IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 5 Ser. 12 (May. 2024), PP 14-17
www.iosrjournals.org

Effect Of Soft Tissue Biotypes On Crestal Bone Loss Around Dental Implants.

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Abstract:
Background:
Crestal bone change is an important factor to determine the success of implant treatment. Various factors including vertical soft tissue thickness around dental implant play vital role in early crestal bone loss.
Aim:
The purpose of this study was to evaluate the effect of different soft tissue biotypes on crestal bone changes around dental implants.
Materials and Method:
A total 30 units of implants were included in study and assigned to two group, 15 in group A (thick soft tissue biotype, >2mm) and 15 in group B (thin soft tissue biotype, ≤ 2mm). 27 units of implant were followed up for 12 months of period and crestal bone loss was measured at baseline, 3 months, 6 months and 12 months.
Results:
The mean crestal bone loss for group A and group B was 0 mm at baseline. At 3 months the mean crestal bone loss for group A was 0.58±0.17 mm, and for group B was 0.71±0.23 mm, at 6 months it was 1.20±0.41 mm for group A, and 1.52±0.37 mm for group B and at 12 months it was 2.01±0.59 mm for group A and 2.63±0.45 mm for group B. The mean crestal bone loss was significantly more in group B compared to group A. ($p<0.05$) Intragroup comparison showed significant increase in crestal bone loss in both the group from baseline to 3 months, 6 months and 12 months, and it was highly significant.($p<0.05$)
Conclusion:
Dental implants with thin soft tissue biotype have more crestal bone loss compared to thick soft tissue biotype.

Date of Submission: 21-05-2024 Date of Acceptance: 31-05-2024

I. Introduction:

Survival of endosseous implants is highly dependent on the integration between the implant surface and the oral tissue which includes both hard and the soft tissues. Albrektsson in 1986[1] suggested that, for a successful dental implant, the peri-implant crestal bone loss should be < 1.5 mm during the first year and the continuing annual bone loss to be < 0.2 mm.

A review proposed by Hammerle and Tarnow[2] suggested that vertical mucosal thickness can influence the bone remodelling around dental implants. Avila-Ortiz et al.[3] in their article stated that supracrestal tissue height affects bone remodelling independently from implant level design or prosthetic features.

The transition of alveolar mucosa to peri-implant soft tissues after implant placement is a difficult and complex process. The data regarding the relationship between mucosal thickness and marginal bone loss around implants are sparse. However, the question remains whether gingival tissue thickness plays a role in the etiology of early crestal bone loss.

Hence, this study is conducted to assess the effect of soft tissue biotype in marginal bone loss around implants.

II. Subjects And Methods:

The patients for this study were selected from the Outpatient Department of Periodontics & Implantology in Manubhai Patel Dental College, Vadodara after fulfilling the inclusion & exclusion criteria. Written informed consent was obtained from patients and the ethical clearance was obtained.

Inclusion criteria:

1. Presence of healed bone sites (at least 4 months after tooth extraction)
2. Edentulous gap large enough to accommodate at least an implant in posterior region of the mouth.
3. Age: above 18 years
4. Good periodontal health
5. Adequate amount of bone for implant placement.
6. Patients who are able and willing to provide informed consent.

Exclusion criteria:

1. Patients requiring ridge augmentation with barrier membranes or bone grafts.
2. Patients with a history of diabetes or any other debilitating systemic disease.
3. Pregnancy or lactation
4.Infection at the implant site.
5. History of bruxism.

Study design:

In the present clinical trial, a total of 18 patients in the age group of 18 to 55 years were selected and a total of 30 implants were placed in the edentulous sites and followed up over a period of one year. Sites of implants were divided into 2 groups; 15 sites in group A with thick soft tissue biotype (>2mm) and 15 sites in group B with thin soft tissue biotype (≤2mm). Implants were placed at the level of crest and conventional loading protocol was followed.

Surgical Procedure and Measurement of Mucosal Thickness:

Placement of implants were planned after clinical and radiographic examination. Under local anaesthesia, a mid-crestal incision on the centre of the edentulous ridge was performed. The flap was raised in two stages:

A buccal flap was raised, and the vertical mucosal thickness of the unseparated palatal-lingual flap was measured with a UNC-15 periodontal probe at the bone crest at the center of the future implant site. Based on the vertical mucosal thickness measure during implant placement, the implant sites were divided in two groups.

Group A: Thick soft tissue biotype - more than 2mm of vertical soft tissue thickness.

Group B: Thin soft tissue biotype - less than or equal to 2 mm of vertical soft tissue thickness.

A palatal/lingual flap was elevated to expose the implant site. Sequential drillings were done with a speed of 800 rpm along with copious saline irrigation. Osteotomy site was prepared as per the standard protocol.

Placement of Implant.

An implant of adequate length and diameter was placed in the edentulous area. Implant were places at the level of crest. Two stage approach was followed and the implant head was covered with the cover screw. Primary stability was achieved in all the cases.

Post- operative instructions were given to all the patients.

Second stage surgery:

Patients of both the groups were recalled 3 months after implant placement, and second stage surgery was performed. Mid-crestal incision was given at the implant site and flap was reflected to expose the implant collar. The cover screw was removed and a healing collar was placed to aid in the formation of gingival cuff around the implant

Prosthetic reconstruction:

- After 3-4 months of second stage surgery, all fixtures were checked for stability.
- Prosthodontist fabricated the final prosthesis.

Radiographic Assessment and Measurement:

Intraoral radiographs with Rinn's film holder were taken with paralleling technique. Measurement of crestal bone height was taken from Implant-Healing abutment junction to the crest of alveolar bone at baseline, after 3 months, after 6 months and after 12 months at mesial and distal surfaces.

III. Results:

In this study, radiographic assessment of the crestal bone changes on mesial and distal side of implant was done at baseline, 3 months, 6 months and 12 months post implant placement.

There were no significant differences present between groups regarding patient's age (Group-A:44±17.20 years; Group-B:48.5±16.91 years) or gender (group-A:8 males,7 females; group-B: 10 males, 2 females).

Mean crestal bone level of both the groups (group-A: thick biotype and group B: thin biotype) were compared at baseline, 3 months, 6 months and 12 months. The mean value of crestal bone level at baseline was 0 mm for both the group.

At 3 months the mean crestal bone loss for Group A was 0.58±0.17 mm, and for Group B was 0.71±0.23 mm. The mean crestal bone loss of group B was statistically higher compared to group A ($p<0.05$).

At 6 months the mean crestal bone loss for Group A was 1.20±0.41 mm, and for Group B was 1.52±0.37 mm. The mean crestal bone loss of group B was statistically higher compared to group A ($p<0.05$).

At 12 months the mean crestal bone loss for Group A was 2.01±0.59 mm, and for Group B was 2.63±0.45 mm. crestal bone loss of group B was statistically higher compared to group A. ($p<0.05$). (Table 3)

In the intragroup comparison of Group A the mean values for crestal bone loss were 0 mm at baseline, 0.58±0.17 mm at 3 months, 1.20±0.41 mm at 6 months and 2.01±0.59 mm at 12 months respectively. Change in mean from baseline to 3 months, baseline to 6 months, baseline to 12 months, 3 months to 6 months, 3 months to 12 months and 6 months to 12 shows highly statistically significant difference ($p<0.05$). (Table 4)

In the intragroup comparison of Group B, the mean values for crestal bone loss were 0 mm at baseline, 0.71±0.23 mm at 3 months, 1.52±0.37 mm at 6 months and 2.63±0.45 mm at 12 months respectively. Change in mean from baseline to 3 months, baseline to 6 months, baseline to 12 months, 3 months to 6 months, 3 months to 12 months and 6 months to 12 shows highly statistically significant difference ($p<0.05$) (Table 5)

IV. Discussion:

The successful outcome of implant treatment relies on the stability of the crestal bone. Crestal bone level after implant placement is the key factor to determine the prognosis of implant treatment. Implant treatment have improved dramatically since introduction of crestal bone resorption in 1986 by Albrektsson and colleagues.[1] However, despite all efforts, we still observe the crestal bone loss around implants. Numerous factors are suggested as reasons for crestal bone loss i.e., polished implant collar, overload, microgap[4,5,6] etc. Among one of them is initial soft tissue thickness.

Berglundh and Lindhe[7] in 1996 demonstrated that a certain amount of soft tissue thickness is necessary in order to established the BW around dental implant. If the mucosal thickness is not sufficient, crestal bone loss will occur until enough space is established for both connective tissue and junctional epithelium.

Soft tissue thickness involved in the development of BW around dental implants when they are exposed to the oral environment. The function of vertical soft tissue thickness is thought to be the protection of bone around the osseointegrated bone.[8]

It was theorised that in thick biotype, the presence of lamina bone adjacent to the outer cortical plate of the alveolus provides the foundation for metabolic support of the cortical bone, and hence it provides stability and sustainability to underlying bone. [9,10]

This study consists of 27 units of implants which were divided in two groups according to vertical soft tissue thickness measured at the time of placement of implant. Mean age of patients in group A was 44.16±17.20 years and in group B, it was 48.5±16.19 years. (Table 1)

At 3 months after implant placement the mean crestal bone loss in thick soft tissue biotype (group A) was 0.58±0.17 mm, and in thin soft tissue biotype (group B) it was 0.71±0.23 mm. There was no significant difference present between both the group. (Table 3)

At 6 months after implant placement (at the time of loading), mean crestal bone loss in group A was 1.20±0.41 mm, and in group B it was 1.52±0.37 mm. The mean difference of crestal bone loss was less in group A than group B and also it was statistically significant. ($p<0.05$). It might suggest that at the time of loading more bone resorption could have occurred in the thin group compared to thick group to establish the biologic width.

(Table 3) These findings are in support the statement given by Berglundh and Lindhe 1996[11], that thicker mucosa moderates bone remodelling.

At 12 months after implant placement (6 months after loading), mean crestal bone loss in group A was 2.01±0.59 mm, and for group B was 2.63±0.45 mm. The mean difference was more in thin soft tissue biotype group than thick soft tissue biotype group and also statistically significant. ($p<0.05$) (Table 3) These findings are in accordance with similar study done by Linkevicius T et al. 2009[8] which showed statistically significant increase in crestal bone loss in thin soft tissue biotype group.

In another study, Linkevicius et al. 2009[12] evaluated the influence of three soft tissue biotype groups, thin (up to 2 mm), medium (2.1-3.0 mm) and thick (3.1 mm or more) on crestal bone loss around dental implants.

Bhat PR et al. 2015[13] also found the similar result in their study. There was a significant difference present in the bone levels in both the groups. At the end of 1-year, they found a mean bone loss of 0.61 ± 0.36 mm in thick group and 1.70 ±0.36 mm in thin group.

In contrast, Garaicoa-Pazmino et al. 2020[14] suggested that slightly less bone remodeling occurred in thick biotype group. But there was no significant difference present between mean crestal bone loss in thick and thin soft tissue biotype group at 1 year which indicate that vertical soft tissue does not have any influence on crestal bone loss.

In the intragroup comparison of Group A, the mean values for crestal bone loss were 0 mm at baseline, 0.58±0.17 mm at 3 months, 1.20 ± 0.41 mm at 6 months and 2.01 ± 0.59 mm at 12 months. (Table 4) Similarly, in the intragroup comparison of group B the mean values for crestal bone loss were 0 mm at baseline, 0.71±0.23 mm at 3 months, 1.52 ± 0.37 mm at 6 months and 2.63±0.45 mm at 12 months. (Table 5). This suggests that crestal bone loss occurred in both the group. These findings are in accordance with Bhat PR et al. 2015[13] study, in which they compare the crestal bone loss in thin and thick tissue soft tissue biotype group from baseline to second stage, at cementation, at 6 months and at 12 months. The mean values for crestal bone loss in thick soft tissue biotype group were 0 mm at baseline, 0.16 ± 0.10 mm at second stage, 0.29 ± 0.25 mm at cementation, 0 mm at 6 months and 0.61 ± 0.36 at 12 months. Similarly, in thin soft tissue biotype group mean values for crestal bone loss were 0 mm at baseline, 0.12 ± 0.10 mm at second stage, 0.20 ± 0.15 mm at cementation, 0.95 ± 0.35 mm at 6 months and 1.70 ± 0.36 mm at 12 months, so the crestal bone loss was increased significantly in both the soft tissue biotype group in a time period of baseline to 12 months.

The crestal bone loss from baseline to 6 months also can be due to surgical trauma that includes periosteum elevation from the bone causes increased crestal bone loss. In the present study, implants were placed after full thickness periosteal flap elevation which could have also accounted for the increased peri-implant crestal bone loss. This finding was supported by the study of Wilderman MN et al.[15] which reported that the mean horizontal bone loss after osseous surgery with periosteal elevation is approximately 0.8 mm, and the reparative potential is highly dependent upon the amount of cancellous bone existing underneath the cortical bone.

The amount of crestal bone loss that occurred at the time of 6 months to 12 months was comparable with the results reported by Enkling et al.[16] They suggested that, bacterial colonization might have further influenced crestal bone loss. Also, stress at the marginal bone which may cause micro-fracture or overload, or even the biomechanical adaptation of the bone to the occlusal load can also result in crestal bone loss in the 1st year in function.[17,18]

According to Albrektsson'criteria1 for a successful implant the crestal bone loss should be lesser than 1.5 mm during the first year after loading and 0.2 mm thereafter annually. This theory is further supported by another study Galindo- Moreno P et al. 2013[19] in which they evaluated crestal bone loss around implants after 5 months post- surgery and at 6- and 18-months post-loading. The present study was carried out only for a period of 1 year and demonstrated that both the groups shown bone loss during the study period, though all the implants were Osseo integrated and functionally stable after loading. Therefore, the changes in crestal bone height are inevitable in both thick and thin groups and it can be hoped that crestal bone levels would stabilize at the end of 1-year post cementation and achieve a "steady-state phenomenon."[20]

V. Conclusion:

Within the limits of the present study the following conclusion are drawn after analysis of the results:

- In the intergroup comparison, thin soft tissue biotype group showed more crestal bone loss.
- Intragroup comparison showed statistically significant difference in mean crestal bone level in both groups.

Therefore, it can be concluded that implants with thin soft tissue biotype have more crestal bone loss compared to thick soft tissue biotype.