Complication rates for various retention types in anterior implant-supported prostheses : A retrospective clinical study

Byoung-Heon Kim

Department of Dentistry

The Graduate School, Yonsei University

Complication rates for various retention types in anterior implant-supported prostheses : A retrospective clinical study

Directed by Professor Seong-Ho Choi

The Doctoral Dissertation
submitted to the Department of Dentistry
and the Graduate School of Yonsei University
in partial fulfillment of the requirements for the degree of
Ph.D. in Dental Science

Byoung-Heon Kim

June 2021

This certifies that the Doctoral Dissertation
of Byoung-Heon Kim is approved.

_____
Thesis Supervisor: Seong-Ho Choi

_____
Ui-Won Jung

_____
Jung-Seok Lee

_____
Jae-Kook Cha

_____
Young-Taek Kim

The Graduate School
Yonsei University
June 2021

Table of Contents

List of Figures

List of Tables

Abstract

Complication rates for various retention types in anterior implant-supported prostheses : A retrospective clinical study

Byoung-Heon Kim, D.D.S

Department of Dentistry
The Graduate School, Yonsei University

(Directed by Professor Seong-Ho Choi, D.D.S., M.S.D., PhD.)

Background. Implant-supported prostheses have typically been retained by cement or screws, each of which has advantages and disadvantages. Two new types of prosthesis with complementary advantages and disadvantages have been proposed: the screw- and cement-retained prosthesis (SCRP), which combines cement and screw retention, and the anti-loosening inner-post screw (ALIPS) type, which uses lingual screws. Both esthetic and functional factors should be considered for anterior prostheses; however, clinical studies of the complication rates of these designs are lacking.

Purpose. The purpose of this retrospective clinical study was to evaluate the complications of dental implant-supported restorations with various prosthetic types in the anterior region and to analyze other factors that affect complications.

Material and methods. This study included 51 patients who had 83 implants placed in the anterior region by a single clinician between August 2009 and December 2016. Patient's information was investigated, surgical and prosthetic features were recorded, and implant complications were analyzed.

Results. There were 46 (55.4%) cement-retained implants, 5 (6.0%) SCRP-retained implants, and 32 (38.6%) ALIPS-retained implants. The biological and mechanical complications did not differ significantly with the retention type. However, the types of mechanical complications were different for each retention types. The most common mechanical complication was loss of retention in the cement type (14 of 46, 30.4%) and screw loosening in the ALIPS type (14 of 32, 43.8%).

Implant complications varied with position (maxilla or mandible) and implantation timing (period from tooth extraction to implant placement). The mechanical complication rate was higher in implants placed in the anterior maxilla. And the biological complication rate was higher for immediate and early implantation timing.

Conclusions. The complications of implants placed in the anterior region did not differ significantly with the type of the retention. Therefore, the ALIPS type, which is a newly proposed type, is also a sufficiently considered option for anterior implant prosthesis.

Key words: Implant-supported prostheses, Retrospective clinical study

Complication rates for various retention types in anterior implant-supported prostheses : A retrospective clinical study

Byoung-Heon Kim, D.D.S

Department of Dentistry
The Graduate School, Yonsei University

(Directed by Professor Seong-Ho Choi, D.D.S., M.S.D., PhD.)

I. Introduction

Studies have evaluated the effects of the surface, length, and design of the implant on osseointegration.[1-3] Recently, focus has been placed on the long-term success of implants, and more attention is being paid to factors related to the implant-supported prosthesis.[4] Esthetic aspects are as important as functional aspects in the anterior region,[5-7] and one of

these factors is the retention type in the prostheses, which can be divided into cement and screw retention.

While studies have compared the 2 types of prosthesis retention, which is better remains unclear.[8-10] The screw type can be easily removed and reattached when maintenance is required, but locating the screw hole in a nonesthetic region can be challenging. Although the absence of a screw hole in the cement type (Fig. 1A) may improve esthetics in the anterior region, the retention can be insufficient when the crown height space (CHS; defined as the distance from the cusp tip to the implant platform) is small. In addition, residual cement may induce inflammation around an implant.[11,12]

New methods have been proposed, including the screw- and cement-retained prosthesis (SCRP) (Fig. 1B), which combines cement and screw retention,[13-16] and the anti-loosening inner-post screw (ALIPS) type (Fig. 1C), which has a screw hole on the lingual side.[17,18] The SCRP attaches the lower part of the crown to the abutment with cement, while the upper screw hole can be opened to remove the entire prosthesis.[19] This system has a wide range of applications, and easy detachment of the prosthesis through the upper screw hole allows the complete removal of residual cement.

The ALIPS type is a more advanced form of using a lingual screw as proposed by Clausen.[20] Conventional lingual screw systems have a thread in the abutment, which makes it difficult to connect the lingual screw through the prosthesis. However, the lateral screw system of ALIPS has a thread in the crown. As the lateral screw passes through the abutment and contacts the internal main screw that connects the implant to abutment, the

prosthesis is maintained by the pushing force of the lateral screw.[17] This method has the same advantages of passive fit, easy removal, and esthetic and functional occlusal surfaces as conventional lingual screws, and its manufacturing process is more straightforward.

The present retrospective clinical study evaluated the prevalence of biological and mechanical complications according to the retention type in anterior implants. The retention type was divided into 3 groups: cement type, SCRP type, and ALIPS type. Cement type is most often used in the anterior region for esthetic reasons and to solve problems with improperly inclined implants.[21,22] However, the SCRP and ALIPS types are better than the cement type for implant maintenance because the cement type has poor retrievability and the problem of residual cement.

Implant-supported crowns often need to be removed to access the surgical site directly or to clean the prosthesis itself when treating peri-implant mucositis or peri-implantitis.[23] As separating the crown–abutment complex in the SCRP type of implant is not difficult, any excess cement can be easily removed.[15] The ALIPS type exhibits good retrievability, being easily removed by releasing the lateral screw on the lingual side. Detaching the prosthesis is simpler than for the conventional screw or SCRP type, which require removal of the material sealing the screw-access hole. In addition, the crown and abutment should be detached together in the SCRP type, and reattachment of the abutment can stimulate the surrounding soft tissue. In contrast, only the crown can be separated in the ALIPS type.[18,24] These various advantages and disadvantages of the

different retention types prompted an investigation of the prevalence of complications with the aim of identifying the most appropriate type of retention

Implants can be associated with biological complications such as peri-implantitis and peri-implant mucositis or mechanical complications such as loss of retention, porcelain fracture, and screw loosening.[25,26] These complications can vary according to the type of prosthesis.[18] Factors that can affect implant complications include patient characteristics, implant characteristics, and the design of the prosthesis.

The purpose of this retrospective clinical study was to evaluate the complications of implants placed in the anterior region according to their retention type and to determine what other factors affected complications. The null hypothesis was that the complications would be similar regardless of the retention type.

II. Materials and Methods

1. Subjects

This study was a retrospective clinical analysis of anterior implants performed by a single clinician (K.Y.-T.) between August 2009 and December 2016 at the Department of Periodontology and Prosthodontics, NHIS Ilsan Hospital. Data were collected through clinical charts and panoramic radiographs. The study analyzed 83 implants in 51 patients, comprising 28 men and 23 women with a mean age of 50.3 years (age range from 23 to 80 years). This study was approved by the Institutional Review Board of NHIS Ilsan Hospital (IRB No. 2017-07-028).

Inclusion criteria

Aged 20 to 80 years

Good systemic health

Placement of implants in the anterior region

Follow-up at least 1 year after the definitive delivery of the implant-supported prosthesis

Exclusion criteria

Severe systemic disease

Advanced or untreated periodontal disease

Implant failure before prosthesis

Implant used for overdenture

2. Retrospective date collection

Patient and implant related factors

Patient-related variables of sex, age, presence of hypertension (HTN), and presence of diabetes mellitus (DM) were recorded for each patient. Implant-related variables, including implant position (maxilla or mandible), type of prosthesis (single or splinted), surgical strategy (submerged or not submerged), implant diameter, implant length, and type of retention (cement, SCRP, or ALIPS), were also examined. Implantation timing (period from tooth extraction to implant placement, immediate and early timing or conventional timing) and prosthetic timing (period from implant placement to prosthesis delivery) were calculated. After completing the prosthesis delivery, the abutment height (length between the implant platform and the crown margin) and the Crown height space (CHS), Ratio of the length of the crown to the length of the implant (C/I) were also examined.

Complications

Biological complications such as peri-implant mucositis and peri-implantitis were recorded, as were mechanical complications such as loss of retention, ceramic chipping or fracture, screw loosening, screw fracture, and abutment fracture. The marginal bone loss

around the implant was measured from the implant platform to the point of implant–bone contact in digital panorama radiographs by using imaging software and its measurement tool (Centricity Enterprise Web 3.0; GE Healthcare). Implants with clinically inflammation were recorded as peri-implant mucositis, and those with marginal bone loss of 1mm or more were recorded as peri-implantitis.

3. Statistical analysis

Statistical analysis was performed using statistical software (IBM SPSS Statistics, v24; IBM Corp). The proportions of complication types were compared according to the type of prosthesis and the type of retention by using the chi-square test (α=.05). The patient- and implant-related variables were compared between 2 groups with and without biological and mechanical complications by using cross-tabulation, the chi-square test, and the *t* test (α=.05). In addition, logistic regression analysis was performed to assess the impact of various factors, including the retention type, on biological and mechanical complications. The retention type was divided into 2 groups: cement group and SCRP and ALIPS group in this analysis.

III. Results

Fifty-one patients were treated with 83 implants with various surgical techniques and prosthetic types. The surgical and prosthetic factors of the analyzed implants are summarized in Table 1.

The prevalence of biological and mechanical complications by the prosthetic retention type is presented in Tables 2 and 3. Biological complications occurred in 16 implants (19.3%), comprising peri-implant mucositis in 14 (16.9%) and peri-implantitis in 2 (2.4%), and mechanical complications occurred in 36 implants (43.4%). Cross-tabulation was performed to compare the prevalence of biological and mechanical complications according to the prosthetic retention type without identifying a statistically significant difference ($P>.05$).

The mechanical complications of implant-supported restorations comprised 17 (20.5%) with screw loosening, 15 (18.1%) with loss of retention, and 3 (4.8%) with porcelain fracture (Table 3). The most common type of mechanical complication was loss of retention in the cement type of prosthesis (30.4%) and screw loosening in the ALIPS type (43.8%). The type of mechanical complication differed significantly with the prosthetic retention type ($P<.05$).

Other factors that affected biological and mechanical complications were investigated. There were no statistically significant differences in patient-related factors in Table 4

(P>.05). For implant-related factors in Table 5, the biological complication rate was higher for immediate and early implantation timing than for conventional timing (P=.009). The mechanical complication rate varied only with the position of implant placement, being higher in implants placed in the anterior maxilla (P=.023).

The results of logistic regression analysis of biological and mechanical complications are similar to the results presented in Table 5 and are presented in Tables 6 and 7. The implantation timing significantly affected biological complications (P=.020), and the implant position significantly affected mechanical complications (P=.017).

IV. Discussion

The present retrospective study demonstrated the complications of implants placed in the anterior region, and there were no differences in the prevalence of complications according to their retention type; cement type, SCRP type, and ALIPS type. However, some differences were found in the type of complications. Thus, the null hypothesis was partially rejected.

This study found that the prevalence of biological complications was 19.3% across all implants, comprising 16.9% with peri-implant mucositis and 2.4% with peri-implantitis. This ratio was lower than that reported in a systematic review of peri-implant diseases (30.7% with peri-implant mucositis and 9.6% with peri-implantitis),[25] with the difference probably because the present study evaluated only anterior implants. Oral hygiene is generally easier to maintain around anterior implants than around posterior implants, resulting in reduced dental plaque and hence a lower probability of peri-implant inflammation.[27] Moreover, the abutment height is usually longer in anterior implants than in posterior implants, which results in less marginal bone loss.[28]

The prevalence of biological complications did not differ significantly with the retention type in this study, being 13.0% in the cement type, 20.0% in the SCRP type, and 28.2% in the ALIPS type (P=.328). This contrasts with previous studies reporting a higher rate of biological complications for the cement type.[29] This difference may be because

residual cement is easier to remove from anterior implants, although Vindasiute et al[22] reported that the amount of residual cement did not differ with the position of anterior and posterior teeth. However, those authors also stated that further studies are needed since they investigated only 4 anterior implants, compared with 39 posterior implants.

The prevalence of mechanical complications was 43.4% across all implants, which was higher than that reported in a previous study (28.9%).[26] However, most of the complications were minor and straightforward to repair, such as screw loosening, loss of retention, and porcelain chipping. Mechanical complications were more prevalent in the maxilla than in the mandible ($P<.05$). Maxillary anterior implants tend to be tilted more labially than those in the mandible, and the direction of the maximum incisal occlusal force is about 12 degrees toward the frontal plane, resulting in the forces not being perpendicular to the implant axis.[30] These forces may induce stresses in the implant, abutment, and crown that are likely to increase the prevalence of mechanical complications.

The mechanical complication rate was 43.5% for the cement type of retention, 50.0% for the ALIPS type, and 0% for the SCRP type. In the cement type, the crown and abutment are bonded with cement, so the bonding cement can be affected by continuous occlusal force. However, in the ALIPS type, the lateral screw retains the crown, so the lateral screw loosens under adverse force, which is relatively straightforward to evaluate.

Mechanical complications occurred in 16 of the ALIPS type prosthesis, most of which were screw loosening (N=14, 87.5%). When lateral screw loosening occurs, the screw can

be easily retightened and the implant-supported prosthesis can be reevaluated and readjusted. This intervention can prevent more complex complications such as screw and abutment fractures. Unlike biological complications, mechanical complications usually occur within 2 years of functional loading,[31] and so the clinician should be able to detect and correct any problem by performing regular inspections at least during this period.

Factors affecting implants complications can be divided into 2 groups: patient-related and implant-related. There were no significant effects of the patient-related factors of sex, age, HTN, and DM. In terms of implant-related factors, implantation timing regardless of prosthetic retention type significantly affected the biological complications ($P<.05$).

Implantation timing is the period from tooth extraction to implant placement, and this was divided into 2 groups: 0 to 2 months (immediate and early) and >2 months (conventional). The prevalence of complications was 5.7 times higher in the immediate and early group than in the conventional group ($P<.05$), which suggests that immediate and early implantation after extraction is more likely to affect biological complications.

The labial bone of the anterior region is thin and concave in most patients, and extraction of anterior teeth can cause bone defects. In teeth with periodontitis, the defect is larger and more severe. In these patients, GBR is often needed because bone remodeling is unpredictable. However, GBR can have a negative effect on the long-term success rate of dental implants. Also, many of the immediate and early implantations were accompanied by GBR, which is likely to have adverse effects on biological complications.[32]

The retrospective design of this study resulted in some inherent limitations. Oral hygiene, smoking, the strength of occlusal forces, and oral habits such as clenching or bruxism could be confounding factors, and participants with these conditions were excluded in the present study. Also, since this study investigated patients over a long period (from 2009 to 2016), the outcomes could have been affected by the large variation in the follow-up duration. In particular, further analysis is needed for the difference in average follow-up period for each group (Cement 41 months, SCRP 26 months, ALIPS 35 months).

V. Conclusion

Based on the findings of this retrospective clinical study, the following conclusions were drawn:

1. Complication rates of implant-supported prostheses did not vary significantly with the retention type.
2. However, there were differences in the types of complications according to the retention type.
3. Immediate and early timing implants and maxillary implants placed in the anterior region had higher implant complication rates.

Therefore, the ALIPS type, which is a newly proposed type, is a good option to consider when manufacturing anterior implant-supported prostheses like the cement and SCRP types that were used previously.

References

1. Kotsovilis S, Fourmousis I, Karoussis IK, Bamia C. A systematic review and meta-analysis on the effect of implant length on the survival of rough-surface dental implants. J Periodontol 2009;80:1700-18.

2. Heba A, Giorgio P, Alberto R, Hom-Lay W. The effect of thread pattern upon implant osseointegration. Clin Oral Implants Res 2010;21:129-36.

3. Ehrenfest DMD, Coelho PG, Kang B-S, Sul Y-T, Albrektsson T. Classification of osseointegrated implant surfaces: materials, chemistry and topography. Trends Biotechnol 2010;28:198-206.

4. Weber HP, Sukotjo C. Does the type of implant prosthesis affect outcomes in the partially edentulous patient? Int J Oral Maxillofac Implants 2007;22 Suppl:140-72.

5. Hebel KS, Gajjar RC. Cement-retained versus screw-retained implant restorations: Achieving optimal occlusion and esthetics in implant dentistry. J Prosthet Dent 1997;77:28-35.

6. Ronald EJ, Anja Z, E. PB, Marcel Z, Daniel ST. Systematic review of the survival rate and the incidence of biological, technical, and aesthetic complications of single crowns on implants reported in longitudinal studies with a mean follow-up of 5 years. Clin Oral Implants Res 2012;23:2-21.

7. Higginbottom F, Belser U, Jones JD, Keith SE. Prosthetic management of implants in the esthetic zone. Int J Oral Maxillofac Implants 2004;19 Suppl:62-72.

8. Wittneben JG, Millen C, Bragger U. Clinical performance of screw- versus cement-retained fixed implant-supported reconstructions--a systematic review. Int J Oral Maxillofac Implants 2014;29 Suppl:84-98.

9. Irena S, Sven M, Marcel Z, F. HCH, David S. Cemented and screw-retained implant reconstructions: a systematic review of the survival and complication rates. Clin Oral Implants Res 2012;23:163-201.

10. Lemos CAA, de Souza Batista VE, Almeida DAdF, Santiago Júnior JF, Verri FR, Pellizzer EP. Evaluation of cement-retained versus screw-retained implant-supported restorations for marginal bone loss. J Prosthet Dent 2016;115:419-27.

11. Pauletto N, Lahiffe BJ, Walton JN. Complications associated with excess cement around crowns on osseointegrated implants: a clinical report. Int J Oral Maxillofac Implants 1999;14:865-8

12. Wilson Jr, Thomas G. The positive relationship between excess cement and peri-implant disease: a prospective clinical endoscopic study. J Periodontol 2009;80:1388-92

13. Valbao FPB, Perez EG, Breda M. Alternative method for retention and removal of cement-retained implant prostheses. J Prosthet Dent 2001;86:181-3.

14. Rajan M, Gunaseelan R. Fabrication of a cement- and screw-retained implant prosthesis. J Prosthet Dent 2004;92:578-80.

15. Heo YK, Lim YJ. A newly designed screw- and cement-retained prosthesis and its abutments. Int J Prosthodont 2015;28:612-4.

16. Aparicio C. A new method for achieving passive fit of an interim restoration supported by Branemark implants: a technical note. Int J Oral Maxillofac Implants 1995;10:614-8.

17. Hong T-Y, Kim M-Y, Yoon J-H. Clinical cases of implant-supported fixed dental prosthesis using modified lingual screw system (T-screw system). J Korean Acad Prosthodont 2016;54:423-30.

18. Lee J-H, Lee J-B, Kim M-Y, Yoon J-H, Choi S-H, Kim Y-T. Mechanical and biological complication rates of the modified lateral-screw-retained implant prosthesis in the posterior region: an alternative to the conventional Implant prosthetic system. J Adv Prosthodont 2016;8:150-7.

19. Al-Omari WM, Shadid R, Abu-Naba'a L, El Masoud B. Porcelain fracture resistance of screw-retained, cement-retained, and screw-cement-retained implant-supported metal ceramic posterior crowns. J Prosthodont 2010;19:263-73.

20. Clausen GF. The lingual locking screw for implant-retained restorations--aesthetics and retrievability. Aust Prosthodont J 1995;9:17-20.

21. Wittneben JG, Joda T, Weber HP, Brägger U. Screw retained vs. cement retained implant-supported fixed dental prosthesis. Periodontol 2000 2017;73:141-51.

22. Vindasiute E, Puisys A, Maslova N, Linkeviciene L, Peciuliene V, Linkevicius T. Clinical factors influencing removal of the cement excess in implant-supported restorations. Clin Implant Dent Relat Res 2015;17:771-8.

23. Serino G, Turri A, Lang NP. Maintenance therapy in patients following the surgical treatment of peri-implantitis: A 5-year follow-up study. Clin Oral Implants Res 2015;26:950-6.

24. Abrahamsson I, Berglundh T, Lindhe J. The mucosal barrier following abutment dis/reconnection: an experimental study in dogs. J Clin Periodontol 1997;24:568-72.

25. Atieh MA, Alsabeeha NH, Faggion Jr CM, Duncan WJ. The frequency of peri-implant diseases: a systematic review and meta-analysis. J Periodontol 2013;84:1586-98.

26. Pjetursson BE, Thoma D, Jung R, Zwahlen M, Zembic A. A systematic review of the survival and complication rates of implant-supported fixed dental prostheses (FDP s) after a mean observation period of at least 5 years. Clin Oral Implants Res 2012;23:22-38.

27. Prasad KV, Sreenivasan PK, Patil S, Chhabra KG, Javali SB, DeVizio W. Removal of dental plaque from different regions of the mouth after a 1-minute episode of mechanical oral hygiene. Am J Dent 2011;24:60-4.

28. Lee BA, Kim BH, Kweon HH, Kim YT. The prosthetic abutment height can affect marginal bone loss around dental implants. Clin Implant Dent Relat Res 2018;20:799-805.

29. Wadhwani C, Rapoport D, La Rosa S, Hess T, Kretschmar S. Radiographic detection and characteristic patterns of residual excess cement associated with cement-retained implant restorations: a clinical report. J Prosthet Dent 2012;107:151-7.

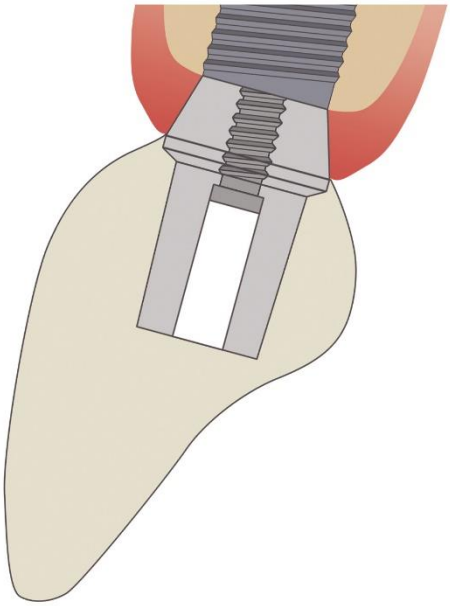
30. Hsu M-L, Chen F-C, Kao H-C, Cheng C-K. Influence of off-axis loading of an anterior maxillary implant: a 3-dimensional finite element analysis. Int J Oral Maxillofac Implants 2007;22:301-9.

31. Simonis P, Dufour T, Tenenbaum H. Long-term implant survival and success: a 10–16-year follow-up of non-submerged dental implants. Clin Oral Implants Res 2010;21:772-7.

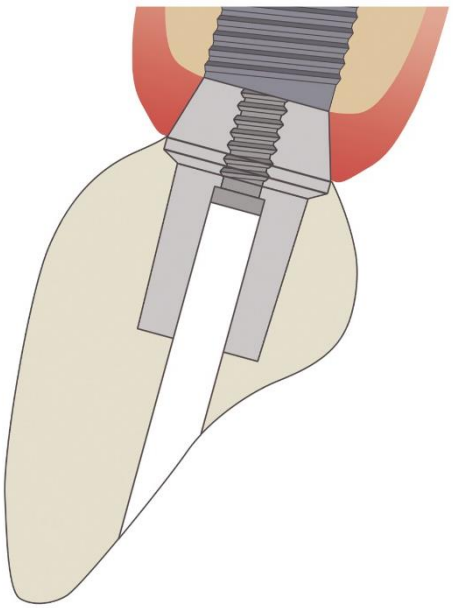
32. Tonetti MS, Cortellini P, Graziani F, Cairo F, Lang NP, Abundo R et al. Immediate versus delayed implant placement after anterior single tooth extraction: the timing randomized controlled clinical trial. J Clin Periodontol 2017;44:215-24.

Figures

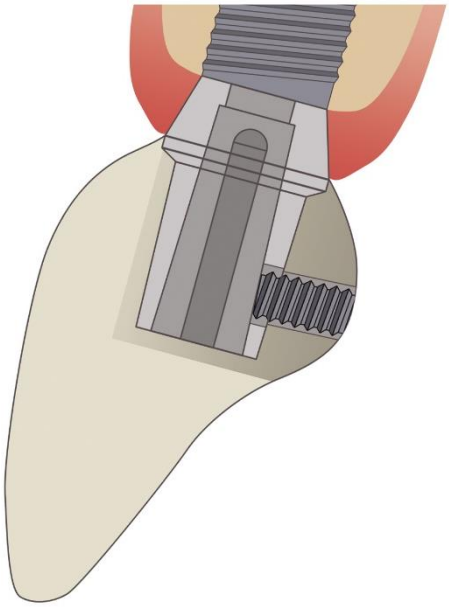
Figure 1. Implant-supported prostheses evaluated. A, Cement type. B, SCRP type. C, ALIPS type. ALIPS, Anti-loosening inner-post screw; SCRP, Screw- and cement-retained prosthesis.



A



B



C

Tables

Table 1. Surgical and prosthetic factors of analyzed implants (*N*=83)

Variable			Prevalence
Surgical factor (*N*=83)	Position	Maxilla	61 (73.5)
		Mandible	22 (26.5)
	Surgical strategy	Submerged	26 (31.3)
		Not submerged	57 (68.7)
Prosthetic factor (*N*=83)	Prosthetic type	Single	28 (33.7)
		Splinted	55 (66.3)
	Retention type	Cement	46 (55.4)
		SCRP	5 (6.0)
		ALIPS	32 (38.6)

Values presented as *N* (%).

ALIPS, Anti-loosening inner-post screw; SCRP, Screw- and cement-retained prosthesis.

Table 2. Biological complications according to retention type

Retention type	No complication	Peri-implant mucositis	Peri-implantitis
Cement (*N*=46)	40 (87.0)	6 (13.0)	0 (0)
SCRP (*N*=5)	4 (80.0)	1 (20.0)	0 (0)
ALIPS (*N*=32)	23 (71.9)	7 (21.9)	2 (6.3)
Total (*N*=83)	67 (80.7)	14 (16.9)	2 (2.4)

Values are presented as *N* (%).

ALIPS, Anti-loosening inner-post screw; SCRP, Screw- and cement-retained prosthesis.

Table 3. Mechanical complications according to retention type

Retention type	No complication	Loss of retention	Porcelain fracture	Screw loosening
Cement (*N*=46)	26 (56.5)	14 (30.4)	3 (6.5)	3 (6.5)
SCRP (*N*=5)	5 (100.0)	0 (0.0)	0 (0)	0 (0)
ALIPS (*N*=32)	16 (50.0)	1 (3.1)	1 (3.1)	14 (43.8)
Total (*N*=83)	47 (56.6)	15 (18.1)	4 (4.8)	17 (20.5)

Values presented as *N* (%).

ALIPS, Anti-loosening inner-post screw; SCRP, Screw- and cement-retained prosthesis.

Table 4. Biological and mechanical complication rates according to patient-related variables (*N*=51)

Characteristic		Biological complication (*N*=10)	Biological success (*N*=41)	*P*	Mechanical complication (*N*=23)	Mechanical success (*N*=28)	*P*
Sex	Male (*N*=28)	5	23	.728	12	16	.723
	Female (*N*=23)	5	18		11	12	
Age (yr)		46.0 ±12.9	51.8 ±13.4	.224	50.3 ±0.3	49.5 ±15.8	.508
HTN	Yes (*N*=12)	3	9	.591	7	5	.292
	No (*N*=39)	7	32		16	23	
DM	Yes (*N*=4)	1	3	.777	1	3	.400
	No (*N*=47)	9	38		22	25	

DM, Diabetes mellitus; HTN, Hypertension

Values presented as *N* or mean ±standard deviation.

Table 5. Biological and mechanical complication rates according to implant-related variables (*N*=83)

Characteristic		Biological complication (*N*=16)	Biological success (*N*=67)	*P*	Mechanical complication (*N*=36)	Mechanical success (*N*=47)	*P*
Position	Maxilla (*N*=61)	11	50	.632	31	30	.023*
	Mandible (*N*=22)	5	17		5	17	
Surgical strategy	Submerged (*N*=26)	3	23	.227	10	16	.542
	Not submerged (*N*=57)	13	44		26	31	
Prosthetic type	Single (*N*=28)	6	22	.723	12	16	.946
	Splinted (*N*=55)	10	45		24	31	
Diameter (mm)		3.8 ±0.3	3.9 ±0.3	.681	3.9 ±0.2	3.9 ±0.4	.971
Length (mm)		11.1 ±1.4	10.6 ±0.8	.058	10.6 ±1.0	10.7 ±1.0	.572
Implantation timing (mo)	0–2 (*N*=18)	8	10	.009*	9	9	.522
	>2 (*N*=65)	8	57		27	38	
Prosthetic timing (mo)		7.4 ±1.8	8.2 ±3.5	.165	8.3 ±4.0	7.8 ±2.5	.519
Abutment height (mm)		2.8 ±1.0	2.7 ±0.8	.773	2.8 ±0.8	2.7 ±0.8	.373
CHS (mm)		11.9 ±1.8	12.8 ±2.0	.100	13.0 ±2.0	12.3 ±2.0	.099
C/I (mm/mm)		1.09 ±0.22	1.21 ±0.20	.050	1.24 ±0.22	1.15 ±0.20	.062

Values presented as *N* or mean ±standard deviation.

CHS, Crown height space. C/I, Crown/implant ratio.

*Statistically significant difference compared with baseline.

Table 6. Results of multivariable logistic regression of biological complications

Factor	Exp(*B*)	95% CI	*P*
Retention type	0.372	(0.058–2.391)	.297
Position	0.395	(0.041–3.820)	.423
Surgical strategy	2.188	(0.319–14.998)	.425
Prosthetic type	0.291	(0.039–2.154)	.227
Diameter	12.593	(0.576–275.262)	.107
Length	0.292	(0.004–20.110)	.569
Implantation timing	0.066	(0.007–0.647)	.020*
Prosthetic timing	1.252	(0.907–1.728)	.171
Abutment height	0.797	(0.283–2.245)	.667
CHS	2.820	(0.040–201.272)	.634
C/I	0.036	(0.000–178×10^{16})	.886

CHS, Crown height space. C/I, Crown/implant ratio.

*Statistically significant difference compared with baseline.

Table 7. Results of multivariable logistic regression of mechanical complications

Factor	Exp(*B*)	95% CI	*P*
Retention type	0.600	(0.173–2.081)	.420
Position	0.154	(0.033–0.716)	.017*
Surgical strategy	1.804	(0.522–6.232)	.351
Prosthetic type	1.270	(0.348–4.637)	.717
Diameter	1.610	(0.269–9.620)	.602
Length	0.509	(0.048–5.406)	.575
Implantation timing	0.891	(0.202–3.925)	.879
Prosthetic timing	0.983	(0.837–1.156)	.840
Abutment height	1.286	(0.655–2.524)	.465
CHS	2.181	(0.224–21.230)	.502
C/I	0.000	(0.000–127×10^4)	.409

CHS, Crown height space. C/I, Crown/implant ratio.

*Statistically significant difference compared with baseline.

국문요약

다양한 유지 형태에 따른 전치부 임플란트의 합병증 : 후향적 임상 연구

<지도교수 **최 성 호**>
연세대학교 대학원 치의학과
김 병 헌

임플란트 보철은 일반적으로 시멘트 형태와 나사 형태로 유지되며, 각각의 형태에는 장점과 단점이 있다. 이러한 장단점을 보완하기 위해서 두 가지의 새로운 유지 형태가 고안되었다. 하나는 시멘트 형태와 나사 형태를 결합한 Screw- and cement-retained prosthesis (SCRP) 형태이고, 다른 하나는 설측 나사를 사용하는 Anti-loosening inner-post screw (ALIPS) 형태이다.

전치부 임플란트에는 심미적인 목적때문에 시멘트 형태의 보철을 많이 사용했다. 하지만 시멘트 형태의 보철은 보철물의 제거가 어려워 잔존 시멘트가 문제를 일으킬 가능성이 있었다. 시멘트 형태의 단점을 보완하기 위해 보철물의 제거가 가능한 SCRP 형태를 사용하기도 했으나, SCRP 형태는 나사 구멍을 감추지 못하는 경우에는 심미적이지 못해 사용하기 어려웠다. 최근에는 이러한 기능적, 심미적 문제를 해결할 수 있는 ALIPS 형태를 사용하기 시작했다. 하지만 이와 같은 새로운 형태는 아직 합병증에 대한 임상연구가 부족하다.

따라서 이 후향적 임상 연구의 목적은 ALIPS 형태를 포함하여 전치부 임플란트

보철의 다양한 유지 형태에 따른 합병증을 평가하는 것이다. 또한 다른 여러 요인을 분석하고 비교하여 어떤 요인이 합병증에 영향을 미치는지 확인하는 것이다.

이 연구는 2009년 8월부터 2016년 12월까지 51명의 환자에게 식립된 83개의 전치부 임플란트를 대상으로 자료를 수집했다. 모든 임플란트는 동일한 치과의사가 식립했고, 최소 1년 이상의 추적 관찰 기간을 가졌다. 대상이 된 환자의 정보를 조사했고, 각각의 임플란트에 대해 수술적 특징과 보철적 특징을 기록했으며, 합병증의 종류와 빈도에 대해서 분석했다.

시멘트 형태의 임플란트 보철은 46개(55.4%), SCRP 형태의 임플란트 보철은 5개(6.0%), ALIPS 형태의 임플란트 보철은 32개(38.6%)였다. ALIPS 형태에서 임플란트 주위 점막염이 가장 많이 관찰되었으나(7개/32개, 21.9%), 유지 형태에 따른 생물학적 합병증의 비율은 유의미한 차이가 없었다.

기계적 합병증 역시 유지형태에 따른 합병증의 비율에는 유의미한 차이가 없었다. 다만, 유지 형태별로 합병증의 유형이 달랐는데 시멘트 형태에서 가장 흔한 기계적 합병증은 유지력 상실 (14개/46개, 30.4%)이었고, ALIPS 형태에서는 나사 풀림 (14개/32개, 43.8%)이었다.

분석한 여러가지 요인 중에서는 두 가지 요인이 임플란트 합병증에 영향을 미쳤는데, 식립 위치(상악 및 하악)와 식립 시기(발치 후부터 식립까지의 기간)였다. 상악 전치부에 식립된 임플란트에서 하악 전치부에 식립된 임플란트에 비해 더 많은 기계적 합병증이 발생했다. 또한 발치 후 즉시 임플란트를 식립한 경우 혹은 2달 내에 식립한 경우에는 생물학적 합병증의 비율이 더 높게 나타났다.

전치부에 식립된 임플란트는 식립 위치나 식립 시기와 같은 요인에 영향을 받아 합병증의 비율에 유의미한 차이를 보였다. 반면, 유지 형태에 따른 비교에서는 발생하는 합병증의 유형에는 차이가 있었지만, 합병증의 비율에는 유의미한 차이가 없었다. 따라서 새롭게 제안된 형태인 ALIPS 형태도 기존에 사용되었던 시멘트,

SCRP 형태와 마찬가지로 전치부 임플란트 보철을 만드는 데에 있어서 충분히 고려할 만한 선택이라 할 수 있다.

핵심되는 말: 전치부 임플란트, 임플란트 보철, ALIPS, 후향적 임상 연구