The effect of interceptive treatment on bone loss caused by early coverscrew exposure : a comparative retrospective study

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The effect of interceptive treatment on bone loss caused by early coverscrew exposure : a comparative retrospective study

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ABSTRACT

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The aim of this study was to evaluate whether interceptive treatment on premature bone loss caused by early coverscrew exposure is effective or not.

patients with a mean age of 53.8 years who had exposed and non exposed implants were selected. When coverscrew exposure was observed between the first and the second surgeries, an uncovering surgery was performed immediately. An inflammatory tissue was excised and healing abutments were connected after coverscrews removal without flap elevation. For the coverscrews non-exposed group, the second surgery was performed six months later for maxillary implants and three months for mandibular implants. Bone loss around each implant was analyzed after

one year of functional loading and gingival parameters (modified plaue index and modified sulcus bleeding index) of peri implant tissue were evaluated. Bone loss after loading and gingival parameters were compared using Wilcoxon signed-rank test.

The mean crestal bone loss from fixture placement to prosthesis delivery was 0.41±0.43 mm in exposed implants and 0.16±0.22 mm in non-exposed implants. The difference in change of crestal bone loss was statistically significant between exposed and non-exposed implants (p=0.0034). The mean crestal bone loss from prosthesis delivery to 1-year of functional loading was 0.07±0.08 mm in exposed implants and 0.06±0.09 mm in non-exposed implants. The difference in change of crestal bone loss was not statistically significant between exposed and non-exposed implants (p= 0.8603).

In light of the present findings, connection of a healing abutment as soon as a perforation is detected allows for peri-implant soft tissue to re-establish the dimension of the biologic width, or a soft tissue barrier. After a healthy fibrointegration is stabilized, premature bone loss caused by early coverscrew exposure does not influence the peri-implant bone level any further.

Key words : coverscrew early exposure, interceptive treatment, marginal bone level

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I. INTRODUCTION

In a recent clinical study performed by our group, unintentionally exposed coverscrews seemed to accelerate peri-implant crestal bone loss as compared with non-exposed implants in identical subjects, though a healing abutment was placed as soon as a perforation was detected (Kim et al., 2009). It was speculated that the cause of premature bone loss was due to breakdown of the mucosal seal by plaque accumulation and invasion of the biological width. Similar findings were also reported by previously published clinical studies (Tal et al., 2001; Van Assche et al.,

2008) and animal studies (Jeong et al., 2008; Yoo et al., 2008).

To avoid progressive peri-implant bone loss, early detection and treatment of these exposures were supposed to be important and several treatments were suggested (Barboza and Caula, 2002; Tal and Dayan, 2000; Toljanic et al., 1999). Through a proper interceptive treatment and meticulous plaque control, peri-implant soft tissue establishes a new healthy barrier and bone loss is limited (Jeong et al., 2008; Yoo et al., 2008).

The partial exposure of coversrews acts as a plaque-retentive site and may results in immediate bacterial infection and possible bone loss, if left untreated (Barboza and Caula, 2002). These results are similar to plaque-induced inflammatory reactions around the implants, which give rise to peri-implant mucositis and peri-implantitis (Schou et al., 1992). The treatments for achievement of complete resolution of peri-implant diseases caused by bacterial colonization have been proposed over the years, which were largely based on the evidence available for treatment of periodontitis (Claffey et al., 2008; Renvert, Roos-Jansaker, and Claffey, 2008; Roos-Jansaker et al., 2006).

Though successful outcomes about treatment of peri-implant diseases have been reported, a few clinical studies were carried out and mostly case reports, not comparative studies. Also, to our knowledge, there is no study about the effect of interceptive treatment on premature bone loss caused by early coverscrew exposure.

In the present study, when coverscrew early exposure was detected, inflammatory tissue was excised and coverscrew was replaced by healing abutment to

establish a new healthy fibrointegration and limit bone loss. The wound healing process takes place following healing abutment placement which establishes re-morphogenesis of peri-implant mucosa within several weeks (Berglundh et al., 2007).

According to the recent report published by our group, although proper interceptive treatment was conducted to re-establish the peri-implant soft tissue, premature bone loss was detected by previously accumulated plaque and breakdown of biological width (Kim et al., 2009). As a following study, the present report was conducted to make out that after healthy fibrointegration iis established, premature bone loss caused by early coverscrew exposure didn't affect the stability of peri-implant bone level continuously continuously or not.

After the soft tissue barrier is properly reorganized, further follow-up study is necessary to compare the bone level at the exposed implants with premature bone loss and non-exposed implants with standard bone level in identical patients. The aim of this study was to evaluate the effect of the interceptive treatment on peri-implant bone level after 1-year of functional loading.

II. MATERIALS AND METHODS

This study was approved by the Institutional Review Board of Yonsei University. The patients were informed of the study procedures and all provided informed consents.

1. Patient selection

19 patients (13 males and 6 females) with a mean age of 53.8 years (range 30 to 71) who had exposed and non exposed implants were selected at the Department of Periodontology, Gangnam Severance Hospital for the purpose of intra-individual comparison of the crestal bone loss between the exposed and non- exposed implants. One of the patients had two exposed implants. As a result, 20 exposed and 20 non-exposed implants on 19 patients were evaluated (Table 1). All the patients were in good general health.

Table 1. Information of the patients and distribution of the implants

Patient	Gender	Age (years)	Placed site	
			Exposed	Non-Exposed
1	F	66	30	19
2	M	51	30	3
3	M	33	19	31
4	F	61	29	30
5	M	57	19	29
6	M	42	3	14
7	M	68	15	31
8	M	71	14	13
9	M	42	14	15
10	M	40	18	21
11	M	64	19	18
12	M	68	2	3
13	F	30	30	19
14	F	42	8	19
15	M	56	5	12
16	F	60	4	3
17	F	60	3	4
18	M	61	19	20
19	M	51	19	3
			18	31

Gender : M=Male, F=Female

Age : age of patients at the date of first surgery

Placed site : American Dental Association numbering system

2. Treatment procedure

A conservative 2-stage surgical procedure was performed. The threaded conical or straight implants (Astra Tech implants, Astra Tech, Mölndal, Sweden) were placed at or slightly below the marginal bone level, following the manufacturer's guidelines. Flap incision was closed in an attempt to achieve complete closure, applying simple interrupted sutures using 4-0 silk suture material.

Patients were instructed to rinse their mouth with antiseptic solution (Fresh burst Listerine, Pfizer Consumer Healthcare, Walton-on-the-Hill, Surrey, U.K) twice a day for 10 days. Temporary removable restorations were adjusted and soft diet was recommended to avoid trauma to the surgical sites. Smokers were asked to quit smoking for 7 days postoperatively. Sutures were removed 10 days after implant placement.

Patients were checked 1, 3 and 7 weeks after suture removal and 1 week before the second surgery. When coverscrew exposure was observed between the first and the second surgeries, an uncovering surgery was performed immediately. An inflammatory tissue was excised and healing abutments were connected after coverscrews removal without flap elevation. Patients were instructed to clean around the healing abutments by gently rubbing with soft toothbrushes. Soft diet was recommended to avoid overloading on implants.

For the coverscrews non-exposed group, the second surgery was performed six

months later for maxillary implants and three months for mandibular implants. The prostheses were delivered three weeks after the second surgery. Patients were recalled every three months for oral hygiene evaluation and professional plaque control.

3. Radiographic examination

Standardized periapical intraoral radiographes were taken at one day after implant placement, immediately after prosthesis delivery and one year after functional loading by parallel cone technique (70kV, 8mA, 0.250 second) with an XCP device (XCP Kit, Ran, Elgin, IL, USA) using films (Kodak Insight F-speed film, Eastman Kodak, Rochester, NY.) or a CDR digital sensor (Schick Technologies, Long Island City, NY). A 5.5mm spherical metal bearing was placed for calibrating length measurement.

The films were digitized using a digital scanner (EPSON GT-12000, EPSON, Nagano, Japan) at an input resolution of 2,400 dots per inch with 256 gray scales. Digital images were converted to the tagged image file format (tiff) by a picture archiving and communicating system (PiViewSTAR, Infinitt, Seoul, Korea). All files were transferred to a personal computer (Processor, Intel Celeron D, Intel, Santa Clara, CA; operating system, Windows XP Professional 2002, Microsoft, Redmond, WA) and examined using the same monitor (Flatron 775FT Plus, LG, Seoul, Korea)

which was set to a resolution of 1,024 x 768 pixels (Lee et al., 2005).

The radiographs of exposed and non-exposed implants were evaluated for the distance between the implant shoulder and the bone/implant contact point at the mesial and distal surfaces using a computerized image-analysis system (UTHSCSA Image Tool, version 3.00, University of Texas Health Science Center in San Antonio) and the average value was obtained. The measurements were made to the nearest 0.01 mm.

The measurements were done by a single operator (E-K-L). To test intra-observer variability, marginal bone losses on arbitrarily selected 40 periapical films were measured twice, with a 1- week interval.

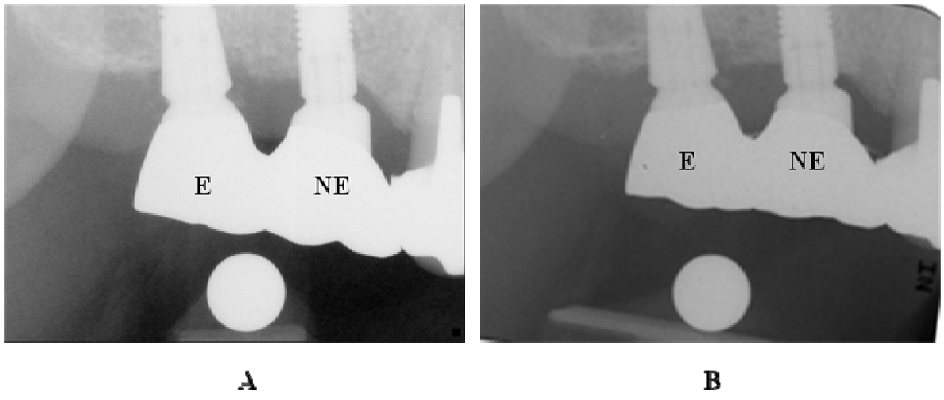

Figure 1. Intra-oral radiograph of implants

(E: Exposed implant; /NE: Non-exposed implant).
A, At prosthesis delivery; B, One year after functional loading

4. Follow-up parameters

At 1-year follow-up visit after the prostheses were delivered, implants were evaluated for pain, discomfort, and implant-related infection. An implant was deemed as surviving when it was stable, functional, and asymptomatic. To evaluate inflammatory changes of the peri-implant tissues, the modified plaque index (mPI) and modified sulcus bleeding index (mBI) were measured at four aspects around each implant (Mombelli et al., 1987). Averages of the four obtained plaque and sulcus bleeding index values were calculated to represent the respective values for each implant.

5. Statistics

The null hypothesis was there would be no difference on amounts of crestal bone loss between exposed and non-exposed implants from prosthesis delivery to one year of functional loading. Mean values and ranges were calculated for the exposed and non-exposed implants in the same patient.

Intraclass correlation was used to test intrarater reliability. The normality of the distribution was tested using D'Agostino–Pearson test. As the normality of the distribution of both groups were rejected, data analysis for marginal bone loss, mPI

and mBI were performed by Wilcoxon signed-rank test. Computer software (MedCalc Software, version 11.0, Mariakerke, Belgium) was used to process data. The value was deemed statistically significant if the P-value was < 0.05.

III. RESULTS

1. Clinical examination

No remarkable complications were found during the observation period. No patient was suffered from pain and mobility on implants was not detected. Also, there were no prosthetic complications.

2. Marginal bone changes

Intrarater reliability was high(r=0.91) for both measurements of coverscrew early exposed implants and non-exposed implants.

The mean crestal bone loss from fixture placement to prosthesis delivery was 0.41±0.43 mm in exposed implants and 0.16±0.22 mm in non-exposed implants. The difference in change of crestal bone loss was statistically significant between exposed and non-exposed implants (p=0.0034).

The mean crestal bone loss from prosthesis delivery to 1-year of functional loading was 0.07±0.08 mm in exposed implants and 0.06±0.09 mm in non-exposed implants. The difference in change of crestal bone loss was not statistically significant between exposed and non-exposed implants (p= 0.8603).

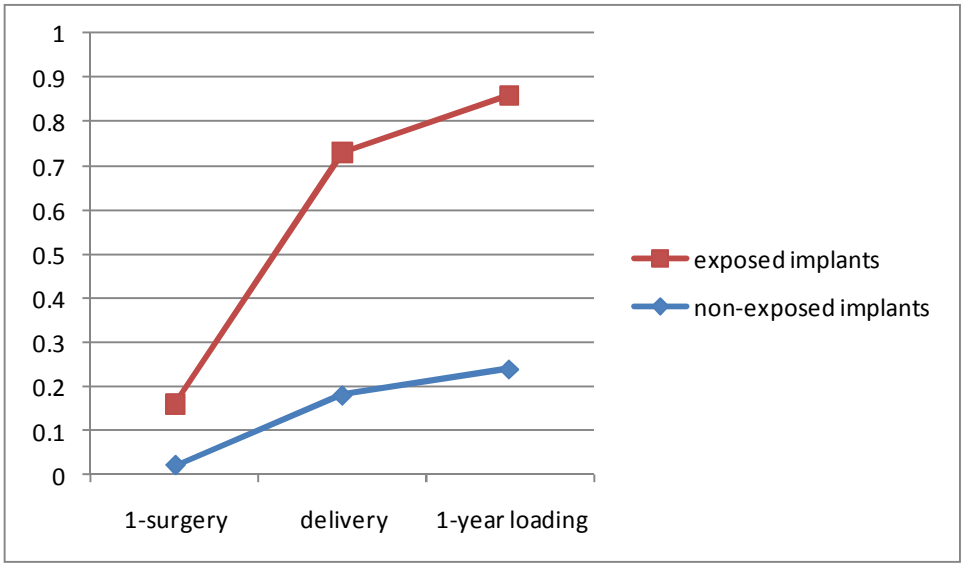

Figure 2. Cumulative distribution graph of exposed and non-exposed implants

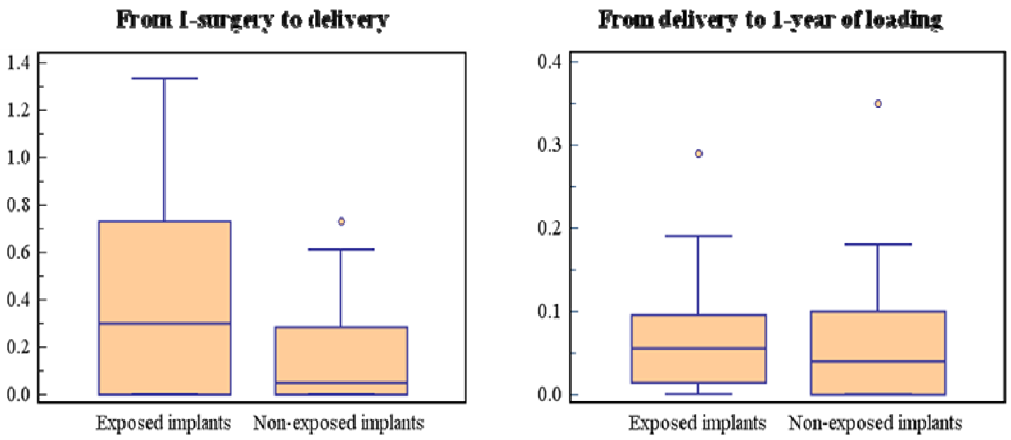

Figure 3. Box plot of marginal bone loss.

Table 2. Marginal bone loss of exposed and non-exposed implants

Patient	Exposed Implants			Non-Exposed Implants		
	A-B	B-C	A-C	A-B	B-C	A-C
1	0.28	0.19	0.47	0.00	0.15	0.15
2	0.47	0.09	0.56	0.42	0.18	0.60
3	0.01	0.08	0.09	0.00	0.00	0.00
4	0.89	0.03	0.92	0.34	0.08	0.42
5	1.24	0.03	1.27	0.61	0.05	0.66
6	0.22	0.01	0.23	0.33	0.04	0.37
7	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.29	0.29	0.00	0.00	0.00
9	0.06	0.02	0.08	0.00	0.00	0.00
10	0.68	0.06	0.74	0.14	0.08	0.22
11	0.00	0.14	0.14	0.10	0.12	0.32
12	1.33	0.13	1.46	0.73	0.07	0.80
13	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00
16	0.83	0.05	0.88	0.00	0.01	0.01
17	0.44	0.04	0.47	0.16	0.14	0.30
18	0.32	0.06	0.38	0.24	0.04	0.28
19	0.77	0.10	0.87	0.00	0.00	0.00
	0.69	0.08	0.77	0.10	0.35	0.45
Mean	0.41	0.07	0.48	0.16	0.06	0.23
SD	0.43	0.08	0.44	0.22	0.09	0.26
Median	0.30	0.05	0.42	0.05	0.04	0.18
95% Confidence interval for the median	0.00166 - 0.6883	0.02170 - 0.08830	0.09848 - 0.7649	0.0000 - 0.2264	0.0000 - 0.08000	0.0000 - 0.3615
p value	0.0034	0.8603	0.0027			

A-B : from implant first surgery to prosthesis delivery

B-C : from prosthesis delivery to 1-year of loading

A-C : from implant first surgery to 1-year of loading

P value : Wilcoxon signed-rank test

3. Evaluation of peri-implant soft tissue

The peri-impalnt soft tissue were clinically healthy with little tendency to bleed on probing. The average modified plaque index of exposed implants was 0.40, while the average of non-exposed implants was 0.55. The average modified sulcus bleeding index of exposed implants was 0.16, while the average of non-exposed implants was 0.25. There was no significant difference between the two groups for the modified plaque index and modified sulcus bleeding index.

Table 3. Modified plaque index of exposed and non-exposed implants

Patient	Exposed Implants	Non-Exposed Implants
1	1	1
2	1.25	0.75
3	0	0.5
4	0.25	0.25
5	0	0
6	0.5	0
7	0	0
8	0.25	0.25
9	0.25	0.25
10	0	0
11	0	0
12	0.75	0.75
13	0.25	0.25
14	0.25	1.5
15	0.25	0.25
16	1	0.75
17	0.75	1
18	1.25	1.25
19	0	0.25
	0	0
Mean	0.40	0.55
SD	0.44	0.57
Median	0.25	0.25
95% Confidence interval for the median	0.0000 - 0.7076	0.04240 - 0.7500
p value	0.2324	

Table 4. Modified sulcus bleeding index of exposed and non-exposed implants

Patient	Exposed Implants	Non-Exposed Implants
1	0	0.25
2	0	0
3	0	0.5
4	0.25	0.25
5	0	0
6	0.25	0.25
7	0	0
8	0.25	0.25
9	0.25	0.25
10	0	0
11	0	0
12	0.75	0.25
13	0	0
14	0.25	0.75
15	0	0
16	0.25	0
17	1	1
18	0	0
19	0	0.25
	0	0
Mean	0.16	0.25
SD	0.27	0.32
Median	0.00	0.25
95% Confidence interval for the median	0.0000 - 0.2500	0.0000 - 0.2500
p value	0.2969	

IV. DISCUSSION

This study was carried out for the comparison of crestal bone changes from prosthesis delivery to 1-year of functional loading at exposed and non-exposed implants in identical subjects when interceptive treatment was properly conducted. The average bone loss of the exposed implants was 0.07mm, while the average of the non-exposed implants was 0.06mm. There was no statistically significant differences between exposed and non-exposed implants ($p=0.8603$). This result indicated that premature bone loss caused by early coverscrew exposure didn't affect the stability of peri-implant bone level continuously after healthy fibrointegration is established.

In this present study, differed from Van Assche et al. (Van Assche et al., 2008) in which there was no interventive treatment after the diagnosis of perforation, when implant coverscrew exposure was detected, the migrated epithelium of the perforated mucosa was excised and coverscrew was replaced by healing abutment. Though interceptive treatment was properly conducted, accumulated plaque before the uncovering surgery resulted in statistically significant bone loss (Kim et al., 2009). But, it was assumed that the re-morphogenesis of a peri-implant soft tissue zone following healing abutment connection would stabilize peri-implant bone level after that. That is, premature bone loss caused by early coversrew exposure would not affect the peri-implant bone level any further after healthy fibrointegration is established.

Incision of migrated epithelium and placement of healing abutment is similar to peri-implantitis treatment procedures which include removal of granulation tissue around implant and decontamination of implant surface (Claffey et al., 2008; Renvert, Roos-Jansaker, and Claffey, 2008; Roos-Jansaker et al., 2006). Though osseointegration wasn't successfully occurred, previously conducted animal studies reported re-establishment of soft tissues after treatment of peri-implantitis, including histologic observations. Persson et al. (Persson et al., 1999) disclosed that connective tissue of oral mucosa was in apparent contact with the pristine coverscrew after open debridement and submerged healing. Ericsson et al. (Ericsson et al., 1996) reported that after non-submerged peri-implantitis treatment, all the exposed components of fixture and abutment were in contact with junctional epithelium and connective tissue attachment. Also, according to other animal studies about the treatment of peri-implantitis, implants were surrounded by regenerated junctional epithelium and connective tissue attachment exhibited no aberrations to normally developed gingival tissue (Grunder et al., 1993; Schou et al., 2003). The morphogenesis of the re-established peri-implant mucosa is analogous to the biologic width associated with natural teeth (Abrahamsson, Berglundh, and Lindhe, 1997; Abrahamsson et al., 1996; Berglundh et al., 1991; Buser et al., 1992; Cochran et al., 1997) and may protect the zone of osseointegration from the factors from the oral cavity (Moon et al., 1999).

In this present study, during the functional loading, there was no statistically significant difference on marginal bone loss between the exposed and non-exposed

implants. The point is whether peri-implant soft tissue and hard tissue is stabilized over time or not. Hermann et al. (Hermann et al., 2000) reported that under loaded condition, the overall dimension of the biologic width was not altered, though dynamic changes did occur within the dimension. Also, according to a clinical study using the implants same as the present study, after 1 year of functional loading the marginal bone loss of implants showed stable state and 1-year interim result would be worth considering (Lee et al., 2007; Kim et al.,2010).

Within the limitation of human study, histological examination couldn't be carried out for the ethical considerations. From the point of clinical view, though there was no significant difference on crestal bone level between early exposed and non-exposed implants, it is necessary to compare the histological appearances. A further investigation with animal study may be required to evaluate the biological differences.

V. CONCLUSION

The aim of this study was to evaluate whether interceptive treatment on premature bone loss caused by early coverscrew exposure is effective or not. The clinical and radiographic changes of the peri-implant tissue from prostheses delivery to 1-year of functional loading were examined which were exposed and non-exposed implants in identical subjects.

In light of the present findings, connection of a healing abutment as soon as a perforation is detected allows for peri-implant soft tissue to re-establish the dimension of the biologic width, or a soft tissue barrier. After a healthy fibrointegration is stabilized, premature bone loss caused by early coverscrew exposure does not influence the peri-implant bone level any further.

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국문 요약

덮개나사 조기 노출시 적절한 초기 치료가 향후 임플란트 주위 변연골에 미치는 영향 : 후향적 비교 연구

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이번 연구에서는 임플란트 식립 후 덮개나사가 조기 노출되었을 경우 적절한 초기 치료가 향후 임플란트 주위 변연골에 미치는 영향에 대하여 알아보려 하였다.

구강내에 임플란트 식립 후 이차 수술 전에 덮개 나사가 조기 노출된 임플란트와 그렇지 않은 임플란트가 있는 총 20명의 환자를 대상으로 연구가 이루어 졌다. 덮개 나사가 조기 노출되었을 경우 덮개 나사를 덮고 있는 염증조직을 절개하고 덮개 나사를 제거한 후 잇몸을 관통하는 긴 연결나사를 연결하였다. 덮개 나사가 조기 노출되지 않은 임플란트의 경우 상악은 6개월, 하악은 3개월 후에 이차수술을 시행하였다. 이후 상부 보철물 연결시의 방사선 사진과 기능적 부하를 가하고 1년 후 방사선 사진 사이의 임플란트 주위 변연골 변화량을 조사하였다. 또한 덮개 나사가 조기 노출된 임플란트와

그렇지 않은 임플란트에서 변연골에 미치는 염증의 영향을 조사하기 위해 기능적 부하를 가하고 1년 후 각각의 임플란트에서 치은 지수를 측정하였다. 임플란트 주위 변연골의 변화량과 치은 지수는 Wilcoxon signed-rank test를 이용하여 비교하였다.

임플란트 식립 후 상부 보철물 연결시까지의 변연골 변화량은 덮개나사가 조기 노출된 임플란트에서 0.41 ± 0.43 mm 이고 그렇지 않은 임플란트에서 0.16 ± 0.22 mm 로 통계학적으로 유의할 만한 차이가 있었다 (p=0.0034).

상부 보철물 연결 후 1 년 동안 기능적 부하가 가해진 시점까지 임플란트 주위 변연골의 변화량은 덮개 나사가 조기 노출된 임플란트에서 0.07 ± 0.08 mm 이고 그렇지 않은 임플란트에서 0.06 ± 0.09 mm 로 통계학적으로 유의할 만한 차이가 없었다 (p= 0.8603).

이번 연구에서 덮개나사가 조기 노출되었을 때 초기에 부분적으로 노출된 덮개나사를 제거하고 구강 내로 관통되는 긴 연결나사를 연결함으로써 건강한 연조직이 재형성되었다고 할 수 있다. 따라서 본 연구 결과에 의하면 임플란트의 덮개나사가 조기 노출되었을 때 적절한 초기 치료를 통해 임플란트 주위 연조직이 구강내의 외부환경으로부터 방어막을 형성하게 되면 덮개나사의 조기 노출에 의해 조기 골 소실이 일어났다고 하더라도 이후 더 이상의 변연골 소실이 나타나지 않음을 알 수 있다.

핵심되는 말 : 덮개나서 조기 노출, 적절한 초기 치료, 변연골 소실량