Influence of early cover screw exposure on the crestal bone loss around implants: comparison between exposed and non-exposed implants in identical subjects

Tae-Hyung Kim

The Graduate School

Yonsei University

Department of Dental Science

Influence of early cover screw exposure on the crestal bone loss around implants: comparison between exposed and non-exposed implants in identical subjects

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Tae-Hyung Kim

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This certifies that the dissertation thesis

of Tae-Hyung Kim is approved.

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Thesis Supervisor: Ik-Sang Moon

_____

Chong-Kwan Kim

_____

Kwang-Ho Park

The Graduate School

Yonsei University

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감사의 글

이제야 비로소 세상을 향해 한 걸음 더 나아갈 수 있는 준비가 된 것 같습니다. 치과의사로서의 학문적, 임상적 능력을 끌어 올려 주시고 논문을 쓰기 시작할 때부터 완성될 때까지 언제나 한결같은 관심으로 지켜봐 주시고 많은 가르침을 주신 문익상 교수님, 이동원 교수님과 이지현 교수님께 깊은 감사를 드립니다. 바쁘신 와중에도 심사를 맡아 주시고 논문의 완성에 큰 도움을 주신 김종관 교수님과 박광호 교수님께 큰 감사를 드립니다.

언제나 물심양면으로 저를 보살펴 주시고 제 인생의 귀감이 되어 주시는 박형식 교수님 감사합니다.

짧지 않은 대학원, 수련 기간동안 세세한 부분까지 신경 써 주고 많은 도움을 준 권희준 선생님, 김정주 선생님, 송동욱 선생님께 감사의 말씀을 전합니다.

먼 곳에서 공부하느라 현장에서 일하느라 고생하는 누나와 형, 항상 제가 좋은 길로 나아갈 수 있도록 해 주시고 바르게 키워 주신 어머니가 없었다면 지금의 저는 없었을 것이라고 생각합니다. 가족 모두에게 고마운 마음을 전합니다. 제 인생의 보물이신 어머니 존경합니다. 사랑합니다.

제 주변에서 저를 생각해 주시는 모든 분들께 감사의 마음을 전합니다.

감사합니다.

2007년 12월

김 태 형

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Abstract

Influence of early cover screw exposure on the crestal bone loss around implants: comparison between exposed and non-exposed implants in identical subjects

Tae-Hyung Kim, D.D.S.

Department of Dental Science
The Graduate School, Yonsei University
(Directed by Professor Ik-Sang Moon, D.D.S., M.S.D., Ph.D.)

Plaque accumulation and epithelial invagination can occur during osseointegration period when a direct communication between the implant surface and the oral environment is established, and it can be a harmful factor resulting in early crestal bone loss.

The present study population consisted of 278 patients who were treated with dental implants. 612 threaded conical implants were placed following the 2-stage surgical protocol (312 in maxilla, 300 in mandible). 21 implants in 17 patients were exposed to the oral cavity through the mucosa before uncovering surgery (3.4%), 9 implants in the maxilla presented spontaneous early exposure (2.8%) and 12 implants in the mandible (4.0%).

Among the study population, there were 12 subjects who had both early exposed and non-exposed implants (13 early exposed and non-exposed implants

in each). The crestal bone losses of exposed and non-exposed implants in identical subjects were examined when the final restorations were inserted. The crestal bone losses were compared with Wilcoxon Signed Ranks Test. The mean crestal bone loss of exposed implants was 0.49±0.62mm, ranged from loss of 0.00mm to 2.15mm. The mean crestal bone loss of non-exposed implants was 0.19±0.24mm, ranged from loss of 0.00mm to 0.77mm. There was statistically significant difference between the crestal bone losses of exposed and non-exposed implants (Wilcoxon Signed Ranks Test, p=0.008).

The breakdown of mucosal seal around implants that result in early exposure of cover screw seems to facilitate peri-implant crestal bone loss. Periodic follow-up after stage I surgery may be critical to minimize the influence of early exposure.

Key words : dental implants, exposure, bone loss, plaque accumulation, maintenance

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Tae-Hyung Kim, D.D.S.

Department of Dental Science

The Graduate School, Yonsei University

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I. Introduction

The periimplant mucosa had many features in common with gingival tissue. Like the gingiva, the periimplant mucosa established a cuff-like barrier (seal), the junctional epithelium adheres to the implant surface through a basal lamina and hemidesmosomes. Dimension of the junctional epithelium was about 2mm in 'apico-coronal' direction and zone of connective tissue attachment was about 1mm high. Once the implant is exposed to the oral environment and in function, a mucosal attachment of a certain minimum dimension is required to protect osseointegration (Berglundh et al., 1991, 1994, 1996; Listgarten et al., 1991).

Loss of the supporting bone during the period between stage I and stage II surgery can occur and becomes clinically apparent only at the time when

the fixture is uncovered. Numerous factors could be attributed to the early bone loss, however, during the early developmental period of osseointegration, many authors believed that sealing the communication between the implant and oral cavity was crucial to the success of osseointegration. (Bränemark et al., 1969; Adell et al., 1985; Albrektsson et al., 1985). On the contrary, some authors reported that periimplant soft and hard tissues of intentionally non-submerged (1-stage protocol) implants had similar dimension and composition with submerged (2-stage protocol) implants, however, these studies performed strict plaque control program (Buser et al., 1992; Abrahamsson et al., 1996, 1999 Cochran et al., 1997).

Adell et al. (1981) in a 15-year study observed early exposure in 4.6%. Toljanic et al. (1999) and Tal et al. (1999) reported 5.1% and 13.7% exposure rates in each study. In histopathologic examination of perforated soft tissue specimens, hyperplastic epithelium showed a gradual invagination tendency closer to the exposed site. A space was formed between the epithelial margins that induced the direct communication of implant cover screw to the oral cavity (Tal et al., 2000). The breach between the perforated mucosa and cover screw is an ideal space to cause plaque accumulation and bacterial colonization during osseointegration period (Tal et al., 1999). If plaque accumulates on the implant surface, the subepithelial connective tissue becomes infiltrated with inflammatory cells (Ericsson et al, 1992 Lindhe et al, 1992). When the apical migration of the plaque front continues, clinical and radiographic signs of tissue destruction are seen around implants (Lindhe et al, 1992; Marinello et al, 1995).

The aim of this study was to compare the marginal bone losses of

exposed and non-exposed implants in identical patients, and to evaluate the influence of spontaneous early exposure on the crestal bone loss around implants.

II. Material & methods

A. Subjects

Subjects of this study were selected from patients who received implant surgeries at the department of Periodontology at the Yongdong Severance Hospital (College of Dentistry, Yonsei University, Seoul, Korea) from August 2000 to May 2007.

The patients included in this study showed good general health at the time of implant treatment. In total, 149 males and 129 females participated in the present study with a mean age of 50.1 years (range 17－79).

Among the study population, there were 12 patients who had both early exposed and non-exposed implants (13 early exposed and non-exposed implants in each).

B. Procedures

1. Treatment procedure

612 threaded conical implants (Astra Tech® implants, Astra Tech, Mölndol, Sweden) were placed following the 2-stage surgical protocol, 312 implants were placed in maxilla and 300 in mandible (Table 1). At insertion, the fixtures were placed at a depth according to the guidelines given by the manufacturers, i.e, the placement aimed to get the top of the implant at or slightly below the marginal bone level as the mesiodistal aspect of the crest. However, small variations in insertion depth occurred, depending on the

anatomy of the crest. After a healing period of 3 months in the mandible and 6 months in the maxilla, a second stage surgery was performed. 3~4 weeks after the second stage surgery, the suprastructure was inserted.

When cover screw exposure through the oral mucosa between stage I and II surgery was observed, uncovering surgery was performed immediately. And patients were requested to perform strict plaque control around the healing abutments. After proper healing period, suprastructure was inserted.

Table 1. The distribution of implants

Jaw	Placed site														Total
	7	6	5	4	3	2	1	1	2	3	4	5	6	7	
Maxilla	31	60	28	22	4	10	15	12	13	5	18	21	52	21	312
Mandible	41	44	20	8	3	12	3	6	11	2	7	18	62	63	300

2. Radiographic examination and evaluation

12 patients who had both exposed and non-exposed implants were included in radiographic examination, and the crestal bone losses of 26 implants (13 exposed implants, 13 non-exposed implants) were evaluated.

Periapical radiographic examinations of implants were performed at stage I surgery and suprastructure insertion using a paralleling technique, Kodak insight F-speed film (Eastman Kodak Co., Rochester, NY, USA) and CDR digital sensor (Schick technologies Inc., Long Island City, NY, USA).

The films were digitized using a digital scanner (EPSON GT-12000, EPSON, Nagano, Japan) at an input resolution of 400 dpi with 256 gray scales. Digital images were converted to the Tif file format at PiViewSTAR (Infinitt Co., NJ, USA). All files were transferred to a personal computer

(processor, Intel Celeron D, Santa Clara, CA, USA; operating system, Windows XP professional 2002, Redmond, WA, USA) and examined using the same monitor (Flatron 775FT Plus, LG, Seoul, Korea), which was set to a resolution of 1024 X 768 pixels (Lee et al., 2007).

The radiographs of exposed and non-exposed implants were evaluated regarding marginal bone level at mesial and distal surface using Photoshop 7.0 (Adobe system Inc., San Jose, CA, USA) and took an average value. Then the crestal bone loss, difference between marginal bone level at stage I surgery and suprastructure insertion, was calculated (Figure 1).

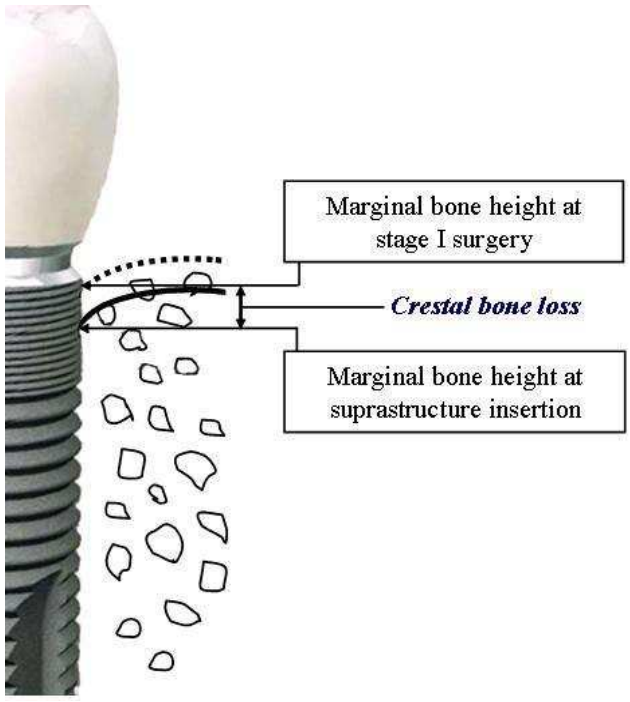

Figure 1. Measuring the crestal bone loss crestal bone loss is determined by measuring the distance between marginal bone level at stage I surgery and suprastructure insertion.

C. Statistics

The crestal bone losses of exposed and non-exposed implants in identical subjects were compared with Wilcoxon Signed Ranks Test (SPSS for windows release 13.0, SPSS Inc., Chicago, IL, USA).

III. Results

21 implants in 17 patients were exposed to the oral cavity through the mucosa before uncovering surgery (3.4%), 9 implants in the maxilla presented spontaneous early exposure (2.8%) and 12 implants in the mandible (4.0%) (Table 2).

Table 2. Implant exposure rates in maxilla and mandible

	Maxilla	Mandible	Total
Implants placed	312	300	612
Exposed implants	9	12	21
Exposure rates	2.8%	4.0%	3.4%

The mean crestal bone loss of exposed implants was 0.49±0.62mm, ranged from loss of 0.00mm to 2.15mm. The mean crestal bone loss of non-exposed implants was 0.19±0.24mm, ranged from loss of 0.00mm to 0.77mm. There was statistically significant difference between the crestal bone losses of exposed and non-exposed implants (Wilcoxon Signed Ranks Test, p=0.008) (Table 3).

Table 3. Mean values and standard deviations for crestal bone loss of each implants

	Mean	Std. Deviation	Minimum	Maximum	p-value
Exposed implants (n=13)	0.49mm	0.62mm	0.00mm	2.15mm	0.008
Non-exposed implants (n=13)	0.19mm	0.24mm	0.00mm	0.77mm	

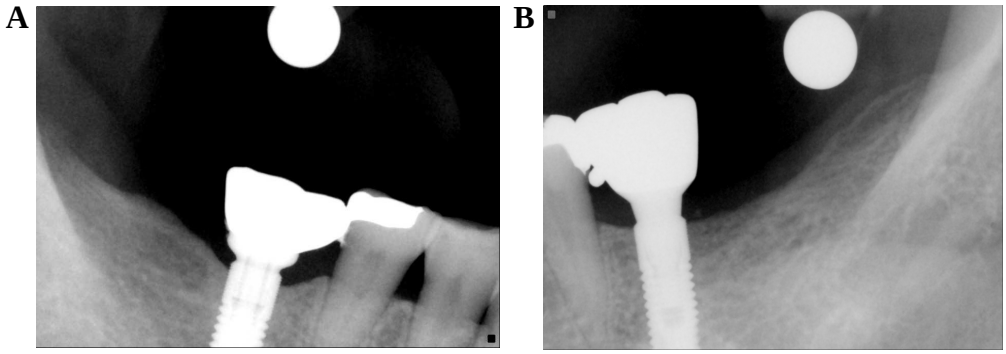

Figure 2. Periapical radiograph of the patient who had both exposed and non-exposed implant (lower right molar : exposed, lower left molar : non-exposed) (A, B) periapical view at suprastructure insertion.

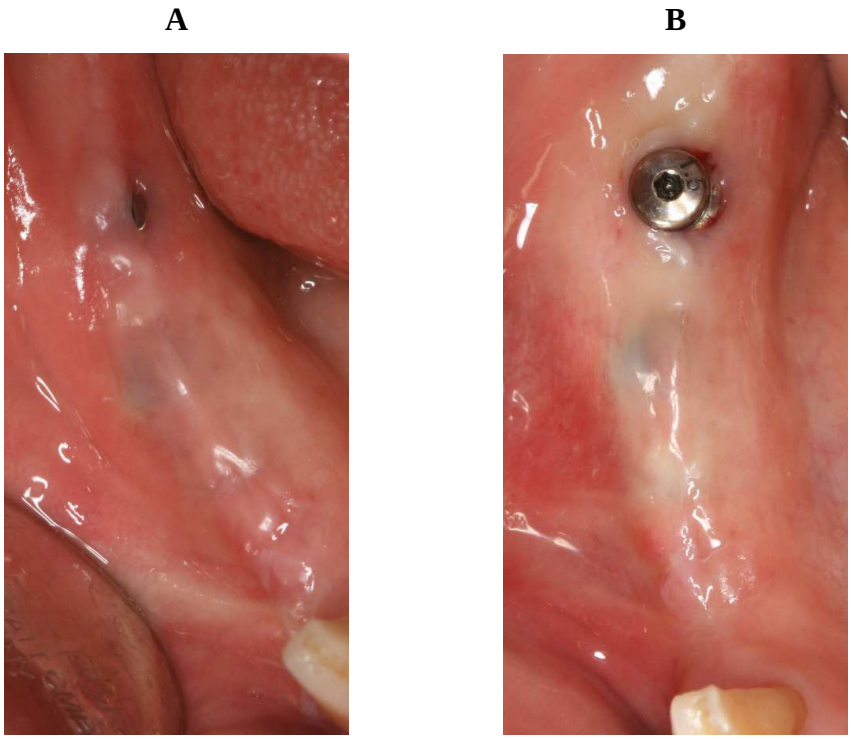

Figure 3. Clinical features of exposed implant (A) exposure of cover screw (B) after treatment of exposure, healing abutment connection.

IV. Discussion

Early cover screw exposures had been observed in 4.6% to 13.7% of cases reported in different studies (Adell et al., 1981; Toljanic et al., 1999; Tal et al., 1999). One possible reason for this complication is the location of the implant cover screw relative to the surrounding bony crest, supracrestal location of the implant cover screw can cause primary tension or irritation of the covering mucosa. External hex implants placed subcrestally and internal hex implants in which the cover device was leveled with the surrounding bone were less involved with spontaneous early exposure than external hex implants placed at the crestal level (Tal et al., 1999). In this study the early exposure rate was 3.4%, implants were internal conical seal design which may result in less spontaneous exposures.

In the present study, there was statistically significant difference between the crestal bone losses of exposed and non-exposed implants (p=0.008). The difference of the crestal bone loss between exposed implants and non-exposed implants might be mainly due to plaque accumulation. The period of time that submerged implants exposed to oral environment was various; plaque might be congregated and accumulated around periimplant mucosa during this untreated period. Sometimes patients were not aware of perforations and it could accelerate the plaque accumulation. Adell et al. (1981) thought that isolation of submerged implant from oral environment by primary closure is an important factor for successful osseointegration. The authors proposed that active surgical measures to be taken with excision of bordering gingiva and full flap coverage

of the perforated site when early exposures of the cover screw were observed. Barboza et al. (2002) stated that the space between the cover screw and the overlying mucosa formed by spontaneous early exposure is an ideal area for accumulation of food debris and bacterial growth, and these areas are very difficult for patient to perform adequate oral hygiene procedure. Continuous plaque formation during postoperative period after implant placement may result in tissue destruction around the implants (Lindhe et al, 1992; Marinello et al, 1995). Tal et al. (2001) described the pathologic structure of the perforated lesions as a plaque-retentive site that could increase bone loss. Toljanic et al. (1999) demonstrated a statistically significant relationship between implant exposure through the oral mucosa between stage I and stage II surgeries and an increased risk for crestal bone loss.

2-part implant is commonly inserted in a 2-stage surgical procedure. Some authors compared the radiographic bone loss between 2-part implant followed 2-stage surgical protocol and that followed 1-stage surgical protocol, and they carried out plaque control program. Abrahamsson et al. (1999) concluded that radiographic bone loss amounted to 0.4mm for the submerged group and 0.3mm for the non-submerged group. Ericsson et al. (1994), Collaert et al. (1998) also reported that there were no statistically significant differences between both treatment modalities.

The crestal bone loss of intentionally non-submerged implants under meticulous plaque control program and submerged implants didn't show statistically significant differences. (Abrahamsson et al., 1999; Ericsson et al., 1994; Collaert et al., 1998). If the early exposure can be detected immediately and instruct patients to perform oral hygiene procedure around exposed

implants after uncovering surgery, there would be no differences in crestal bone losses of exposed and non-exposed implants in present study, either. However there were considerable period of time between exposure of cover screw and second stage surgery to allow plaque accumulation, leading to statistically significant differences in crestal bone losses of exposed and non-exposed implants. It may be critical to find out early exposure instantly. Van Assche et al. (2008) compared the early marginal bone level change of two-stage exposed and non-exposed group. They found that the bone loss of exposed group was significantly higher (1.96mm). The mean bone loss was greater than that of exposed implants in this study (0.49mm). The difference may be due to the treatment modality of exposure, as there were no placing of healing abutments after the diagnosis of perforation on the aforementioned study (Van Assche et al., 2008). The protocol of the present study was to place the healing abutments as soon as the perforations were diagnosed.

Many authors recommended to excise the migrated epithelium of perforated mucosa as soon as possible and connect the healing abutment after cover screw removal for the treatment of spontaneous early exposure since it allowed for better hygiene and minimized the risk of infection (Rosenquist et al., 1996; Toljanic et al., 1999; Tal et al., 2000; Barboza et al., 2002). During healing of the soft tissue wound, an attachment is formed between the mucosa and healing abutment. After properly matured, this attachment effectively re-establishes the soft tissue barrier and separates the bone tissue from the oral cavity. (Berglundh et al., 1991; Moon et al., 1999). Our protocol was in concordance with this treatment modality.

The limitation of the present study was that it was not able to identify

the exact time of exposure, thus making it impossible to consider the plaque accumulation period into statistical analysis. It was hard to detect early exposure immediately because patients were commonly asymptomatic. Exposed (plaque accumulation) period, left untreated, should be examined to clarify the relationship between plaque accumulation and the occurrence of crestal bone loss. Within the limits of a human study, the influence of spontaneous, untreated early exposure on crestal bone can be studied only radiographically or biometrically (Tal et al., 2000) and there would be ethical contemplation to create early exposure by factitious manipulation.

A further investigation with animals treated with intentionally exposed implants may be required to evaluate the influence of plaque accumulation on exposed area to early crestal bone loss.

V. Conclusion

The aim of this study was to compare the marginal bone losses of exposed and non-exposed implants in identical patients, and to evaluate the influence of spontaneous early exposure on the crestal bone loss around implants.

The early exposure rate was 3.4%. The mean crestal bone loss of exposed implants was 0.49±0.62mm, ranged from loss of 0.00mm to 2.15mm. The mean crestal bone loss of non-exposed implants was 0.19±0.24mm, ranged from loss of 0.00mm to 0.77mm. There was statistically significant difference between the crestal bone loss of exposed and non-exposed implants (Wilcoxon Signed Ranks Test, p=0.008).

The breakdown of mucosal seal around implants that result in early exposure of cover screw seems to facilitate peri-implant crestal bone loss. Periodic follow-up after stage I surgery may be critical to minimize the influence of early exposure.

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국문 요약

임플란트 덮개 나사의 조기 노출이 임플란트 주위의 변연골 소실에 미치는 영향 : 동일인에서 노출된 임플란트와 노출되지 않은 임플란트의 비교

김 태 형, D.D.S.

연세대학교 대학원 치의학과

(지도교수 문 익 상, D.D.S., M.S.D., Ph.D.)

골유착 기간 동안 임플란트 표면과 구강 내 환경의 직접적인 개통이 발생할 경우 치태 침착, 세균의 군집과 상피의 함입이 나타날 수 있으며, 이는 초기 변연골 소실을 야기할 수 있는 위험 요소가 될 수 있다.

본 연구는 노출된 임플란트와 노출되지 않은 임플란트의 변연골 소실량을 비교하여 덮개 나사의 조기 노출이 임플란트 주위의 변연골 소실에 미치는 영향을 살펴보고자 한다.

임플란트 시술을 받은 278명의 환자를 대상으로 하였으며, 2단계 수술 방법에 따라 식립한 612개의 원추형 지대주 형태의 임플란트가 연구에 포함되었다. 연구에 참여한 대상 중, 조기 노출된 임플란트와 노출되지 않은 임플란트를 모두 포함하고 있는 환자는 12명이었으며 임플란트 수는 각각 13개였다. 조기 노출 빈도를 조사하였고, 동일인 (12명)에서 각각 13개씩의 노출된 임플란트와 노출되지 않은 임플란트의 변연골 소실량을 방사선 사진 상에서 측정하고, Wilcoxon Signed Ranks Test를 이용하여 비교하였다.

21개의 임플란트가 조기 노출 되었으며, 백분율로 환산한 결과 3.4% 였다 (상악:2.8%, 하악4.0%). 노출된 임플란트와 노출되지 않은 임플란트의 변연골 소실량은 각각 0.49±0.62mm, 0.19±0.24mm이었으며, 통계학적으로 유의성 있는 차이를 보였다 (p=0.008).

임플란트 덮개 나사의 조기 노출은 임플란트 주위 골 소실을 촉진하는 것으로 보인다. 임플란트 수술 후 초기 치유 기간 동안의 주기적인 검진은 조기 노출의 영향을 최소화할 수 있는 방법일 것이다.

핵심 되는 말 : 치과용 임플란트, 노출, 골소실, 치태 축적, 유지