A comparative clinical study on oxidized titanium implants and sandblasted large-grit acid etched implants in soft bone

Jun-Young Lee

The Graduate School

Yonsei University

Department of Dental Science

A comparative clinical study on oxidized titanium implants and sandblasted large-grit acid etched implants in soft bone

The Master's Thesis
submitted to the Department of Dental Science
and the Graduate School of Yonsei University
in partial fulfillment of the requirements for the degree of
Master of Dental Science

Jun-Young Lee

June 2009

This certifies that the dissertation thesis
of Jun-Young Lee is approved.

_____

Thesis Supervisor : Kyoo-Sung Cho

_____

Seong-Ho Choi

_____

Chang-Sung Kim

The Graduate School

Yonsei University

June 2009

감사의 글

우선, 오늘날 제가 있기까지 모든 것을 준비해 주시고, 인도해 주신 사랑의 하나님께 감사의 인사를 드립니다.

이 논문이 완성되기까지 부족한 저를 지도해 주시고 따뜻한 격려와 사랑으로 이끌어주신 조규성 교수님께 깊은 감사를 드립니다. 그리고, 부모와 같은 사랑으로 제자들에게 애정을 쏟으시고, 소중한 가르침으로 이끌어주시는 최성호 교수님, 김창성 교수님께 깊은 감사를 드립니다. 또한, 논문을 작성하는데 필요한 궂은 일을 도맡아 해 준 치주과 의국원들에게도 고마움을 전합니다.

힘들 때나 슬플 때나 기쁠 때나 괴로울 때 항상 곁에서 있어 준 사랑하는 아내와 얼마 전 태어난 세상에서 가장 큰 선물인 아가에게 고마움과 사랑을 전합니다. 마지막으로, 아낌없는 사랑과 헌신으로 제 인생의 가장 든든한 후원자이자 버팀목이 되어주시는 아버지, 어머니와 장인, 장모님께 존경과 사랑을 담아 이 논문을 드립니다.

2009 년 6 월

저자씀.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

A comparative clinical study on oxidized titanium implants and sandblasted large-grit acid etched implants in soft bone

The aim of this retrospective study was to compare the survival rate of oxidized titanium implants (Brånemark Ti-Unite^{TM}) and sandblasted large-grit acid etched implants (ITI SLA) in soft bone. 201 oxidized titanium implants were inserted in 84 patients between May 1999 and May 2004. 120 sandblasted large-grit acid etched implants were inserted in 74 patients between December 2000 and May 2004. In both groups, the implants were placed mainly in the posterior maxilla. The majority of the bone quality and quantity were clinically judged as type 4 or type C respectively in accordance to the Lekholm and Zarb index. The following information was collected from the patient records: age, gender, systemic disease, implant type, number, length and diameter of the implants, their location in the jaws, bone quality and quantity, the number of failed implants, the causes of failure, and advanced surgery for bone augmentation.

In the oxidized titanium implants, 8 implants showed early failure, and 1 implant showed late failure, respectively. The cumulative survival rate was 95.48%. In the sandblasted large-grit acid etched implants, 1 implant showed late failure and

cumulative survival rate was 99.10%. The cumulative survival rate and the survival rates in the case of the advanced procedure during the implant placement were not significantly different in both groups. Oxidized titanium implants and sandblasted large-grit acid etched implants can be used successfully in soft bone regardless of the surgical methods used during the implant placement.

Key words: oxidized titanium implant, survival rate, sandblasted large-grit acid etched implant

A comparative clinical study on oxidized titanium implants and sandblasted large-grit acid etched implants in soft bone

Jun-Young Lee, D.D.S.

Department of Dental Science
Graduate School, Yonsei University
(Directed by Prof. Kyoo-Sung Cho, D.D.S., M.S.D., PhD.)

I. Introduction

Placement of endosseous implants has become a predictable option in comprehensive periodontal treatment planning for both fully and partially edentulous patients. The initial stability of an implant is a critical factor for the achievement of osseointegration (Albrektsson et al. 1981). But, it is often difficult to obtain proper implant stability in soft bone. The lack of initial stability in soft bone can lead to lower success rates, which can vary from 50% to 94% (Martinez et al. 2001). Occasionally, the placement of implant in the posterior maxilla is limited by insufficient bone volume. However, it can be solved by sinus augmentation using various surgical procedures (Boyne et al. 1980; Tatum 1986; Summers 1994). Indeed,

when the width and height of residual alveolar ridges were significantly modified after tooth extraction, it may jeopardize the correct implant placement and stability. To effect more ideal implant placement or allow the fabrication of better restorations, the application of the principle of guided bone regeneration (GBR) has become a predictable treatment option in implant dentistry (Buser et al. 1996; Fugazzotto 2005).

Since the 1980s, it has been tried to overcome the high failure rate of machined surface implants and gain adequate primary stability in sites with poor bone quality and quantity. Firstly, the evolution of implant design has been proposed. Many manufactures developed more variable implants using an increase in implant diameter, double–spiraled thread or root shape anatomy. Secondly, bone condensation using osteotomes was proposed by Summers (Summers 1994). This is an useful and predictable procedure for implant placement in soft maxillary bone. Finally, the development of new surface textures has been studied widely with the aim of improving the initial implant stability and bone healing. There are many implants of new surface, but we were interested in two typical implant surfaces. One is a novel titanium porous oxide implant surface (Ti-Unite^{TM}) which has been introduced by the Nobel Biocare AB (Gothenburg, Sweden) since 2000. The highly porous titanium oxide layer is thickened toward the apex of the threaded root-form oral implant. The other is a sandblasted large-grit acid etched implant surface (SLA) which has been proposed by the Straumann Institute since the early 1990s. The titanium surface is

firstly sandblasted with large particles causing a grossly rough surface which is secondly acid-etched, forming a finely rough surface.

Recently, a few studies have compared Brånemark System® implants with ITI System® Implants. SLA ITI implants (98%) have a significant higher survival rate than machine-surfaced Brånemark implants (81%) in autogenous grafted maxillary bone (Pinholt 2003). In a 3-year follow-up of a randomized study, there was a high survival rate (97.3%) and low marginal bone loss for both ITI (TPS surface) implants and Brånemark (turned surface) implants in the treatment of a partially edentulous maxilla (Åstrand et al. 2004). However, there have been few studies that have compared the survival rate between the Brånemark Ti-Unite™ implants and the ITI SLA implants in soft bone.

The aim of this study was to compare the survival rate of Brånemark Ti-Unite™ implants and ITI SLA implants in soft bone.

II. Materials and Methods

1. Patients and implants

In the Brånemark Ti-Unite™ (BRA) group, 84 patients (39 men and 45 women, mean age of 54 years, age range of 21 to 75 years) were treated with 201 Brånemark Ti-Unite™ MK Ⅲ or MK Ⅳ implants between May 1999 and May 2004. In the ITI SLA (ITI) group, 74 patients (44 men and 30 women, mean age of 57 years, age range of 21 to 81 years) were treated with 120 ITI SLA implants between December 2000 and May 2004. The patients were mainly healthy or had well-controlled systemic disease. All the implants were placed in soft bone at the Department of Periodontology, College of Dentistry, Yonsei University.

2. Implant distribution

In both groups, the implants were mainly placed in the posterior maxilla (Table 1). Implant distribution by bone quality and quantity is illustrated in Table 2. The majority were clinically judged as type 4 or type C, respectively in accordance to the Lekholm and Zarb index (Lekholm et al. 1985). As shown in Table 3, MK Ⅳ

implants were mostly installed in the BRA group (81.1%), and ITI solid screw implants were mostly installed in the ITI group (75.8%), respectively.

Table 1. Implant distribution according to the location (WHO site classification)

BRA	8	22	31	8	7	3	2	1	1	-	2	7	19	35	26	8
ITI	2	10	18	5	-	-	-	1	1	-	1	3	8	20	19	4
	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
BRA	2	4	1	2	-	-	-	-	-	-	1	2	2	3	4	-
ITI	1	4	5	-	-	-	-	-	-	-	-	-	4	5	9	-

BRA: Brånemark Ti-Unite™ implants

ITI: ITI SLA implants

Table 2. Implant distribution according to bone quality and quantity

Quality	1		2		3		4		Total	
Quantity	BRA	ITI	BRA	ITI	BRA	ITI	BRA	ITI	BRA	ITI
A										
B					1	3	54	32	55	35
C				1	17(1)	7	102(6)	40	119	48
D				3	4	16	23(2)	18(1)	27	37
E										
Total				4	22	26	179	90	201	120

BRA: Brånemark Ti-Unite™ implants

ITI: ITI SLA implants

*Number of failed implants is presented within parentheses

Table 3. Implant distribution according to the diameter (D) and length (L).

	Brånemark Ti-Unite™					ITI SLA						
	MK Ⅲ			MK Ⅳ		Solid screw			Esthetic plus		TE™	
L＼D	Ø3.75	Ø4	Ø5	Ø4	Ø5	Ø4.1/4.8	Ø4.8/4.8	Ø4.8/6.5	Ø4.1/4.8	Ø4.8/4.8	Ø4.1/4.8	Ø4.8/6.5
7 ㎜				3								
8 ㎜						2	2					1
8.5 ㎜			7	2	11							
10 ㎜		2	10	11	21	27	13	12	4			13
11.5 ㎜		4	2	21	23							
12 ㎜						12	9	6	1	1	4	5
13 ㎜	1	8	3	49	15		2					
14 ㎜						6						
15 ㎜		1		7								
Total	1	15	22	93	70	47	26	18	5	1	4	19

3. Study design

The study was carried out retrospectively using the patients' chart. The following information was collected from the patient records: age, gender, systemic disease, the type, number, length and diameter of the implants, their location in the jaws, bone quality and quantity, the number of failed implants, the causes of failure, and advanced surgery for bone augmentation [Osteotome Sinus Floor Elevation (OSFE),

Bone Added Osteotome Sinus Floor Elevation (BAOSFE), Sinus graft (1-stage), Sinus graft (2-stage), and GBR].

4. Survival criteria

The survival rates were calculated according to the method reported by Buser et al (Buser et al. 1990) as follows:

1) The absence of persistent subjective complaints, such as pain, foreign body sensation, and/or dysesthesia
2) The absence of recurrent peri-implant infections with suppuration
3) The absence of mobility
4) The absence of continuous radiolucency around the implant
5) The possibility for restoration

5. Statistical analysis

The results were evaluated using the life table analysis described by Cutler & Ederer (Cutler et al. 1958). The differences in the survival rates between the implant types were examined using a Mantel-Haenszel chi-square, and the differences among the advanced surgical techniques were examined using the Fisher's exact test.

III. Results

1. Cumulative survival rate

In the BRA group, 2 submerged implants were lost before healing abutment connection following flap dehiscence with suppuration, 5 submerged implants were lost at the time of abutment connection and 1 non-submerged implant was lost 5 weeks postoperatively following healing abutment loosening and fixture mobility. Of the failed implants, one upper anterior implant (MK Ⅳ Ø4x15mm, #11 area) was installed 7 weeks after removal of MK Ⅱ Ø3.75x18mm. The previous MK Ⅱ implant was installed with GBR technique because of labial bone penetration, but it was lost 10 months postoperatively due to repeated pus discharge. One lower posterior implant (MK Ⅲ Ø3.75x13mm, #45 area) was failed at the time of healing abutment connection. The six upper posterior failed implants (MK Ⅲ Ø5x8.5mm, #26, 27 area; MK Ⅳ Ø4x13mm, #25 area; MK Ⅳ Ø5x8.5mm, #16, 26 area; MK Ⅳ Ø5x11.5mm, #25 area) were related to sinus augmentation. One MK Ⅲ Ø5x8.5mm fixture on #26 area was installed with sinus membrane perforation at the time of OSFE technique. Two patients (3 implant) had smoking habit and one patient (1 implant) had bruxism, and one patient (1 implant) had a stable angina pectoris. A total of 8 implants failed early, resulting in a 96.02 % survival rate. After loading, one

implant (MK Ⅳ Ø4x13mm, #24 area) was lost at the 7th month after using an overdenture due to overloading, resulting in a cumulative survival rate of 95.48%. In the ITI group, no implant was removed but one implant (ITI TE^{TM} Ø4.1/4.8x12mm, #27 area) showed repeated suppuration after installation of the permanent prosthesis. After being treated with antibiotics, chlorhexidine irrigation, and curettage, the peri-implantitis was controlled. The implant was left in place but a suppurative peri-implant infection was found at the last annual examination. This implant was considered to be a failure, resulting in a cumulative survival rate of 99.10% (Table 4, Fig. 1). Therefore, there were 1 of 120 failure in the ITI SLA implants and 9 of 201 failures in the Brånemark Ti-Unite^{TM} implants, respectively. However, there was no significant difference between both groups (Mantel-Haenszel=0.138).

Table 4. Life table analyses

Time period	Implants at start of interval		No. of failed implants		Survival rate (%)		Cumulative survival rate (%)	
	BRA	ITI	BRA	ITI	BRA	ITI	BRA	ITI
Placement-loading	201	120	8	0	96.02	100	96.02	100
Loading-1 year	193	120	1	1	99.44	99.10	95.48	99.10
1 year-2 years	162	102	0	0	100	100	95.48	99.10
2 years-3 years	61	45	0	0	100	100	95.48	99.10
3 years-4 years	38	20	0	0	100	100	95.48	99.10
4 years-5 years	26	5	0	0	100	100	95.48	99.10
5 years-	18		0		100		95.48	

BRA: Brånemark Ti-Unite^{TM} implants

ITI: ITI SLA implants

2. Survival rate for each surgical method

The surgical methods used at the time of implant placement are described below (Table 5). In the case of OSFE, or 1-stage sinus graft, or 2-stage sinus graft, respectively, there was higher percentage of BRA cases than ITI cases. Figure 2 shows the survival rate according to the additional surgical procedures and implant type. In all cases, the survival rate was not significantly different in the two implant types according to Fisher's exact test ($p>0.05$).

Table 5. Implant distribution according to the additional surgical procedures and implant group

	None	OSFE	BAOSFE	Sinus graft (1-stage)	Sinus graft (2-stage)	GBR	BAOSFE +GBR
BRA (%)	46 (22.9%)	55 (27.4%)	25 (12.4%)	28 (13.9%)	40 (19.9%)	5 (2.5%)	2 (1%)
ITI (%)	61 (50.8%)	10 (8.3%)	35 (29.2%)	4 (3.3%)	8 (6.7%)	2 (1.7%)	0 (0%)

BRA: Brånemark Ti-Unite™ implants
ITI: ITI SLA implants
None: No additional surgery
OSFE: Osteotome Sinus Floor Elevation
BAOSFE: Bone Added Osteotome Sinus Floor Elevation
GBR : Guided Bone Regeneration

IV. Discussion

Many studies have demonstrated that a lack of initial stability in soft bone, particularly in the posterior maxilla, leads to lower success rates than in other locations and bone qualities (Engquist et al. 1988; Friberg et al. 1988; Jaffin et al. 1991). In order to overcome the high failure rate of implants in soft bone, a modification of the surgical methods during implant placement has been suggested that bone condensation with osteotomes, minimal or no countersinking, not to drill to the total implant length, and light forces during implant insertion. In addition, wide diameter implant, wide collar, and the implant design for increasing the surface of bone to implant contact are recommended. Finally, the surface texture of the oral implant have been modified to enhance the cellular activity and primary stability. Rough surfaces of implant are advocated not only to increase primary stability but mainly to improve bone healing (Martinez et al. 2001). To improve the initial implant stability, high removal torques and maximize the quality of the bone-implant interface, a novel titanium porous oxide implant surface or a sandblasted large-grit acid etched implant surface are studied respectively (Wilke et al. 1990; Buser et al. 1998; Henry et al. 2000; Glauser et al. 2001). However, there have been few studies that have compared the survival rate between both implants in soft bone.

In this study, 201 (BRA) and 120 (ITI) implants were placed in soft bone. Among

the 8 early failed implants (BRA), 6 implants were related to the sinus augmentation procedure in the posterior maxilla, and 2 implants were rotated at the time of healing abutment connection because of osseointegration failure. There was only 1 implant failure within 1 year after loading in each group, and no implant failed in both group after 1 year. Therefore, the cumulative survival rate was 95.48% in BRA group, and 99.10% in ITI group, respectively. At the time of implant placement, none or the BAOSFE method were more frequently used in the ITI group, while other procedures were more frequently used in the BRA group. The survival rates in the BRA group (97.5%) and ITI group (87.5%) were significantly different in the case of sinus graft (2-stage), however there was no overall significant difference between the two groups because the number of implant placement in the ITI group (8) was significantly lower than in the BRA group (40). The cumulative survival rate and overall survival rate for each surgical method was similar in the two groups (Mantel-Haenszel=0.138 and Fisher's exact test>0.05, respectively).

High survival and success rates (90.7-100%) for the two systems have been individually reported in many earlier studies (Rocci et al. 2001; Glauser et al. 2002; Stricker et al. 2003; Fugazzotto et al. 2004; Nedir et al. 2004; Nordin et al. 2004; Salvi et al. 2004; Vanden Bogaerde et al. 2004; Bornstein et al. 2005; Ferrigno et al. 2005; Friberg et al. 2005; Glauser et al. 2005; Luongo et al. 2005; Vanden Bogaerde et al. 2005). Regarding the Brånemark Ti-Unite^{TM} implant, Glauser et al demonstrated

a 97.1% success rate after 4 years of prosthetic loading in soft bone (Glauser et al. 2005). In addition, Friberg et al reported a 96.2% survival rate in type 4 bone over a follow-up period of 1 year (Friberg et al. 2005). Likewise, Pinholt reported a 98% overall survival rate of ITI SLA surface implants in the human bone-grafted maxilla, bone quality 4 over a follow-up period of 20-67 months (Pinholt 2003). Stricker et al demonstrated a 99.5% survival rate after 15-40 months of implant placement during maxillary sinus augmentation with autogenous bone grafts (Stricker et al. 2003). Therefore, the survival rate in the BRA group (95.48%) and ITI group (99.10%) in this study is comparable to other studies. In this retrospective article, most cases had been applied a delayed loading after the placement of implant. Further studies will be needed to evaluate the radiographic changes over a long follow-up period in each implant system and to study the survival rate after immediate loading.

V. Conclusion

In conclusion, the survival rates of the oxidized titanium implants and the sandblasted large-grit acid etched implants were similarly high in soft bone. Both implants can be used successfully in soft bone regardless of the surgical methods used at the time of implant placement.

References

Albrektsson, T., P. I. Brånemark, H. A. Hansson and J. Lindstrom Titanium implants. Requirements for ensuring a long-lasting direct bone anchorage in man. *Acta Orthop Scand* 52: 155-170, 1981.

Åstrand, P., B. Engquist, B. Anzén, T. Bergendal, M. Hallman, U. Karlsson, S. Kvint, L. Lysell and T. Rundcranz A three-year follow-up report of a comparative study of ITI dental implants® and Brånemark System® implants in the treatment of the partially edentulous maxilla. *Clin Implant Dent Relat Res* 6: 130-141, 2004.

Bornstein, M. M., B. Schmid, U. C. Belser, A. Lussi and D. Buser Early loading of nonsubnerged titanium implants with a sandblasted and acid-etched (SLA) surface: 5-year results of a prospective study in partially edentulous patients. *Clin Oral Implants Res* 16: 631-638, 2005.

Boyne, P. J. and R. A. James Grafting of the maxillary sinus floor with autogenous marrow and bone. *J Oral Surg* 38: 613-616, 1980.

Buser, D., H. P. Weber and N. P. Lang Tissue integration of non-submerged implants:

1-year results of a prospective study with 100 ITI hollow-cylinder and hollow-screw implants. *Clin Oral Implants Res* 1: 33-40, 1990.

Buser, D., K. Dula, N. P. Lang and S. Nyman Long-term stability of osseointegrated implants in bone regenerated with the membrane technique. Five-year results of a prostective study with 12 implants. *Clin Oral Implants Res* 7: 175-183, 1996.

Buser, D., T. Nydegger, H. P. Hirt, D. L. Cochran and L. P. Nolte Removal torque values of titanium implants in the maxilla of miniature pigs. *Int J Oral Maxillofac Implants* 13: 611-619, 1998.

Cutler, S. J. and F. Ederer Maximum utilization of the life table method in analyzing survival. *J Chronic Dis* 6: 699-712, 1958.

Engquist, B., T. Bergendal, T. Kallus and U. Linden A retrospective multicenter evaluation of osseointegrated implants supporting overdentures. *Int J Oral Maxillofac Implants* 3: 129-134, 1988.

Ferrigno, N. and M. Laureti Surgical advantages with ITI TE® implants placement in conjunction with split crest technique: 18-month results of an ongoing prospective

study. *Clin Oral Implants Res* 16: 147-155, 2005.

Friberg, B., T. Jemt and U. Lekholm Early failures in 4,641 consecutively placed Brånemark dental implants: a study from stage I surgery to the connection of completed prostheses. *Int J Oral Maxillofac Implants* 3: 129-134, 1988.

Friberg, B., C. Dahlin, G. Widmark, P. O. Östman and C. Billström One-year results of a prospective multicenter study on Brånemark System® implants with a TiUnite™ surface. *Clin Implant Dent Relat Res* 7: s70-75, 2005.

Fugazzotto, P. A., J. Vlassis and B. Butler. ITI implant use in private practice: Clinical results with 5,526 implants followed up to 72+ months in function. *Int J Oral Maxillofac Implants* 19: 408-412, 2004.

Fugazzotto, P. A. Success and failure rates of osseointegrated implants in function in regenerated bone for 72 to 133 months. *Int J Oral Maxillofac Implants* 20: 77-83, 2005.

Glauser, R., M. Portmann, P. Ruhstaller, A. K. Lundgren, C. H. F. Hämmerle and J. Gottlow Stability measurements of immediately loaded machined and oxidized

implants in the posterior maxilla. A comparative clinical study using resonance frequency analysis. *Appl Osseointegration Res* 2(1): 27-29, 2001.

Glauser, R., J. Gottlow, A. K. Lundgren, L. Sennerby, M. Portmann, P. Ruhstaller and C. H. F. Hämmerle Immediate occlusal loading of Brånemark MkⅣ TiUnite™ implants placed in bone quality type 4. *Appl Osseointegration Res* 3(1): 22-24, 2002.

Glauser, R., P. Ruhstaller, S. Windisch, A. Zembic, A. K. Lundgren, J. Gottlow and C. H. F. Hämmerle Immediate occlusal loading of Brånemark TiUnite™ implants placed predominantly in soft bone: 4-year results of a prospective clinical study. *Clin Implant Dent Relat Res* 7: s52-s59, 2005.

Henry, P., A. Tan, B. Allan, J. Hall and C. Johansson Removal torque comparison of TiUnite and turned implants in the Greyhound dog mandible. *Appl Osseointegration Res* 1: 15-17, 2000.

Jaffin, R. and C. Berman The excessive loss of Brånemark fixtures in type Ⅳ bone: a 5-year analysis. *J Periodontol* 62: 2-4, 1991.

Lekholm, U. and G. A. Zarb Patient selection and preparations. In: Brånemark, P. I., G. A. Zarb and T. Albretksson, eds. Tissue-integrated prostheses: Osseointegration in Clinical Dentistry. Chicago, *Quintessence Publishing* 199-220, 1985.

Luongo, G., R. Raimondo, P. Filippini, F. Gualini and C. Paoleschi Early loading of sandblasted, acid-etched implants in the posterior maxilla and mandible: A 1-year follow-up report from a multicenter 3-year prospective study. *Int J Oral Maxillofac Implants* 20(1): 84-91, 2005.

Martinez, H., M. Davarpanah, P. Missika, R. Celletti and R. Lazzara Optimal implant stabilization in low density bone. *Clin Oral Implants Res* 12: 423-432, 2001.

Nedir, R., M. Bischof, J. M. Briaux, S. Beyer, S. Szmukler-Moncler and J. P. Bernard A 7-year life table analysis from a prospective study on ITI implants with special emphasis on the use of short implants: Results from a private practice. *Clin Oral Implants Res* 15: 150-157, 2004.

Nordin, T., R. Nilsson, A. Frykholm and M. Hallman A 3-arm study of early loading of rough-surfaced implants in the completely edentulous maxilla and in the edentulous posterior maxilla and mandible: results after 1 year of loading. *Int J Oral*

Maxillofac Implants 19: 880-886, 2004.

Pinholt, E. M. Brånemark and ITI dental implants in the human bone grafted maxilla: a comparative evaluation. *Clin Oral Implants Res* 14: 584-592, 2003.

Rocci, A., M. Martignoni, J. Gottlow and B. Rangert Immediate function of single and partial reconstructions in the maxilla using MkⅣ fixtures: A retrospective analysis. *Appl Osseointegration Res* 2(1): 22-26, 2001.

Salvi, G. E., G. Gallini and N. P. Lang Early loading (2 or 6 weeks) of sandblasted and acid-etched (SLA) ITI® implants in the posterior mandible: A 1-year randomized controlled clinical trial. *Clin Oral Implants Res* 15:142-149, 2004.

Stricker, A., P. J. Voss, R. Gutwald, A. Schramm and R. Schmelzeisen Maxillary sinus floor augmentation with autogenous bone grafts to enable placement of SLA-surfaced implants: preliminary results after 15-40 months. *Clin Oral Implants Res* 14: 207-212, 2003.

Summers, R. B. The osteotome technique: Part Ⅲ: Less invasive methods of elevating the sinus floor. *Compendium* 15: 698,700,702-704, 1994.

Summers, R. B. A new concept in maxillary implant surgery: The osteotome technique. *Compendium* 15: 152, 154-156, 158, 1994.

Tatum, O. H. Maxillary and sinus implant reconstruction. *Dent Clin North Am* 30: 207-229, 1986.

Vanden Bogaerde, L., G. Pedretti, P. Dellacasa, M. Mozzati, B. Rangert and I. Wendelhag Early function of splinted implants in maxillas and posterior mandibles, using Brånemark System® TiUnite™ implants: An 18-month prospective clinical multicenter study. *Clin Implant Dent Relat Res* 6(3): 121-129, 2004.

Vanden Bogaerde, L., B. Rangert and I. Wendelhag Immediate/early function of Brånemark System® TiUnite™ implants in fresh extraction sockets in maxillae and posterior mandibles: An 18-month prospective clinical study. *Clin Implant Dent Relat Res* 7: s121-s130, 2005.

Wilke, H. J., L. Claes and S. Stenemann Clinical implant material. In: Heimke, G., U. Soltesz and Lee A. J. C., eds. Advances in biomaterials. Vol. 9. Amsterdam: *Elsevier Science Publ* 390, 1990.

Figure legends

Figure 1. Cumulative survival rates in relation to the implant type (BRA: Brånemark Ti-Unite™ implants, ITI: ITI SLA implants)

Figure 2. Implant survival rate according to the additional surgical procedures and implant type (BRA: Brånemark Ti-Unite™ implants, ITI: ITI SLA implants)

Figures

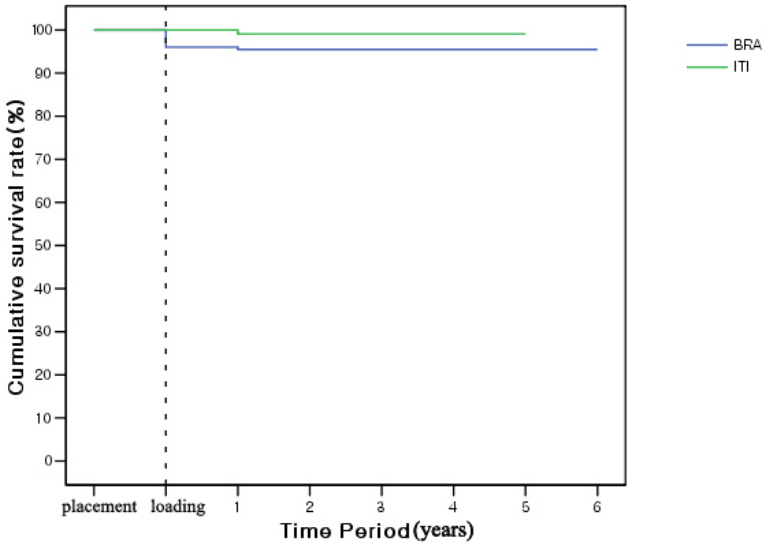

Figure 1

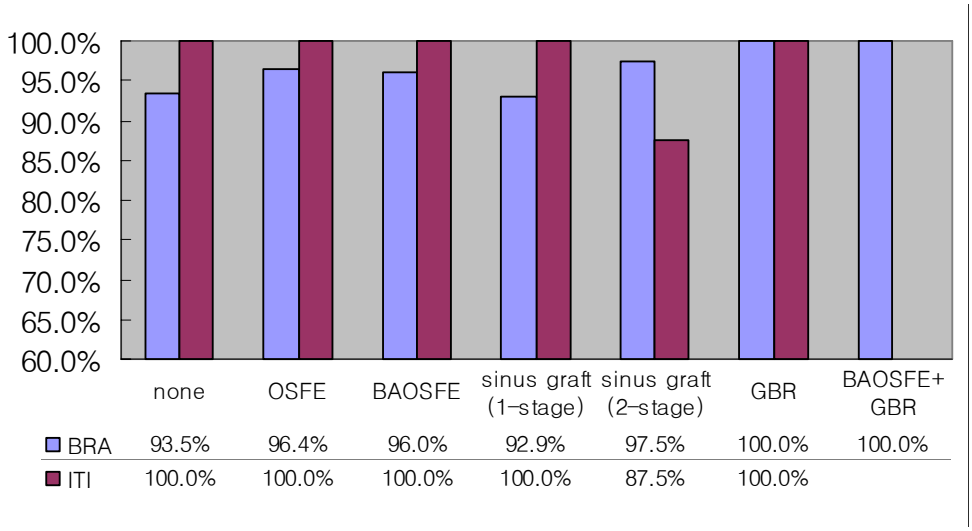

Figure 2

국문 요약

불량한 골질에서 산화티타늄 표면처리 임플란트와 샌드블라스트 후 산 부식 처리 표면 임플란트의 임상적 생존률 비교

<지도 교수 조규성>

연세대학교 대학원 치의학과

이 준 영

상실된 치아를 대체하기 위한 치료법으로 임플란트가 널리 쓰이고 있으나, 불량한 골질에서는 임플란트 초기 고정을 얻기가 힘들고 낮은 성공률을 보이고 있다. 성공률을 높이기 위해 다양한 종류의 표면처리 방법이 사용되고 있지만, 본 연구에서는 불량한 골질에서 산화티타늄 표면처리 임플란트 (Brånemark Ti-Unite™)와 샌드블라스트 후 산부식 처리 표면 임플란트 (ITI SLA)의 생존률 비교를 하였다.

산화 티타늄 임플란트는 1999 년 5 월에서 2004 년 5 월까지 84 명 환자에 201 개 식립되고, 샌드블라스트 후 산 부식 처리 표면 임플란트는

2000 12 월부터 2004 년 5 월까지 74 명 환자에 120 개가 식립되었다. 두 군 모두 상악 구치부에 많이 식립되었다. Lekholm 과 Zarb index 에 따른 분류에 의해 임상적으로 판단한 결과, 4 형 골질과 C 형 골량에 많이 식립되었다. 환자 자료를 바탕으로 나이, 성별, 전신질환, 임플란트 형태, 수, 길이, 직경, 악궁내 위치, 골질과 골량, 실패한 임플란트 수, 실패 원인, 부가적인 골 수술 여부를 알아보았다.

산화 티타늄 임플란트는 조기 실패 8 개, 지연 실패 1 개가 있고, 누적 생존률은 95.48%이다. 샌드블라스트 후 산부식 처리 표면 임플란트는 지연실패 1 개가 있고, 누적 생존률은 99.10%이다. 두군 사이의 유의한 차이는 없었다(Mantel-Haenszel=0.138). 또한, 두군 임플란트 식립 도중 시행한 부가적인 수술기법에 따라 생존률을 비교한 결과 두군 모두 유의한 차이는 없었다 ($p>0.05$). 산화 티타늄 임플란트와 샌드블라스트 후 산부식 처리 표면 임플란트는 식립 방법에 상관없이 불량한 골질에서 성공적으로 사용할 수 있을 것이다.

핵심되는 말 : 산화 티타늄 임플란트, 생존률, 샌드블라스트 후 산부식 처리 표면 임플란트