center analog. Four types of impression coping were prepared with different combinations of types (transfer, pick-up) and lengths (long, short) of the coping. The impressions were made using vinyl polysiloxane (one step, heavy + light body) with an individual tray, and 10 impressions were made for each group. Eventually, 40 experimental casts were produced. Then, the difference in the distance between the master cast and the experimental cast were measured, and the error rate was determined. The analysis of variance was performed using the SPSS (v 12.0) program (α = .05), and the statistical significance was set at $P < .05$.

RESULTS : The ANOVA showed that the pick-up type impression coping exhibited a significantly lower error rate than the transfer type. However, no significant difference was observed with respect to the length of the impression coping. Additionally, no significant difference was observed between the parallel and mesial angulated groups.

CONCLUSION : Within the limitations of this study, the pick-up type impression coping exhibited a more accurate implant master cast than the transfer type in parallel group. The accuracy of the implant master cast did not differ for different lengths of impression coping of at least 11 mm. Additionally, the accuracy of the implant cast was not different for the parallel and 10° mesial angulated groups.

Bansal DJ, Kedige DS, Bansal DA, Anand DS. A Relaxed Implant Bed: Implants Placed After Two Weeks of Osteotomy with Immediate Loading- A One Year Clinical Trial. J Oral Implantol. 2010;38(2):155-64.

BACKGROUND : A waiting period of two weeks after osteotomy increases the surrounding tissue activity to its maximum level as collagen formation and neoangiogenesis represents a relaxed and acceptable implant bed configuration.

PURPOSE : The aim of the present study was a clinical and radiological evaluation of early osteotomy with implant placement delayed for two weeks with immediate loading in the anterior and premolar region with minimally invasive approach.

MATERIALS AND METHODS: A total of seven GSII implants (Osstem) were placed in six patients. Osteotomy was done followed by flap closure without the placement of implant. After approximately waiting for a period of two weeks, implant placement was done which were loaded immediately with provisional crown in implant protected occlusion. It was replaced by definitive restoration after 6-8 weeks which was considered as baseline. Implant stability and marginal bone levels were assessed with clinical and radiological parameters at baseline, 6th and 12th month intervals. Results: None of the implants were found mobile during the one year period. The amount of average mean marginal bone loss was 0.4 mm over the one year follow up period.

CONCLUSION: In the present study, early osteotomy with delayed implant placement showed negligible crestal bone loss with no mobility.

Huang JS, Zhao JJ, Liu Q, Liu TT. Clinical research of immediate restoration with mini-implants in edentulous space. Hua Xi Kou Qiang Yi Xue Za Zhi. 2010;28(4):412-6.

OBJECTIVE: The purpose of this study was to investigate the clinical effective of immediate restoration with Osstem MS mini-implant in the edentulous space of 5-6 mm.

METHODS: The sample consisted of 36 consecutively treated partially edentulous patients who had a total of 36 Osstem MS mini-implants, which were 2.5 mm or 3.0 mm in diameter and placed in 5-6 mm gap. The chair-side-made or laboratory-made provisional crowns for implants were fabricated at the time of fixtures placed. The final restorations were fabricated with gold alloy-fused-porcelain crown 3 to 5 months later. During the mean 21.3 months (12-37 months) follow-up time since fixtures placement, all implants were examined clinically and radiologically.

RESULTS: No implant failed before restoration. One implant led an adjacent tooth pulp necrosis after the implantation, but the natural tooth and implant were successfully retained by root canal therapy. 36 implants in 36 patients who were followed-up were successful and their aesthetic results were satisfactory.

CONCLUSION: Immediate loaded implant with Osstem MS mini-implant has good clinical prosthetic effects in the edentulous space of 5-6 mm.

Park JC, Ha SR, Kim SM, Kim MJ, Lee JB, Lee JH. A randomized clinical 1-year trial comparing two types of non-submerged dental implants. Clin Oral Implants Res. 2010;21(2):228-36.

OBJECTIVES : This study compared the implant stability and clinical outcomes obtained with two types of non-submerged dental implants that have different thread designs and surface treatments.

MATERIALS AND METHODS : A randomized clinical trial with 1 year of follow-up was performed on 56 participants with 75 implants (control group, 36 implants in 28 subjects; experimental group, 39 implants in 28 subjects). The experimental group received the Osstem SSII Implant system; the control group received the Standard Straumann Dental Implant System. The diameter and length of the fixture were uniform at 4.1 mm and 10 mm and all the implants restored the unilateral loss of one or two molars from the mandible. To compare implant stability, the peak insertion torque, implant stability quotient (ISQ), and periotest value (PTV) were evaluated during surgery, and at 4 and 10 weeks after surgery. To compare marginal bone loss, standard periapical radiographs were obtained during surgery, and at 10 weeks and 1 year after surgery.

RESULTS : This study showed statistically significant differences between the two groups in peak insertion torque (P=0.009) and ISQ (P=0.003) but not in PTV (P=0.097) at surgery. In contrast, there was no statistically significant difference in the pattern of change of ISQ during the 10 weeks after surgery (P=0.339). For marginal bone loss, no significant difference was observed between the control and the experimental groups before functional loading (P=0.624), but after 1 year of follow-up, a borderline difference was observed (P=0.048).

CONCLUSION : The success rate after 1 year of follow-up was 100% for both implant system despite the presence of a significant difference in implant stability during surgery. There was a borderline difference in marginal bone loss after 1 year of follow-up.

Kim KS, Lim YJ, Kim MJ, Kwon HB, Yang JH, Lee JB, Yim SH. Variation in the total lengths of abutment/implant assemblies generated with a function of applied tightening torque in external and internal implant-abutment connection. Clin Oral Implants Res 2011;22:834-839.

AIM : Settling (embedment relaxation), which is the main cause for screw loosening, is developed by microroughness between implant and abutment metal surface. The objective of this study was to evaluate and compare the relationship between the level of applied torque and the settling of abutments into implants in external and internal implant-abutment connection

MATERIALS AND METHODS: Five different implant-abutment connections were used (Ext, External butt joint+two-piece abutment; Int-H2, Internal hexagon+two-piece abutment; Int-H1, Internal hexagon+one-piece abutment; Int-O2, Internal octagon+two-piece abutment; Int-O1, Internal octagon+one-piece abutment). All abutments of each group were assembled and tightened with corresponding implants by a digital torque gauge. The total lengths of implant-abutment samples were measured at each torque (5, 10, 30Ncm and repeated 30Ncm with 10-min interval) by an electronic digital micrometer. The settling values were calculated by changes between the total lengths of implant-abutment samples.

RESULTS: All groups developed settling with repeated tightening. The Int-H2 group showed markedly higher settling for all instances of tightening torque and the Ext group was the lowest. Statistically significant differences were found in settling values between the groups and statistically significant increases were observed within each group at different tightening torques ($P < 0.05$). After the second tightening of 30Ncm, repeated tightening showed almost constant settling values.

CONCLUSIONS: Results from the present study suggested that to minimize the settling effect, abutment screws should be retightened at least twice at 30Ncm torque at a 10-min interval in all laboratory and clinical procedures.

KEY WORDS : dental implants, implant-abutment interface, repeated tightening, settling effect, tightening torque

Kim YK, Kim BS, Lee HJ, Hwang JW, Yun PY. Surgical repositioning of an unrestorable implant using a trephine bur: a case report. Int J Periodontics Restorative Dent 2010;30:181-5.

Implants are placed in the wrong position for various reasons. However, severely misplaced implants cannot be restored. To correct the misplacement of implants, surgical repositioning or removal of the implants is necessary. In this study, a clinical case requiring surgical repositioning of an unrestorable implant using a trephine bur is presented. This technique focuses on minimizing damage to the osseointegration and surrounding tissues of the implant.

Jung SW, Son MK, Chung CH, Kim HJ. Abrasion of abutment screw coated with TiN. J Adv Prosthodont. 2009;1(2):102-6.

STATEMENT OF PROBLEM : Screw loosening has been a common complication and still reported frequently.

PURPOSE : The purpose of this study was to evaluate abrasion of the implant fixture and TiN coated abutment screw after repeated delivery and removal with universal measuring microscope.

MATERIAL AND METHODS : Implant systems used for this study were Osstem and 3i. Seven pairs of implant fixtures, abutments and abutment screws for each system were selected and all the fixtures were perpendicularly mounted in liquid unsaturated polyesther with dental surveyor. After 20 times of repeated closing and opening test, the evaluation for the change of inner surface of implant and TiN-coated abutment screw, and weight loss were measured. Mann-Whitney test with SPSS statistical software for Window was applied to analyze the measurement of weight loss.

RESULTS : TiN-coated abutment screws of Osstem and 3i showed lesser loss of weight than non-coated those of Osstem and 3i ($P < .05$, Mann-Whitney test).

CONCLUSION : Conclusively, TiN coating of abutment screw showed better resistance to abrasion than titanium abutment screw. It was concluded that TiN coating of abutment screw would reduce the loss of preload with good abrasion resistance and low coefficient of friction, and help to maintain screw joint stability.

Kim YK, Yun PY, Kim SG, Kim BS, Ong JL. Evaluation of sinus bone resorption and marginal bone loss after sinus bone grafting and implant placement. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;107(2):e21-8.

OBJECTIVE : The objective of this study was to evaluate the sinus bone graft resorption and marginal bone loss around the implants when allograft and xenograft are used.

STUDY DESIGN : Sinus bone grafting and implant placement (Osstem, Korea) were performed on 28 patients from September 2003 to January 2006. In group I, a total of 49 implants were placed in 23 maxillary sinus areas of 16 patients together with bone graft using xenograft (Bio-Oss) and a minimal amount of autogenous bone. In group II, 24 implants were placed in 13 maxillary sinus areas of 12 patients together with bone graft using a minimal amount of autogenous bone and equal amounts of allograft (Regenaform) and Bio-Oss in group II.

RESULTS : Early osseointegration failures of 3 implants in 3 patients (group I: 1 patient, 1 implant; group II: 2 patients, 2 implants) were observed, and revisions were performed for these 3 implant sites, followed by complete prosthodontic treatments. The average height of the remaining alveolar bone before the surgery, immediately after the surgery, and 1 year after the surgery was 4.9 mm, 19.0 mm, and 17.2 mm, respectively, in group I. In group II, the average height of the remaining alveolar bone was 4.0 mm, 19.2 mm, and 17.8 mm before the surgery, immediately after the surgery, and 1 year after the surgery, respectively. The average marginal bone loss 1 year after prosthodontic loading and after 20.8 months' follow-up was 0.6 mm and 0.7 mm, respectively, in group I. A 93.9% success rate was observed for group I, with 3 implants showing bone resorption of 〉1.5 mm within 1 year of loading. For group II, the average marginal bone loss 1 year after prosthodontic loading and after 19.7 months' follow-up was 0.7 mm and 1.0 mm, respectively. An 83.3% success rate was observed for group II, with 4 implants showing bone resorption of 〉1.5 mm within 1 year of loading.

CONCLUSIONS : Based on the observations in this study, it was concluded that mixed grafting with demineralized bone matrix for maxillary sinus bone grafting has no significant short-term merit regarding bone healing and stability of implants compared with anorganic bovine bone alone.

Jeon WJ, Kim SG, Lim SC, Ong JL, Oh DS. Histomorphometric evaluation of immediately loaded SSII implants of different surface treatments in a dog model. J Biomed Mater Res A. 2009;90(2):396-400.

This study compared splint (experimental) and nonsplint (control) methods for immediately loaded implants and examined the bone-implant contact rate for smooth, oxidized, and resorbable blast medium (RBM) surfaces. The first through fourth mandibular premolars were extracted from six young adult dogs. Twelve weeks after extraction, implantation was performed at the extraction sites. The SSII OSSTEM implant had one of three surface treatments: smooth, oxidized, or RBM. Sixteen weeks after implantation, the dogs were euthanized; the hemimandibles were obtained and processed histologically to obtain nondecalcified sections. Longitudinal sections were made for each implant and analyzed using light microscopy. Independent of the splinting method, a significantly higher bone-implant contact was observed for implants with oxidized and RBM surfaces when compared with implants with smooth surfaces. Irrespective of the splinting method, immediately loaded implants with oxidized and RBM surfaces may result in higher bone-implant integration when compared with implants with smooth surfaces.

Kim YK, Kim SG, Oh HK, Choi YG, Cho YS, Oh YH, Son JS, Ong JL. Evaluation of peri-implant tissue in nonsubmerged dental implants: a multicenter retrospective study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;108(2):189-95.

OBJECTIVES : The objective of this study was to evaluate the peri-implant's hard and soft tissue response associated with the 1-stage, nonsubmerged, endosseous dental implant.

STUDY DESIGN : A multicenter retrospective clinical evaluation was performed on 339 nonsubmerged implants placed in 108 patients at 5 clinical centers between January 2003 and December 2007.

RESULTS : After a mean follow-up period of 30 months, the mean crestal bone resorption in 339 implants was 0.43 mm. The survival and success rates were observed to be 99.1% and 95.1%, respectively. The mean calculus, inflammatory, and plaque indices were 0.13, 0.37, and 0.73, respectively, and the mean width of buccal keratinized mucosa was observed to be 2.43 mm.

CONCLUSION : The short- to intermediate-term evaluation of the 1-stage, nonsubmerged, endosseous implant yields relatively high survival and success rates.

Kim BS, Kim YK, Yun PY, Yi YJ, Lee HJ, Kim SG, Son JS. Evaluation of peri-implant tissue response according to the presence of keratinized mucosa. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;107(3):e24-8.

OBJECTIVES : The purpose of this study was to evaluate the responses of peri-implant tissue in the presence of keratinized mucosa.

STUDY DESIGN : A total of 276 implants were placed in 100 patients. From the time of implant placement, the average follow-up observation period was 13 months. The width of keratinized mucosa was compared and evaluated through the gingival inflammation index (GI), plaque index (PI), the pocket depth, mucosal recession, and marginal bone resorption.

RESULTS : The GI, PI, and pocket depth in the presence or absence of the keratinized gingiva did not show statistically significant differences. However, mucosal recession and marginal bone resorption experienced statistically significant increases in the group of deficient keratinized mucosa. Based on implant surface treatments, the width of keratinized gingiva and crestal bone loss did not show a significant difference.

CONCLUSION : In cases with insufficient keratinized gingiva in the vicinity of implants, the insufficiency does not necessarily mediate adverse effects on the hygiene management and soft tissue health condition. Nonetheless, the risk of the increase of gingival recession and the crestal bone loss is present. Therefore, it is thought that from the aspect of long-term maintenance and management, as well as for the area requiring esthetics, the presence of an appropriate amount of keratinized gingiva is required.

Oh JS, Kim SG, Lim SC, Ong JL. A comparative study of two noninvasive techniques to evaluate implant stability: Periotest and Osstell Mentor. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;107:513-9.

OBJECTIVES : The purpose of this study was to examine the usefulness of Periotest and Osstell Mentor (a resonance frequency analysis) as nondestructive analytical tools for determining implant stability in clinics, to evaluate the precision of both instruments, and to determine the applicability of these measured values as clinically relevant indices.

STUDY DESIGN : Four adult mongrel dogs weighing about 12 to 15 kg were used in this study. Bilateral extractions of the first through the fourth mandibular and maxillary premolars were performed and a total of 48 commercially pure titanium screw implants (USII Plus; OSTEM Implant, Seoul, Republic of Korea) were placed at 4 weeks after extraction. All implants (10 mm length and 3.3 mm diameter) were self-tapping and surface-treated with resorbable blast media (RBM). Periotest values (PTVs) obtained from Periotest, and Implant Stability Quotient (ISQ) obtained from Osstell Mentor, were measured at the time of implantation, and 3 and 6 weeks after implantation. At 3 and 6 weeks after implantation, 4 dogs were humanely killed and histomorphometric analysis was performed. The new peri-implant bone formation rate (NBFR) was measured.

RESULTS : The PTV value was lower and ISQ value was higher at 6 weeks when compared with data collected at 3 weeks after implantation. The PTVs of the maxilla were higher than the mandible and the ISQ values of the maxilla were lower than the mandible. Based on the NBFR, the 6-week group showed higher bone formation when compared to the 3-week group, correlating to the observed PTV and ISQ values. Additionally, the NBFR was higher in the maxilla than the mandible. No significant difference between PTV and ISQ was also observed when PTV and ISQ were compared to NBFR.

CONCLUSION: The results indicated that the Periotest and Osstell Mentor, both noninvasive diagnostic devices, were useful and comparably reliable, showing a strong association with each other in assessing implant stability.

Lee JY, Kim SG, Moon SY, Lim SC, Ong JL, Lee KM. A short-term study on immediate functional loading and immediate nonfunctional loading implant in dogs: Histomorphometric evaluation of bone reaction. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;107:519-24.

OBJECTIVES : The purpose of this study was to evaluate implant stability after short-term immediate loading in a canine model.

STUDY DESIGN : The control group used in this study was immediate nonfunctional loading and the experimental group was immediate functional loading. Each group was measured for its periotest value (PTV) and bone-to-implant contact (BIC) ratio.

RESULTS : Statistically significant differences in PTV and BIC ratio were not observed between the control and the experimental groups.

CONCLUSION : It was concluded that implant stability can be achieved even with immediate loading.

Kim JI, Choi BH, Li J, Xuan F, Jeong SM. Blood vessels of the peri-implant mucosa: a comparison between flap and flapless procedures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;107:508-12.

OBJECTIVES : The vascularity of a peri-implant tissue is a very important parameter in the establishment and maintenance of healthy tissue after dental implant insertion. The purpose of this study was to compare the vascularity of the periimplant mucosa between flap and flapless implant surgeries by using a canine mandible model.

STUDY DESIGN : In six mongrel dogs, bilateral, edentulated, and flat alveolar ridges were created in the mandible. After 3 months of healing, 2 implants were placed in each side by either flap or flapless procedure. After another healing period of 3 months, biopsies were obtained, prepared for light microscopy, and exposed to morphometric measurements.

RESULTS : The supracrestal connective tissue lateral to the implant was found to be more richly vascularized in the flapless group than in the flap group.

CONCLUSION : These results suggest that the flapless procedure may increase the vascularity of the peri-implant mucosa.

You TM, Choi BH, Li J, Xuan F, Jeong SM, Jang SO. Morphogenesis of the peri-implant mucosa: a comparison between flap and flapless procedures in the canine mandible. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;107:66-70.

OBJECTIVES : Although it has been shown that the exclusion of the mucoperiosteal flap can prevent postoperative bone resorption associated with flap elevation, there have been only a few studies on the peri-implant mucosa following flapless implant surgery. The purpose of this study was to compare the morphogenesis of the peri-implant mucosa between flap and flapless implant surgeries by using a canine mandible model.

STUDY DESIGN : In six mongrel dogs, bilateral edentulated flat alveolar ridges were created in the mandible. After 3 months of healing, 2 implants were placed in each side by either the flap or the flapless procedure. Three months after implant insertion, the peri-implant mucosa was evaluated by using clinical, radiologic, and histometric parameters, which included the gingival index, bleeding on probing, probing pocket depth, marginal bone loss, and the vertical dimension of the peri-implant tissues.

RESULTS : The height of the mucosa, length of the junctional epithelium, gingival index, bleeding on probing, probing depth, and marginal bone loss were all significantly greater in the dogs that had the flap procedure than in those that had the flapless procedure (P 〈 .05).

CONCLUSION : These results indicate that gingival inflammation, the height of junctional epithelium, and bone loss around nonsubmerged implants can be reduced when implants are placed without flap elevation.

Song YD, Jun SH, Kwon JJ. Correlation Between Bone Quality Evaluated by Cone-Beam Computerized Tomography and Implant Primary Stability. Int J Oral Maxillofac Implants 2009;24:59-64.

PURPOSE : To examine the relationship between bone quality, as evaluated by cone-beam computerized tomography (CBCT), and implant primary stability, as measured by resonance frequency analysis (RFA).

MATERIALS AND METHODS : A preliminary clinical study was conducted in which implant placements were scheduled for 20 patients. The CT scan was obtained after initial drilling, and implant stability was measured with the Osstell Mentor instrument before flap closure. With CBCT, CT numbers of surrounding bone were calculated and the thickness of compact bone was measured at the buccal, lingual, mesial, and distal surfaces of each implant. The correlations between CT numbers and implant stability quotients (ISQs) and between compact bone thickness and ISQs were tested with the Pearson correlation coefficient.

RESULTS : Overall, 61 implants were examined in 20 patients. The statistics showed that the CT numbers and the thickness of compact bone had strong correlations to ISQs (P 〈 .025).

CONCLUSION : CT scanning was suggested to be effective for evaluating bone quality and predicting initial implant stability.

Huh JB, Eckert SE, Ko SM, Choi YG. Heat Transfer to the Implant-Bone Interface during Preparation of a Zirconia/Alumina Abutment. Int J Oral Maxillofac Implants 2009;24:679-83.

PURPOSE : Excessive heat at the implant-bone interface may compromise osseointegration. This study examined the heat generated at the implant surface during preparation of a zirconia/alumina abutment in vitro.

MATERIALS AND METHODS : Sixty zirconia/alumina abutments were randomized into 12 experimental groups. The abutments were connected to implants and embedded in an acrylic resin block in a 37 degrees C water bath. The abutments were reduced by 1 mm in height over a period of 1 minute with a high-speed handpiece and then polished for 30 seconds with a low-speed handpiece, both with and without an air/water coolant. Temperatures were recorded via thermocouples at the cervical, middle, and apical part of the implant surfaces. The Mann-Whitney rank-sum test was used to assess the statistical significance of the difference in temperature between the abutment/implant complexes altered with and without coolant.

RESULTS : The 1-mm reduction with the high-speed handpiece without coolant resulted in a maximum temperature of 41.22 degrees C at the cervical portion of the implant. Three of four temperatures above 40 degrees C were observed at the cervical part of the implant following use of the high-speed handpiece without coolant. The temperature difference between "with coolant" and "without coolant" during both low-speed polishing and high-speed reduction was statistically significant at the cervical portion of the implant (P = .009). In contrast, the temperature difference between "with coolant" and "without coolant" during both low-speed polishing and high-speed reduction was not statistically significant at the middle and apical parts of the implant (P 〉 .05).

CONCLUSION : Preparation of a zirconia/alumina abutment caused an increase in temperature within the implant, but this temperature increase did not reach the critical levels described in the implant literature.

Duncan WJ, Lee MH, Dovban AS, Hendra N, Ershadi S, Rumende H. Anodization increases early integration of Osstem implants in sheep femurs. Ann R Australas Coll Dent Surg. 2008;19:152-6.

BACKGROUND : Spark discharge anodic oxidation forms a porous TiO2 film on the surface of titanium oral implants, increasing surface roughness and concentrations of calcium and phosphate ions. In this study, anodic-treated oral implants were placed in an animal model and analysed using clinical, micro-computerized tomographic (micro-CT) and histometric techniques.

METHODS : Pairs of 3.5 mm x 8.5 mm long titanium implants (Osstem Implant Co., Ltd. Seoul, Korea), with blasted (control) or blasted and oxidized surfaces (test), were placed into the right femoral condyles of 10 sheep. Animals were sacrificed after 1 month unloaded healing. Resonant frequency analysis (RFA) was measured in implant stability quotient (ISQ) using the Mentor II device. Specimens were scanned using medium resolution micro-CT (Skyscan 1172). Mean percent bone-to-implant contact (%BIC) was calculated

from two images per implant by three different operators, using Image J software. Inter- and intra-examiner differences were calculated. Specimens were then embedded in methacrylate and undemineralized ground sections were digitized. Mean %BIC was measured using Image J at x 20 magnification for the best-three consecutive threads from the most central section.

RESULTS : Mean micro-CT %BIC was similar for control and test (57.2 +/- 0.05% versus 56.4 +/- 0.03%, p = 0.5). There was considerable inter-examiner variability (interclass correlation coefficient = 0.44). RFA showed no clinically-detectable difference between the two groups (control ISQ: 75.2 +/- 4.2; test ISQ: 76.3 +/- 1.7; p = 0.48). However, histometric analysis found a marked and highly statistically-significant difference (%BIC Test 72.5 +/- 8.6%, Control 46.2 +/- 12.1%, p = 0.01).

CONCLUSIONS : The novel anodic oxidation technique increased early ossointegration of rough-surfaced implants by 157%. Neither clinical testing with resonant frequency analysis nor radiographic analysis using micro-CT had sufficient resolution to detect this improvement. Whether this gain in early bone-implant contact is clinically significant in the context of early occlusal loading is the subject of subsequent experiments.

Moon SY, Kim SG, Lim SC, Ong JL. Histologic and histomorphometric evaluation of early and immediately loaded implants in the dog mandible. J Biomed Mater Res A. 2008;86(4):1122-7.

New bone formation around USIII OSSTEM implants after early and immediate loading was evaluated in this study. Three premolars and the first and second molars were first removed from the left mandible of five dogs. At 3 weeks after extraction of the teeth in the left mandible, the corresponding teeth in the right mandibles were removed. After 12 weeks of bone healing, five implants were placed in the left mandible. At 3 weeks after placement of implants in the left mandible, another five were placed in the right mandible. At the time of placing implants in the right mandible, four implants on each side were restored using a fixed provisional restoration. The anterior-most implant was not loaded and was used as controls. Periotest measurements performed immediately after implantation and after 16 weeks loading indicated implant stability for all groups tested. At 16 weeks after loading, the rate of peri-implant bone formation for the early loaded, immediately loaded (IL), and control implants were observed to be 75.00, 73.37, and 62.04%, respectively. It was thus concluded that early stability was achieved in early and IL implants using fixed provisional restoration, thereby resulting in the high rate of peri-implant bone formation.

Yeo IS, Han JS, Yang JH. Biomechanical and Histomorphometric Study of Dental Implants With Different Surface Characteristics. J Biomed Mater Res Part B: Appl Biomater 2008;87B:303-11.

The aim of this study was to investigate the early bone response to the titanium dental implants with different surface characteristics using the rabbit tibia model. Calcium metaphosphate coated, anodic oxidized, hydroxyapatite particle-blasted, and turned (control) surfaces were compared. Surface topography was evaluated by field emission scanning electron microscope and optical interferometer. Eighteen rabbits received 72 implants in the tibia. Resonance frequency was analyzed every week for 6 weeks. Removal torque values were measured 2 and 6 weeks after placement. The implant-bone interfaces were directly observed by light microscope and bone-to-implant contact ratios were measured 2 and 6 weeks after insertion. All the surface-modified implants showed superior initial bone responses to the control. No significant differences were found among the surface-modified groups. Data suggest that various surface modification methods can provide favorable bone responses for early functioning and healing of dental implants.
Keywords: surface modification; resonance frequency analysis; bone-to-implant contact; anodic oxidation; calcium metaphosphate coating

Jeong SM, Choi BH, Li J, Xuan F. The Effect of Thick Mucosa on Peri-Implant Tissues: An Experimental Study in Dogs. J Periodontol 2008;79:2151-5.

BACKGROUND : Findings from animal studies have indicated that the implant mucosal barrier consists of a junctional epithelium ; 2mm long and a connective tissue compartment about 1 to 1.5 mm high. It may be argued that different features develop in the implant-mucosal barrier when it is placed within the alveolar bone with thick mucosa. The aim of this study was to examine the influence of a thick mucosa on peri-implant tissue healing around dental implants.

METHODS : The bilateral fourth mandibular premolars and all maxillary premolars were removed in six mongrel dogs. On one side (test side) of the mandible, a standardized bone defect (8.0 mm in height) was created in the premolar region, whereas no defect was created on the other side (control side). After 3 months of healing, one implant was placed on each side of the mandible; a long abutment (12 mm in height) was connected to the fixture on the bone defect side, whereas a normal abutment was connected to the fixture on the control side. After a healing period of 6 months, all dogs were sacrificed to evaluate peri-implant tissues.

RESULTS: The height of the mucosa, the length of the junctional epithelium, and the height of the zone of connective tissue integration were significantly greater in the thick mucosa than in the normal mucosa ($P < 0.05$). No significant difference was found between the control and test sides in the marginal level of bone-to-implant contact.

CONCLUSION : The junctional epithelium extended more apically in the thick mucosa than in the normal mucosa. However, additional marginal bone resorption was not observed at the thick mucosa sites.

KEY WORDS : Dental implant; mucosa; osseointegration.

Moon SY, Kim SG, Lim SC, Ong JL. Histologic and histomorphometric evaluation of early and immediately loaded implants in the dog mandible. J Biomed Mater Res 20008;86A:1122-7.

ABSTRACT: New bone formation around USIII OSSTEM implants after early and immediate loading was evaluated in this study. Three premolars and the first and second molars were first removed from the left mandible of five dogs. At 3 weeks after extraction of the teeth in the left mandible, the corresponding teeth in the right mandibles were removed. After 12 weeks of bone healing, five implants were placed in the left mandible. At 3 weeks after placement of implants in the left mandible, another five were placed in the right mandible. At the time of placing implants in the right mandible, four implants on each side were restored using a fixed provisional restoration. The anterior-most implant was not loaded and was used as controls. Periotest measurements performed immediately after implantation and after 16 weeks loading indicated implant stability for all groups tested. At 16 weeks after loading, the rate of periimplant bone formation for the early loaded, immediately loaded (IL), and control implants were observed to be 75.00, 73.37, and 62.04%, respectively. It was thus concluded that early stability was achieved in early and IL implants using fixed provisional restoration, thereby resulting in the high rate of peri-implant bone formation

KEY WORDS : early and immediately loaded implants; dog mandible

Jeong SM, Choi BH, Li J, Kim HS, K CY, Lee SH. Influence of Abutment Connections and Plaque Control on the Initial Healing of Prematurely Exposed Implants: An Experimental Study in Dogs. J Periodontol 2008;79:1070-4.

BACKGROUND : Spontaneous early implant exposure is believed to be harmful, resulting in early crestal bone loss around submerged implants. The purpose of this studywas to examine the influence of abutment connections and plaque control on the initial healing of prematurely exposed implants in the canine mandible.

METHODS : Bilateral, edentulated, flat alveolar ridges were created in the mandible of 10 mongrel dogs. After 3 months of healing, two implants were placed on each side of the mandible following a commonly used two-stage surgical protocol. Implants on each side were randomly assigned to one of two procedures: 1) connection of a cover screw to the implant and removal of the gingiva to expose the cover screw; and 2) connection of a healing abutment to the implant so that the coronal portion of the abutment remained exposed to the oral cavity. In five dogs (plaque control group), meticulous plaque control was performed. In the other five dogs (no plaque control group), plaque was allowed to accumulate. At 8 weeks

post-implantation, microcomputed tomography was performed at the implantation site to measure bone height in the peri-implant bone.

RESULTS : The plaque control group had greater vertical alveolar ridge height (9.7±0.5 mm) than the group without plaque control (7.4±0.7 mm; P 〈 0.05). In the plaque control group, the average bone height was greater with the abutment-connected implant (10.1±0.5 mm) than with the partially exposed implant (9.3±0.5 mm; P 〈 0.05). In the group without plaque control, the average bone height was greater with the partially exposed implant (8.2±0.6 mm) than with the abutment-connected implant (6.5±0.7 mm ; P 〈 0.05).

CONCLUSION : These results suggest that the placement of healing abutments and meticulous plaque controlmay limit bone loss around submerged implantswhen implants are partially exposed.

KEY WORDS : Dental abutment; dental implant; dental plaque; mucositis.

Yoo JH, Choi BH, Li J, Kim HS, Ko CY, Xuan F, Jeong SM. Influence of premature exposure of implants on early crestal bone loss: an experimental study in dogs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:702-6.

OBJECTIVES : Several studies have reported on spontaneous early exposure of submerged implants, suggesting that exposed implants have greater bone loss than nonexposed implants. The purpose of this study was to compare the effects of implant-abutment connections and partial implant exposure on crestal bone loss around submerged implants.

STUDY DESIGN : Bilateral, edentulated, flat alveolar ridges were created in the mandible of 6 mongrel dogs. After 3 months of healing, 2 fixtures were placed on each side of the mandible following a commonly accepted 2-stage surgical protocol. The fixtures on each side were randomly assigned to 1 of 2 procedures. In the first, a cover screw was connected to the fixture, and the incised gingiva was partially removed to expose the cover screw (partially exposed group). In the second, a healing abutment was connected to the fixture so that the coronal portion of the abutment remained exposed to the oral cavity (abutment-connected group). After 8 weeks, micro-computed tomography (micro-CT) at the implantation site was performed to measure the bone height in the peri-implant bone. Data were analyzed by Wilcoxon's signed rank test.

RESULTS : The average bone height was greater for the abutment-connected fixture (9.8±0.5 mm) than for the partially exposed fixture (9.3±0.5 mm; P 〈 .05).

CONCLUSION : These results suggest that when implant exposure is detected, the placement of healing abutments may help limit bone loss around the submerged implants.

Choi BH, Li J, Kim HS, Ko CY, Jeong SM, Xuan F. Comparison of submerged and nonsubmerged implants placed without flap reflection in the canine mandible. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:561-5.

OBJECTIVES : The purpose of this study was to compare the bone healing around submerged and nonsubmerged implants installed in a canine mandible model using a flapless technique.

STUDY DESIGN : Bilateral, edentulated, flat alveolar ridges were created in the mandibles of 6 mongrel dogs. After 3 months of healing, 2 implants were placed in 1 side by either miniflap submerged or flapless nonsubmerged procedures. After healing for an additional 8 weeks, microcomputerized tomography at the implantation site was performed. Osseointegration was calculated as the percent of the implant surface in contact with bone. Bone height was measured in the peri-implant bone.

RESULTS : The mean osseointegration was greater (64.7%) in miniflap submerged sites than in the flapless nonsubmerged sites (56.8%; P _ .05). The mean peri-implant bone height was greater (11.0 mm) in the miniflap submerged sites than in the flapless nonsubmerged sites (10.1 mm; P _ .05).

CONCLUSION : This study demonstrated that the submerged procedure was more effective than the nonsubmerged procedure in improving implant anchorage in the early phase after implant placement.

Jeong SM, Choi BH, Li J, Xuan F. Simultaneous Flapless Implant Placement and Peri-Implant Defect Correction: An Experimental Pilot Study in Dogs. J Periodontol 2008;79:876-80.

BACKGROUND : Minimally invasive implant surgery allows clinicians to place implants in less time, without extensive flaps, and with less bleeding and postoperative discomfort. The purpose of this study was to evaluate a new surgical technique by which implants are inserted in a deficient alveolar ridge using a flapless technique simultaneously with a peri-implant defect correction that is performed using a subperiosteal tunneling procedure.

METHODS : Bilateral, horizontal defects of the alveolar ridge were created in the mandibles of five mongrel dogs. After 3 months of healing, one implant was placed on each side of the mandible by a flapless procedure. The exposed threads of the implant on one side of the mandible were covered with a 1:1 autogenous bone/xenograft mixture using a subperiosteal tunneling technique. Four months later, biopsies of the implant sites were taken and prepared for ground sectioning and analysis.

RESULTS : All implants were well osseointegrated with the host bone. All of the peri-implant defects at the test sites were covered with tissue that resembled bone. In all specimens, a mixture of bone, connective tissue, and residual bone particles was observed in the graft area. In the control sites, where no graft was used, none of the exposed threads on any implants were covered with new bone.

CONCLUSION : This preliminary report indicates the potential use of a minimally invasive flapless technique as a substitute for a more invasive implant placement and ridge augmentation procedure.

KEY WORDS : Animal studies; bone graft; bone regeneration; dental implants; surgery; xenograft.

Sul SH, Choi BH, Li J, Jeong SM, Xuan F. Effects of sinus membrane elevation on bone formation around implants placed in the maxillary sinus cavity: an experimental study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:684-7.

OBJECTIVES : The aim of this study was to investigate the amount of augmented bone tissue formed in the maxillary sinus after sinus membrane elevation and the simultaneous insertion of titanium implants without additional grafting material.

STUDY DESIGN : An implant was placed bilaterally in the maxillary sinus of 6 adult female mongrel dogs in such a way that it protruded 4 mm or 8 mm into the maxillary sinus after sinus membrane elevation. The implants were left in place for 6 months.

RESULTS : The mean height of newly formed bone in the sinus was 3.3 mm on the side with the 4 mm protruding implant and 3.2 mm on the side with the 8 mm protruding implant. There was no difference between the 2 sides regarding new bone height in the sinus (P 〉 .05).

CONCLUSION : The results indicate that the length of implant protrusion into the sinus cavity after sinus membrane elevation is not related to the height of new bone in the sinus.

Sul SH, Choi BH, Li J, Jeong SM, Xuan F. Histologic changes in the maxillary sinus membrane after sinus membrane elevation and the simultaneous insertion of dental implants without the use of grafting materials. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:e1-e5.

OBJECTIVES : The aim of this study was to evaluate the histologic changes in the maxillary sinus membrane after sinus membrane elevation and the simultaneous insertion of dental implants without additional grafting material.

STUDY DESIGN : In 6 mongrel dogs, bilateral edentulated flat alveolar ridges were created in the maxilla. After 3 months of healing, an implant was unilaterally placed in the maxillary sinus in such a way that it protruded 5 mm into the maxillary sinus after sinus membrane elevation. On the opposite side, the maxillary sinus was left untreated as a control site. The animals were killed 6 months after surgery. The maxillary sinus mucosa was examined using light microscopy and scanning and transmission electronic microscopy

RESULTS : There were no morphologic or ultrastructural differences in the sinus membrane between groups.

CONCLUSION : The results indicate that the surgical procedure by which implants are inserted into the sinus cavity by elevating the sinus membrane without adding any graft material appears to have little influence on the histologic characteristics of the sinus membrane.

Kim SH, Choi BH, Li J, Kim HS, Ko CY, Jeong SM, Xuan F, Lee SH. Peri-implant bone reactions at delayed and immediately loaded implants: an experimental study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:144-8.

OBJECTIVES : The aim of this study was to compare the peri-implant bone reactions of implants subjected to immediate loading with those subjected to delayed loading.

STUDY DESIGN : In 6 mongrel dogs, bilateral edentulated flat alveolar ridges were created in the mandible. After 3 months of healing, 1 implant was placed in each side. On one side of the mandible, the implant was loaded immediately with a force of 20 N that was applied at a 120° angle from the tooth's longitudinal axis at the labial surface of the crown for 1800 cycles per day for 10 weeks. On the opposite side, after a delay of 3 months to allow osseointegration to take place, the implant was loaded with the same force used for the immediately loaded implant. Ten weeks after loading, microscopic computerized tomography at the implantation site was performed. Osseointegration was calculated as the percentage of implant surface in contact with bone. Bone height was measured in the peri-implant bone.

RESULTS : The mean osseointegration was greater (65.5%) for the delayed-loading implants than for the immediately loaded implants (60.9%; $P < .05$). The mean peri-implant bone height was greater (10.6 mm) for the delayed-loading implants than for the immediately loaded implants (9.6 mm; $P < .05$).

CONCLUSION : The results indicate that when implants are immediately loaded, the immediate loading may decrease both osseointegration of dental implants and bone height.

Yoon HC, Choi JY, Jung UW, Bae EK, Choi SH, Cho KS, Lee HY, Kim CK, Shim JS. Effects of different depths of gap on healing of surgically cerated coronal defects around implants in dogs: a pilot study. J Periodontol 2008l79(2):355-61.

BACKGROUND : This study investigated the bone growth pattern in surgically created coronal defects with various depths around implants in dogs.

METHODS : Four mongrel dogs were used. All mandibular premolars were extracted under general anesthesia and left to heal for 2 months. After ostectomy, bony defects were prepared in test sites, using a stepped drill with a diameter of 6.3 mm and two depths: 2.5 mm (test sites 1 [T1]) and 5.0 mm (test sites 2 [T2]). In the control sites, the implants were placed after ostectomy without any coronal defects. T1, T2,

and control sites were prepared in the right and left sides of the mandible. Six implants, 3.3 mm in diameter and 10 mm in length, were placed in each dog; the implants were submerged completely. Two dogs were sacrificed 8 weeks after surgery, and the other two dogs were sacrificed 12 weeks after surgery. The stability of all implants was measured with a resonance frequency analyzer after placement and after sacrifice. All sites were block-dissected for ground sectioning and histologic examination.

RESULTS : After 12 weeks of healing, only T2 were not filled fully with bone. At week 8, the mean bone-to-implant contact (BIC) was 47.7% for control, 43.6% for T1, and 22.2% for T2. At week 12, the control BIC was 56.7% and the 2.5-mm defect had a greater BIC (58.8%). However, in the 5-mm defect, the BIC was 35.1%. At insertion, stability was reduced at sites with a greater defect depth. Similar stability was noted in all specimens after 8 and 12 weeks of healing.

CONCLUSION : Bone healing between an implant and marginal bone was compromised at sites with a deeper defect when the width of the bone defect was 1.5 mm.

Lee HJ, Choi BH, Jung JH, Zhu SJ, Lee SH, Huh JY, You TM, Li J. Vertical alveolar ridge augmentation using autogenous bone grafts and platelet-enriched fibrin glue with simultaneous implant placement. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:27-31.

OBJECTIVES : The aim of this study was to evaluate the combined use of autogenous bone and platelet-enriched fibrin glue as grafting material for vertical alveolar ridge augmentation with simultaneous implant placement in a canine alveolar ridge defect model.

STUDY DESIGN : In 6 mongrel dogs, bilateral vertical alveolar ridge defects were created in the mandible. After 3 months of healing, 2 dental implants were placed in each defect of the mandible, creating 6-mm supra-alveolar peri-implant defects. The 2 implants per defect were subjected to surgical treatments involving either a combination of autogenous bone grafts and platelet-enriched fibrin glue, or a conventional flap procedure only (control). After a healing period of 6 months, the dogs were humanely killed for histological and histometric analyses.

RESULTS : Implant placement alone produced limited vertical alveolar height (0.6 +/- 0.4 mm). However, alveolar augmentation including a combination of autogenous bone grafts and platelet-enriched fibrin glue with simultaneous implant placement resulted in alveolar ridge augmentation amounting to 4.2 +/- 1.0 mm, comprising 63% of the defect height. New bone-implant contact was 40.5% in the defects treated with combined autogenous bone grafts and platelet-enriched fibrin glue, and was 48.4% in the resident bone; this difference was not statistically significant.

CONCLUSION: The present study demonstrates that vertical alveolar ridge augmentation using autogenous bone grafts and platelet-enriched fibrin glue with simultaneous implant placement might effectively increase vertical alveolar ridge height and allow for an acceptable level of osseointegration.

You TM, Choi BH, Li J, Jung JH, Lee HJ, Lee SH, Jeong SM. The effect of platelet-rich plasma on bone healing around implants placed in bone defects treated with Bio-Oss: a pilot study in the dog tibia. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103:e8-12.

OBJECTIVES : The aim of this study was to examine the influence of platelet-rich plasma (PRP) used as an adjunct to Bio-Oss for the repair of bone defects adjacent to titanium dental implants.

STUDY DESIGN : In 6 mongrel dogs, 12 screw-shaped titanium dental implants were inserted into the osteotomy sites in the dogs' tibias. Before implantation, a standardized gap (2.0 mm) was created between the implant surface and the surrounding bony walls. The gaps were filled with either Bio-Oss cancellous granules alone or Bio-Oss cancellous granules mixed with PRP.

RESULTS : After 4 months, the Bio-Oss-treated defects revealed a significantly higher percentage of bone-implant contact than the defects treated with Bio-Oss and PRP (60.1% vs. 30.8%; $P < .05$).

CONCLUSION : The results indicate that when PRP is used as an adjunct to Bio-Oss in the repair of bone defects adjacent to titanium dental implants, PRP may decrease periimplant bone healing.

Lee SH, Choi BH, Li J, Jeong SM, Kim HS, Ko CY. Comparison of corticocancellous block and particulate bone grafts in maxillary sinus floor augmentation for bone healing around dental implants. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007 Sep;104(3):324-8.

OBJECTIVE : The aim of this study was to compare 2 types of bone used for maxillary sinus floor augmentation, corticocancellous block or particulate bone grafts, on bone healing around dental implants when installed simultaneously with the implant.

STUDY DESIGN : The mucous membranes of 12 sinuses in 6 dogs were elevated bilaterally. On one side of the maxillary sinus, autogenous corticocancellous block bone was grafted into the space between the membrane and sinus wall. On the opposite side, autogenous corticocancellous particulate bone was grafted. Simultaneously, 2 dental implants were inserted into the grafting material through the maxillary sinus floor. The animals were killed 6 months after surgical procedure.

RESULTS : The mean bone-implant contact was 56.7% on the block side and 32.1% on the particulate side ($P < .05$). The mean height of newly formed bone in the augmented area was 12.3 mm on the block side and 9.7 mm on the particulate side ($P < .05$).

CONCLUSION : Our results show that maxillary sinus floor augmentation using corticocancellous block bone grafts, when installed simultaneously with the implant, is superior to corticocancellous particulate bone grafts for bone healing around dental implants.

You TM, Choi BH, Zhu SJ, Jung JH, Lee SH, Huh JY, Lee HJ, Li J. Platelet-enriched fibrin glue and platelet-rich plasma in the repair of bone defects adjacent to titanium dental implants. Int J Oral Maxillofac Implants. 2007;22(3):417-22.

PURPOSE : The aim of this study was to compare the effects of platelet-enriched fibrin glue and platelet-rich plasma (PRP) on the repair of bone defects adjacent to titanium dental implants.

MATERIALS AND METHODS : In 6 mongrel dogs, 3 screw-shaped titanium dental implants per dog were placed into the osteotomy sites in the tibia. Before implantation, a standardized gap (2.0 mm) was created between the implant surface and the surrounding bone walls. Six gaps were left empty (control group), 6 gaps were filled with autogenous particulate bone mixed with PRP (PRP group), and 6 gaps were filled with autogenous particulate bone mixed with platelet-enriched fibrin glue (fibrin glue group).

RESULTS : After 6 weeks, the bone-implant contact was 59.7% in the fibrin glue group, 29.2% in the PRP group, and 10.2% in the control defects; this difference was statistically significant ($P < .05$).

DISCUSSION AND CONCLUSION : Greater bone-implant contact was achieved with platelet-enriched fibrin glue than with PRP. The results indicate that platelet-enriched fibrin glue can induce a stronger peri-implant bone reaction than PRP in the treatment of bone defects adjacent to titanium dental implants.

You TM, Choi BH, Zhu SJ, Jung JH, Lee SH, Huh JY, Lee HJ, Li J. Treatment of experimental peri-implantitis using autogenous bone grafts and platelet-enriched fibrin glue in dogs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007;103(1):34-7.

OBJECTIVE : The purpose of this study was to evaluate the effects of autogenous bone grafts and platelet-enriched fibrin glue in the treatment of peri-implantitis.

STUDY DESIGN : Thirty-six screw-type commercially pure titanium implants with rough acid-etched surfaces were inserted into 6 mongrel dogs 3 months after extraction of mandibular premolars. After 3 months of healing, peri-implantitis was induced by placing gauze and wire around the implants. Once peri-implantitis was created, surgical treatments involving a combination of autogenous bone grafts and platelet-enriched fibrin glue, autogenous bone grafts alone, or a conventional flap procedure only (control) were carried out. Six months later, biopsies of the implant sites were taken and prepared for ground sectioning and analysis.

RESULTS : The amount of reosseointegration was significantly higher in peri-implantitis defects treated with combined autogenous bone grafts and platelet-enriched fibrin glue as compared with the other 2 treatment procedures. A mean bone-to-implant contact of 50.1% was obtained in the peri-implantitis lesions treated with combined autogenous bone grafts and platelet-enriched fibrin glue. The corresponding values for the autogenous bone grafts and control groups were 19.3% and 6.5%, respectively.

CONCLUSION : The present study demonstrates that surgical treatment involving the combined use of autogenous bone grafts and platelet-enriched fibrin glue might effectively promote reosseointegration in lesions resulting from peri-implantitis.

Lee HJ, Choi BH, Jung JH, Zhu SJ, Lee SH, Huh JY, You TM, Li J. Maxillary sinus floor augmentation using autogenous bone grafts and platelet-enriched fibrin glue with simultaneous implant placement. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103:329-33.

OBJECTIVE : The aim of this study was to evaluate the use of autogenous bone in combination with platelet-enriched fibrin glue as a grafting material for maxillary sinus augmentation with simultaneous implant placement in dogs.

STUDY DESIGN : The mucous membranes of 12 sinuses in 6 dogs were elevated bilaterally. In the right sinus, autogenous bone mixed with platelet-enriched fibrin glue was grafted into the space between the membrane and the sinus wall. In the left sinus, autogenous bone alone was grafted as a control. At the same time, 2 dental implants were inserted into the grafting material through the maxillary sinus floor. The animals were killed 6 months after surgery.

RESULTS : The mean bone-implant contact was 40.5% on the fibrin glue side and 32.3% on the control side ($P < .05$). The mean height of newly formed bone in the augmented area was 12.2 mm on the fibrin glue side and 10.7 mm on the control side ($P < .05$).

CONCLUSION : The results indicate that the use of autogenous bone mixed with platelet-enriched fibrin glue can achieve results superior to those for grafts of autogenous bone alone. The specific improvements of this technique include enhanced osseointegration of dental implants and increased height of new bone.

Jeong SM, Choi BH, Li J, Kim HS, Ko CY, Jung JH, Lee HJ, Lee SH, Engelke W. Flapless implant surgery: an experimental study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;104:24-8.

OBJECTIVE : The purpose of this study was to examine the effect of flapless implant surgery on crestal bone loss and osseointegration in a canine mandible model.

STUDY DESIGN : In 6 mongrel dogs, bilateral, edentulated, flat alveolar ridges were created in the mandible. After 3 months of healing, 2 implants in each side were placed by either flap or flapless procedures. After a healing period of 8 weeks, microcomputerized tomography at the implantation site was performed. Osseointegration was calculated as percentage of implant surface in contact with bone. Additionally, bone height was measured in the peri-implant bone.

RESULTS : The mean osseointegration was greater at flapless sites (70.4%) than at sites with flaps (59.5%) (P 〈 .05). The mean peri-implant bone height was greater at flapless sites (10.1 mm) than at sites with flaps (9.0 mm) (P 〈 .05).

CONCLUSION : Flapless surgery can achieve results superior to surgery with reflected flaps. The specific improvements of this technique include enhanced osseointegration of dental implants and increased bone height.

You TM, Choi BH, Zhu SJ, Jung JH, Lee SH, Huh JY, Lee HJ, Li J.
Treatment of experimental peri-implantitis using autogenous bone grafts and platelet-enriched fibrin glue in dogs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007 ;103(1):34-7.

OBJECTIVE : The purpose of this study was to evaluate the effects of autogenous bone grafts and platelet-enriched fibrin glue in the treatment of peri-implantitis.

STUDY DESIGN : Thirty-six screw-type commercially pure titanium implants with rough acid-etched surfaces were inserted into 6 mongrel dogs 3 months after extraction of mandibular premolars. After 3 months of healing, peri-implantitis was induced by placing gauze and wire around the implants. Once peri-implantitis was created, surgical treatments involving a combination of autogenous bone grafts and platelet-enriched fibrin glue, autogenous bone grafts alone, or a conventional flap procedure only (control) were carried out. Six months later, biopsies of the implant sites were taken and prepared for ground sectioning and analysis.

RESULTS : The amount of reosseointegration was significantly higher in peri-implantitis defects treated with combined autogenous bone grafts and platelet-enriched fibrin glue as compared with the other 2 treatment procedures. A mean bone-to-implant contact of 50.1% was obtained in the peri-implantitis lesions treated with combined autogenous bone grafts and platelet-enriched fibrin glue. The corresponding values for the autogenous bone grafts and control groups were 19.3% and 6.5%, respectively.

CONCLUSION : The present study demonstrates that surgical treatment involving the combined use of autogenous bone grafts and platelet-enriched fibrin glue might effectively promote reosseointegration in lesions resulting from peri-implantitis.

Jung JH, Choi BH, Zhu SJ, Lee SH, Huh JY, You TM, Lee HJ, Li J. The effects of exposing dental implants to the maxillary sinus cavity on sinus complications. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006, 102(5):602-5.

OBJECTIVE : The aim of this study was to investigate whether dental implant exposure to the maxillary sinus cavity increases the risk of maxillary sinus complications.

STUDY DESIGN : An implant was placed bilaterally in the maxillary sinus of 8 adult female mongrel dogs in a way that it penetrated the bone and mucous membrane of the maxillary sinus floor to the extent of 2 mm, 4 mm, or 8 mm. The implants were left in place for 6 months.

RESULTS : Radiographic and histologic examinations did not show any signs of pathologic findings in the maxillary sinus of the 8 dogs.

CONCLUSION : This study indicates that implant protrusion into the maxillary sinus cavity is not related to the development of sinus complications in canines.

Ko SM, Lee JK, Eckert SE, Choi YG. Retrospective Multicenter Cohort Study of the Clinical Performance of 2-stage Implants in South Korean Populations. Int J ORAL & MAXILLOFAC IMPLANTS 2006;21:785-8.

PURPOSE : To evaluate long-term follow-up clinical performance of dental implants in use in South Korean populations.

MATERIALS AND METHODS : A retrospective multicenter cohort study design was used to collect long-term follow-up clinical data from dental records of 224 patients treated with 767 2-stage endosseous implants at Ajou University Medical Center and Bundang Jesaeng Hospital in South Korea from June 1996 through December 2003. Exposure variables such as gender, systemic disease, location, implant length, implant diameter, prosthesis type, opposing occlusion type, and date of implant placement were collected. Outcome variables such as date of implant failure were measured.

RESULTS : Patient ages ranged from 17 to 71.7 years old (mean age, 45.6 years old). Implants were more frequently placed in men than in women (61% versus 39%, or 471 men versus 296 women). Systemic disease was described by 9% of the patients. All implants had hydroxyapatite-blasted surfaces. Most of the implants were 3.75 mm in diameter. Implant lengths 10 mm, 11.5 mm, 13 mm, and 15 mm were used most often. Differences of implant survival among different implant locations were observed. Implants were used to support fixed partial dentures for the majority of the restorations. The opposing dentition was natural teeth for about 50% of the implants. A survival rate of 97.9% (751 of 767) was observed after 4.5 years (mean, 1.95 +/- 1.2 years).

CONCLUSION : Clinical performance of 2-stage dental implants demonstrated a high level of predictability. The results achieved with a South Korean population did not differ from results achieved with diverse ethnic groups.

Lee JS, Kim YS, Kim CW, Han JS. Wave analysis of implant screw loosening using an air cylindrical cyclic loading device. J Prosthet Dent 2002;88:402-8.

STATEMENT OF PROBLEM: The mechanics of implant screw loosening or fracture are well understood in the field of engineering. They have not been as widely explored in dentistry.

PURPOSE : This study investigated the effects of simulated mastication on implant components and used wave analysis to document the basic mechanisms of screw loosening in a simulated oral environment.

MATERIAL AND METHODS : A pneumatic cylindrical cyclic loading device was fabricated to simulate masticatory movement. Thirteen standard abutments were connected on external hexagonal implants with titanium abutment screws tightened to 20 Newton centimeters (Ncm), and single crowns were retained with gold screws tightened to 10 Ncm on each abutment, respectively. Ten single-implant crowns were loaded with the use of a cyclic loading device with 100 N of force at 30° angles to the long-axis for 0.2 seconds of contact time with a frequency of 1 Hz. Three crowns were loaded vertically under the same conditions to serve as the control group.
The effects of up to 1 million cyclic loads and various tightening torque forces (2, 4, 6, 8, 10, and 12 Ncm) on screw loosening were evaluated by wave analysis. A software program was written to record every wave mode and to stop the machine automatically if the amount of horizontal displacement of the crown was more than 0.5 mm, which was designated to represent perceptible loosened implant crown mobility clinically. The general wave patterns and characteristics of loosened and stable screws and the effect of various tightening torques were analyzed by comparing the differences in wave patterns.

RESULTS : The wave mode was divided into 4 stages for loosened gold screws: initial displacement, initial vibration, elastic deformation, and recovery stage. However, the initial displacement and initial vibration stages were not discernible for stable gold screws. Of the 10 gold occlusal screws, 4 loosened before the 1 million cyclic loads in the 10 single crowns tested. There was no screw loosening in the control group. There was no effect of screw loosening on the elastic deformation stage.

CONCLUSION : Within the limitations of this study, tightening torque had a significant effect on screw loosening. It would appear that more than 10 Ncm of tightening torque should be recommended for the gold screws in this external hexagon implant system.

Kim SG, Kim WK, Park JC, Kim HJ. A Comparative Study of Osseointegration of Avana Implants in a Demineralized Freeze-Dried Bone Alone or With Platelet-Rich Plasma. J Oral Maxillofac Surg 2002;60:1018-25.

PURPOSE : The purpose of this study was to assess the efficacy of demineralized bone powder (DBP) alone or combined in a mixture with platelet-rich plasma (PRP) used to enhance osseointegration of dental implants in a dog model.

MATERIALS AND METHODS : Tissue integration was assessed using standard histomorphometric methods at 6 and 12 weeks after surgery. A total of 30 Avana dental implants (SooMin Synthesis Dental Materials Co, Busan, Korea) were inserted in the animals. They were self-tapping screw implants, 10 mm in length and 4 mm in diameter, made of commercially pure titanium. A titanium implant was then placed centrally in each defect. In each dog, the defects were treated with 1 of the following 3 treatment modalities:1) no treatment (control), 2) grafting with DBP, or 3) grafting with DBP and PRP.

RESULTS : Histologic analysis showed that all of the bone defects surrounding the implants that were treated with DBP, with and without PRP, were filled with new bone. The defects that were not treated (control) showed new bone formation only in the inferior threaded portion of the implants. Histomorphometric results revealed a higher percentage of bone contact with DBP and PRP compared with control and DBP.

CONCLUSION : These results suggested that bone defects around titanium implants can be treated successfully with DBP and that PRP may improve bone formation.

You TM, Choi BH, Zhu SJ, Jung JH, Lee SH, Huh JY, Lee HJ, Li J. Treatment of experimental peri-implantitis using autogenous bone grafts and platelet-enriched fibrin glue in dogs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007 ;103(1):34-7.

PURPOSE : To evaluate the effect of particulate dentin-plaster of Paris with and without platelet-rich plasma (PRP) on bone healing and new bone formation around titanium dental implants in a canine model. Histologic sections and histomorphometric analysis of the defects were obtained at 6 and 12 weeks after surgery.

MATERIALS AND METHODS : Three circular bone defects were surgically prepared in iliac crest sites in each of 10 animals. A total of 30 Avana dental implants were placed in the animals. They were self-tapping, screw-type implants, 10mm in length and 4mm in diameter, all made of commercially pure titanium. A titanium implant was placed centrally in each defect. In each dog, the defects were treated with 1 of the following 3 treatment modalities: (1) no treatment (control); (2) grafting with particulate dentin-plaster of Paris; (3) grafting with particulate dentin-plaster of Paris and PRP.

RESULTS : Histologic analysis showed that all of the bone defects surrounding the implants that were treated with particulate dentin-plaster of Paris, with and without PRP, were filled with new bone. The defects that were not treated (control) demonstrated new bone formation only in the inferior threaded portion of the implants.

DISCUSSION : Histomorphometric results revealed a higher percentage of bone contact with particulate dentin-plaster of Paris and PRP compared to the control and particulate dentin-plaster of Paris.

CONCLUSIONS : These results suggested that bone defects around titanium implants can be treated successfully with particulate dentin-plaster of Paris, and that the outcome can be improved if PRP is also used.

www.osstem.com

칼슘이온의 강한 생명력

신제품 출시

TSIII CA

칼슘이온의 강력한 표면 활성화 에너지가 만드는 놀라운 초친수성과
뛰어난 초기 골유착 성능으로 치료기간을 단축시킬 수 있는 신개념 임플란트

OSSTEM IMPLANT

서울동부지점	02-978-1271	동대문지점	02-2297-3414	인천서부지점	032-623-7523	강원지점	033-731-7215	부산동부지점	051-322-2080	서울중구지점	02-794-2903	대전동부지점	042-716-2104
서울북부지점	02-325-6872	서대문지점	02-325-6879	김포지점	032-623-7523	대구/북부지점	053-384-7528	부산서부지점	051-322-2080	서울강서지점	02-2675-7327	청주지점	043-236-2275
서울중부지점	02-2297-3414	반포/서초지점	02-586-2875	경기/군포지점	031-420-1566	대구동부지점	053-982-0428	경남지점	055-274-2872	관악지점	02-851-6162	전주지점	063-276-2871
서울강동지점	031-756-2857	송파지점	031-756-2857	분당/성남지점	031-721-1272	대구서부지점	053-423-2879	경남동부지점	055-274-2873	병원영업팀	02-2125-7934	광주지점	062-366-7528
서울강남지점	031-756-2857	구리지점	02-978-1271	용인지점	031-420-1566	울산지점	052-227-4740	서울서부지점	02-851-5162	상품영업팀	02-2125-7935	광주서부지점	062-374-7525
서울강북지점	02-941-2837	인천지점	032-623-7522	수원/평택지점	031-268-0346	부산/남부지점	051-851-4170	서울중앙지점	02-794-2903	대전지점	042-825-2104	제주지점	064-725-9890