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Soft Tissue thickness study of platform switching on crestal bone with INNO^{TM} Implant

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Abstract

Purpose

This study aimed to evaluate the effect of platform switching on crestal bone maintenance in relation to soft tissue thickness.

The mean age of the patients was 65.2 years with a range from 29 to 68 years. The average loading time was 4 years 9 months and the shortest time period was 4years 3 months with 2 patients.

Materials and Methods

A retrospective clinical study was made in the Seoul Implant Clinic, Seoul, Korea between June 2012 and January 2016. The patient inclusion criteria were: 1) patients with single missing mandibular molar programmed for restoration with dental implants; 2) partially mandibular molar edentulous patients with free extremities programmed for restoration with dental implants; 3) patients requiring dental implant restoration of the entire dental arch; and 4) patients with sufficient bone width (minimum 6.75 mm)and height (minimum 8.5 mm). The exclusion criteria were: 1) patients with systemic diseases contraindicating any type of surgery; 2) patients receiving or who have received bisphosphonates; 3) patients with active disease of the implant bed (e.g., residual cysts); and 4) patients with bone atrophy requiring bone regeneration in both width and height.

KEY WORDS Alveolar bone loss; bone substitutes; dental implants; survival rate.

Introduction

Soft tissue recessions around implants were more pronounced at sites with "inadequate" KT at the short-term evaluation, even if this association is less evident in long-term follow-up studies (1–5 years). A certain minimal dimension of the peri-implant mucosa is required; hence, bone resorption may occur to allow a proper soft tissue attachment to form. [1,2,3,4] The bone resorption due to biological width establishment is, however, seen at early implantation times, that is, within the first year after implant placement,[5] and it is not a relevant factor for long-term marginal bone loss.

There are dimensional ridge alterations that occurs following tooth extraction. Several studies show that the labial bone plate changes in height and thickness,[6,7] and to place an implant at the time of tooth extraction does not help to maintain the height of the labial bone plate [8,9,10] or the labial bone contour. [11,12] Because the natural thickness of the connective tissue overlying the bone around implants at the labial aspect ranges from 2.8 to 3.8 mm, [13,14,] the consequences of labial bone plate resorption after tooth extraction are midfacial soft tissue recession and missing labial tissue volume, which lead to a compromised aesthetic result. [15,16]

Platform switching has become a standard feature in the design of conventional implants. Its introduction has expanded the possibilities of crestal bone preservation, as numerous studies have reported reduced bone resorption for platform-switched implants compared with platform-matched implants. Cappiello and colleagues[17] found a significant bone-protective effect of platform switching, equal to 0.72 mm, in a controlled clinical trial with 131 implants in 45 patients.

Prosper and colleagues[18] and Canullo and colleagues[19] have also shown the superiority of platform-switched implants over regular implants with regard to development of crestal bone stability. Recent systematic reviews unanimously confirm that implants with platform switching preserve crestal bone better than implants with matching abutments.[20–22] From a technical point of view, platform switching results in a horizontal displacement of the implant-abutment microgap away from the bone crest. The microgap is one of the major factors responsible for bone remodeling in the apical direction.[23–27]

However, other factors, such as implant neck polishing [28,29] and mucosal tissue thickness,[30] have been shown to take part in the etiology of crestal bone loss as well. Linkevicius and colleagues[31] previously published a pilot study showing that platform switching might not be effective in preventing bone loss if at the time of implant placement mucosal tissues were 2 mm or less in thickness.

However, the sample size, with only 12 implants evaluated in 4patients, precluded definitive conclusions. Nevertheless, there are data from randomized controlled clinical trials that do not confirm the hypothesis that platform switching is enough to reduce bone loss.[32,33] Some of the studies on platform switching show a wide diversity of crestal bone loss figures, ranging from 0.3 mm to 1.3 mm. 18 Recently it has been suggested that bone resorption may be mainly related to biological factors rather than to biomechanical factors like implant diameter.[34]

Furthermore, the study by Vandeweghe and DeBruyn showed that platform switching is only effective when mucosal thickness allows the establishment of a biological width.[35] It is very interesting to note that most of the studies on platform switching did not evaluate vertical mucosal tissue thickness at implant placement. Hence, the effect of vertical soft tissue thickness on crestal bone level around implants with platform switching is still not clear. This study aimed to evaluate how crestal bone level is maintained around platform-switched implants in relation to soft tissue thickness. The hypothesis was that there was no influence of soft tissue thickness on bone levels around implants with a platform switching design implant.

Surgical techniques

The INNO® dental implant (Cowellmedi, Busan, Korea) were placed using the same surgical protocol in all cases. Anesthesia was provided in the form of 2% lidocaine with epinephrine 1:100,000.A crestal incision was made with the raising of a full thickness mucoperiosteal flap. The surgical zone was subjected to curettage before the drilling phase, according to the recommendations of the manufacturer. The drill speed was reduced from 1200 to 60 rpm as the drill diameter was increased in order to reduce heating of the bone at the implant site. Drilling was carried out under irrigation with saline solution, and the implant was placed with a 25 rpm and 45N of torque. The space between extraction socket wall and implant was filled with CowellBMP® bone graft (Cowellmedi, Busan, Korea) which are composed of the rhBMP-2 and HA/TCP biphasic particles. Suturing was carried out with 4/0 silk.

All surgeries were completed in two staged surgery, except to immediate loading. A standard non-submerged healing abutment was used. All implants were loaded in the conventional healing period after implant placement. Panoramic X-rays (Vatec, Anseong, Korea) were made at the appointment of before surgery, after surgery and 3, 6, annually follow up visit after loading. If the vertical soft tissue thickness was 2 mm or less, the tissue was considered thin (Group 1) at implant in panoramic view and if the mucosa thickness was more than 2 mm, it was considered thick (Group 2)(Figure 1).

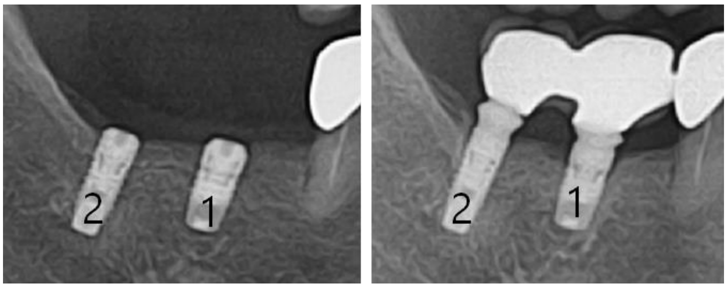

Figure 1 Classification of soft tissue by vertical height at implants.

Image analysis

Panoramic X-rays were analyzed with Easydent viewer version 4.5 software (Vatec, Anseong, Korea). Two reference points were marked on the top of implant surface and the first contact point with bone at the mesial and distal side of implant. The measurement between two points was calculated to a average value. The differences between the values of the first measurement (after surgery) and those of the second (last visiting) were used to establish marginal bone loss (Figures 2). The vertical bone increase of the bone graft in extraction socket is measured to 0 mm change value (Figures 3).

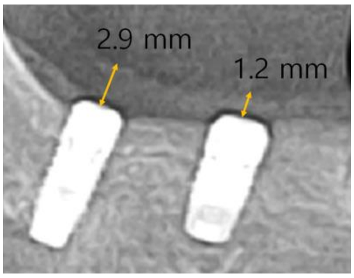

Figure 2 Comparison of marginal bone loss in Group 2 and Group 2 at 5 years follow-up panoramic view.

Statistical analysis

The data were processed using the SPSS version 17.0 statistical package (SPSS Inc., Chicago, IL, USA) for Microsoft Windows. The Student t-test was used for the comparative analysis.

Results

A total 63 dental implants were evaluated in 43 patients (21 patient male of 32 implants and 22 female of 31 implants) in 1st Molar (32 implants), 2nd molar (31 implants). The short 8 mm implant (13 implants) and the longer 10 mm (28 implants) and 12 mm implants (22 implants) of diameter 4 mm (33 implants), 4.5 mm (16 implants), 5 mm (14 implants) were placed in the healed ridge of mandible.

The implant survival rate after 5 years of function in both groups was 100%. No mechanical and/or biological complications were recorded at follow-up visits. Mean soft tissue thickness in Group 1 was 1.62 ± 0.15 mm (range 1.0– 2.0 mm), while soft tissue thickness in Group 2 was 3.01 ± 0.05 mm (range 2.5–4.0 mm). Crestal bone losses after 5 year were 1.21 ± 0.18 mm in Group 1 and 0.05 ± 0.08 in Group 2. There was a significant difference between Group 1 and Group 2 ($p < 0.01$).

DISCUSSION

The results consistently showed that implants in sites with thin soft tissue showed significantly more bone loss compared with implants in sites with thick soft tissue. Based on this outcome, the null hypothesis was rejected. This outcome is in agreement with a pilot study by Linkevicius and colleagues that showed bone loss of 1.76 mm on average in thin tissue. Bone loss was less in the present study and reached up to 1.18 mm after 1-year follow-up. This difference may be related to the difference in implant design between the two studies. Implants in the pilot study had a platform size of 0.7 mm and flaringnecks, while the present study used implants with a platform of 0.2 mm and parallel necks.

It has been suggested that the degree of the implant abutment size mismatch in platform switching might be important for the amount of crestal bone loss. While the small sample size in the study by Linkevicius and colleagues precluded definite conclusions, the results of the current trial with 43 patients and 63 implants justify the statement that implants with platforms witching do not perform well in reduction of bone loss in thin soft tissue.

CONCLUSION

It can be concluded that vertical soft tissue thickness plays a major part in the etiology of early crestal bone loss. Use of implants with platform switching did not preserve crestal bone if at the time of implant placement, mucosal tissues were thin. Conversely, in thick soft tissue, the use of platform switching maintained bone with minimal remodeling.

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