CBCT Evaluation of Crestal Bone Loss Around Dental Implants Placed in Different Tissue Biotypes: A Radiographical Study

Aqrib Mushtaq[1], Suhail Majid Jan[2], Roobal Behal[3]

ABSTRACT

Introduction: This study evaluated changes in the crestal bone height around dental implants placed in different tissue biotypes.

Material and methods: Thirteen patients with single edentulous sites were allocated randomly into group A & Group B. Group A had seven patients in which implants were placed in thick tissue biotype & in Group B six implants were placed in thin tissue biotype. Soft tissue thickness was evaluated using endodontic reamer no.20, 3mm apical to crest using an acrylic stent. A preoperative CBCT was done to evaluate the bone density of the proposed implant site, the mesiodistal space dimensions and proximity to the nearby vital structures. Intra operative IOPAR were taken to check for proper angulation & placement of implant guide pin & thereafter implant placement. Baseline CBCT were done after implant placement in both the groups & follow up CBCT was taken at the time of cementation prior to occlusal loading to evaluate the crestal bone loss around mesial & distal side of implants in both the groups. A p value of < 0.05 was considered statistically significant.

Results: A total of twelve implants were evaluated at follow up visits since one subject in Group A did not come up for follow up visits after implant placement. A significant crestal bone loss at both the mesial and distal sides of the implants at the time of cementation was observed in both the groups but group B (p-value < 0.010 mesial & < 0.009 distal) showed more crestal bone loss as compared to group A.

Conclusion: It could be inferred from the study that mean crestal bone loss was more in Group B (thin tissue biotype) as compared to Group A (thick tissue biotype). Thick biotype causes less crestal bone changes as compared to thin biotype which evokes more crestal bone loss during the period of peri-implant healing.

Keywords: CBCT Evaluation, Crestal Bone Loss, Dental Implants Placed, Tissue Biotypes, Radiographical Study

INTRODUCTION

Implant success is determined by various factors such as crestal bone loss, type of prosthesis, occlusal loading, oral hygiene maintenance, overlying soft tissues and regularity of recall visits.[1] It is considered that median marginal bone loss of 0.5mm during healing, followed by $\leq$1.5mm during first year after loading and $\leq$0.2mm/ year thereafter is a major success criteria for implant therapy. [2] It is observed that thick tissues undergo less bone resorption in order to establish the biologic width around implants than thin tissues which can provoke crestal bone loss during the formation of peri-implant seal.[3] In view of the above speculations the present study was undertaken to radiographically evaluate the crestal bone loss around implants placed in thick & thin tissue biotype.

Aim of the study: To evaluate changes in crestal bone levels around dental implants placed in two different tissue biotype in submerged two stage implant placement.

Objectives: 1) To measure the crestal bone height around implants at baseline and at cementation using CBCT in two groups of thick & thin tissue biotype 2) To compare the crestal bone loss in two groups.

MATERIAL AND METHODS

This study was designed as a prospective controlled radiographic study. Two groups were formulated based on tissue thickness at the implant site as Group A -THICK BIOTYPE with mucosal thickness of $\geq$ 2mm [4] and Group B (mucosal thickness of $<$ 2mm) THIN BIOTYPE [4]. A preoperative CBCT was done to evaluate the bone density of the proposed implant site, the mesiodistal space dimensions and proximity to the nearby vital structures. Baseline CBCT were done after implant placement in both the groups & follow up CBCT was taken at the time of cementation prior to occlusal loading to evaluate the crestal bone loss around mesial & distal side of implants in both the groups. A p value of < 0.05 was considered statistically significant.A sample size of 13 subjects were selected using GPOWER software (Version 3.0.10).The study was conducted in the Department of Periodontics & oral implantology, Govt. Dental College & hospital, Srinagar after getting the approval from the Institutional Review Board. Patients visiting the OPD, Dept. of Periodontics and Oral Implantology with a single edentulous space surrounded by natural teeth on both the sides were screened. The patients were enrolled for the study after fulfilling the inclusion & exclusion criteria & duly attesting to the informed consent.

[1]Post Graduate Student, Department of Periodontics, [2]Professor & Head of Department, Department of Periodontics, [3]Associate Professor, Department of Periodontics, Government Dental College, Srinagar

Corresponding author: Dr. Aqrib Mushtaq, Room No. 217, Government Dental College, Shireen Bagh, Srinagar

How to cite this article: Aqrib Mushtaq, Suhail Majid Jan, Roobal Behal. CBCT evaluation of crestal bone loss around dental implants placed in different tissue biotypes: a radiographical study. International Journal of Contemporary Medical Research 2022;9(9):I1-I6.

Methodology: The present clinical trial was conducted on 13 patients,(Group A ;n=7 & Group B ;n=6) as a comparative radiographic study. Prior to implant placement all patients were prepared following the treatment protocol, first by Phase I therapy & therafter two weeks surgical implant placement was carried out. Patients were assigned into Group A (Thick biotype) and Group B (Thin biotype) based on the preoperative mucosal thickness at the proposed implant site using an acrylic stent for standardization[5] . All examinations were carried out by a single examiner who was trained and calibrated at the Dept. of Periodontics, Govt. Dental College and Hospital, Srinagar.

Surgical procedure: All surgical procedures as well as radiographic measurements were done by a single operator. Following universal precautions, and local anaesthesia (lidocaine HCl with adrenaline 1:80,000) injection, customized acrylic stent was used for subsequent soft tissue measurements. Patients with thickness of ≥2mm were assigned Group A (thick biotype) and those with thickness of < 2mm were assigned group B (thin biotype). Following this, a crestal incision at the centre of the edentulous ridge was performed and a full thickness flap was reflected. Osteotomy was prepared as per the manufacturers guidelines and all the implants were placed in a conventional two stage procedure with submerged placement and in the range of 3.75-4.2 mm in diameter. An IOPAR was taken to confirm proper implant position and the cover screw was placed. Subsequently, baseline CBCT was done to measure the crestal bone height mesially and distally after implant placement. After surgery, mouth rinsing with a chlorhexidine containing solution (0.2%), twice daily for 1 week, was prescribed together with the standard post-surgical medication (analgesics & antibiotics).Thereafter, the patients were recalled first at 1 week, and then every month for follow-up and oral hygiene reinforcement. No provisional restorations were used.

At 4-6 months after the implant placement, the second stage surgery was performed. Full-thickness flaps were elevated, and the cover screw was exposed. Healing abutments were installed and sutures placed. Final restorations were delivered 3-4 weeks after second stage surgery. At the time of cementation of the prosthesis, crestal bone changes were evaluated using CBCT.[6]

Data collection:

A) At the time of implant placement:

Measurement of crestal bone levels: Crestal bone height at the mesial and distal side of the implant at baseline (CBH_b) was measured using CBCT (NEWTOM GIANO) immediately after implant placement. The coronal surface of the implant was taken as the reference line from which 2 perpendicular lines were dropped on the mesial and distal aspect of the implants to the first bone to implant contact. [7] Comparative measurements of mesial and distal crestal bone levels adjacent to implants were made to the nearest 0.1 mm.

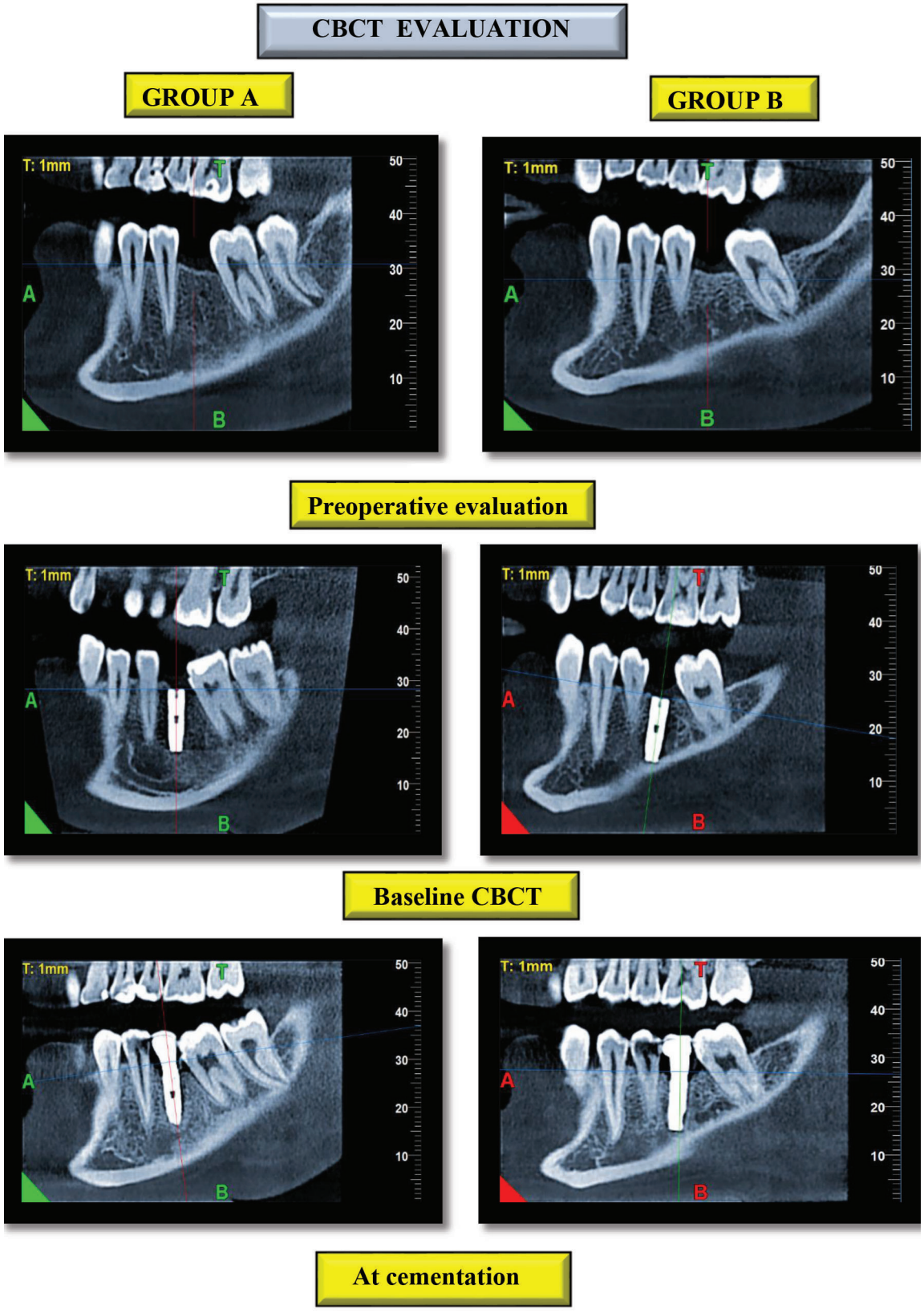
B) At the time of cementation of crown: After cementation of the crown, mesial and distal crestal bone height (CBH_c) was again measured using CBCT.The difference in crestal bone height from baseline to cementation was designated as crestal bone loss (CBL) in both the groups.

Statistical methods: The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc.Chicago, Illinios,USA). Data was summarized as Mean ± SD. For intragroup analysis student's paired t-test was employed to compare the change within the group and Student's independent t-test was employed for intergroup analysis. A P-value of less than 0.05 was considered statistically significant.

RESULTS

The study comprised of total of 13 subjects and were divided into two groups of Thick Biotype (≥2mm) (GROUP A) and Thin Biotype (<2mm) (GROUP B).One subject of Group A did not come up for follow up visits. Both the groups had similar demographic as well as baseline clinical characteristics. Table 1 show the change in Crestal bone height (Mesial) in Group A (Thick Biotype) from baseline (CBH_b) upto the cementation (CBH_c).It was interpreted from the CBCT that there is a mean decrease in mesial crestal bone height from baseline (1.39 ± 0.40 mm) upto the cementation (1.28 ± 0.49 mm).The calculated value from the change in crestal bone height amounts to a mean value of 0.11 ± 0.80mm which is the mean crestal bone loss at the mesial side of the implant in Group A at the time of cementation and is statistically significant (P value- 0.016) .Table 2 show the change in Crestal bone height (Mesial) in Group B (Thin Biotype) from baseline (CBH_b) upto the cementation (CBH_c). It was interpreted from the CBCT that there is a mean decrease in mesial crestal bone height from baseline (1.39± 0.40 mm) upto the cementation (1.19 ± 0.50 mm). The calculated value from the change in crestal bone height amounts to a mean value of 0.19 ± 0.80 mm which is the mean crestal bone loss at the mesial side of the implant in Group B at the time of cementation and is statistically significant (P value- 0.010).Table 3 show the change in Crestal bone height (Distal) in Group A (Thick Biotype) from baseline (CBH_b) upto the cementation (CBH_c).It was interpreted from the CBCT that there is a mean decrease in distal crestal bone height from baseline (1.45 ± 0.37 mm) upto the cementation (1.35 ± 0.42 mm).The calculated value from the change in crestal bone height amounts to a mean value of 0.10 ± 0.62 mm which is the mean crestal bone loss at the distal side of the implant in group A at the time of cementation and is statistically significant (P value- 0.014). Table 4 show the change in Crestal bone height (Distal) in Group B (Thin Biotype) from baseline (CBH_b) upto the cementation (CBH_c).It was interpreted from the CBCT that there is a mean decrease in distal crestal bone height from baseline (1.47 ± 0.38 mm) upto the cementation (1.25 ± 0.54 mm).The calculated value from the change in crestal bone height amounts to a mean value of 0.22 ± 0.86 mm which is the mean crestal bone loss at the distal side of the implant in Group B at the time of cementation and is

statistically significant (P value- 0.009). Table 5 show the comparison of mesial crestal bone loss in both groups A & B. On interpreting the mean values of both the groups, it was observed that the mesial crestal bone loss of Group B (0.19 ± 0.80 mm) was significantly higher than the mesial crestal bone loss of group A (0.11 ± 0.80 mm) evaluated at the time of cementation. However on comparing both the groups no statistically significant difference was seen (P value- 0.426). Table 6 show the comparison of distal crestal bone loss in both groups A & B. On interpreting the mean values of both the groups, it was observed that the distal crestal bone loss of Group B (0.22 ± 0.86 mm) was significantly higher than



Crestal bone height (Mesial)	Mean	SD	P-value
At Baseline (Cbh_b)	1.39	0.40	-
At cementation (Cbh_c)	1.28	0.49	-
Crestal bone loss (Mesial)	0.11	0.80	0.016

Table-1: Group-A : Change in crestal bone height (mesial)

Crestal bone height (Mesial)	Mean	SD	P-value
At baseline (CBH_b)	1.39	0.36	-
At cementation (CBH_c)	1.19	0.50	-
Crestal bone loss (MESIAL)	0.19	0.80	0.010

Table-2: Group-B : Change in crestal bone height (mesial)

Crestal bone heigh (distal)	Mean	SD	P-value
At baseline (CBH_b)	1.45	0.37	-
At cementation (CBH_c)	1.35	0.42	-
Crestal bone loss (distal)	0.10	0.62	0.014

Table-3: Group-A : Change in crestal bone height (distal)

Crestal bone height(distal)	Mean	SD	P-value
At baseline (CBH_b)	1.47	0.38	-
At cementation (CBH_c)	1.25	0.54	-
Crestal bone loss (distal)	0.22	0.86	0.009

Table-4: Group-B : Change in crestal bone height (distal)

Groups	Mean	SD	P-value
A	0.11	0.80	0.016
B	0.19	0.80	0.010
A v/s B	-	-	0.426

Table-5: Comparison of crestal bone loss- loss-mesial in groups A & B

Groups	Mean	SD	P-value
A	0.10	0.62	0.014
B	0.22	0.86	0.009
A v/s B	-	-	0.310

Table-6: Comparison of crestal bone loss- distal in groups A & B

the distal crestal bone loss of group A (0.10 ± 0.62 mm) evaluated at the time of cementation. However on comparing both the groups no statistically significant difference was seen (P value- 0.310)

DISCUSSION

Tooth replacement by Dental implants is an innovative treatment modality for rehabilitation of the lost function and esthetics after tooth extraction. The extensive scientific literature published in the field of implantology offers a plethora of criteria to define implant success.[8,9,10] Traditionally, clinical parameters used to measure implant success include marginal bone loss, sulcus depth, and mobility.[1]

In the same line of thought, the current study was directed to explore any implications of crestal bone stability around dental implants and correlate the same with the success of implant therapy.

Radiographic bone changes were noted using Cone beam computed tomography (CBCT) ,Newtom 3G.[6]The radiographs were made at 0 month i.e., immediately after implant placement and then at the time of cementation but before prosthetic loading.[11] To obtain a reproducible data, the definition of reference points in the image was set. The most coronal point of implant was taken as the reference line because it was permanently visible and easy to locate on all radiographs. [7] Since our protocol was submerged placement of the implant, bone level was coronal to the reference line. Measurements were made at baseline and at the time of cementation at the mesial and distal aspects of the implants by dropping perpendiculars from the reference line to the bone level.[12] The change in crestal bone height from baseline upto cementation was noted as crestal bone loss as an effect of change in soft tissue thickness in this study.

On the basis of soft tissue thickness two groups were made in our study, Group A –Thick Biotype (≥ 2mm) & Group B -Thin Biotype (< 2mm). The decision to divide the test implants into two groups using the benchmark of 2.0 mm of gingival tissue thickness was based on the results of an animal study conducted by Berglundh et al [13] which was the first attempt to analyze the influence of mucosal thickness on stability of bone. In that experiment, the mucosal thickness in the test group was an average of about 2.0 mm; therefore this measurement was used as the means to distinguish between thin and thick mucosa.

Change in crestal bone height

Our study evaluated the effect of change on the crestal bone levels as the stability of the crestal bone levels has been used as a benchmark for implant success. The bone levels were measured on CBCT taken at the baseline after implant placement and thereafter crown placement. Bone loss was observed in both the thick and thin biotype cases, over the duration of the study.

At baseline, in group A the mean crestal bone height measured mesially and distally using CBCT was noted as 1.39 ± 0.40 mm and 1.45 ± 0.37 mm respectively while in group B the mean crestal bone height measured mesially and distally using CBCT was noted as 1.39 ± 0.36 mm and 1.47 ± 0.38 mm respectively.

Similarly, at cementation, in group A the mean crestal bone height measured mesially and distally using CBCT was noted as 1.28 ± 0.49 mm and 1.35 ± 0.42 mm respectively while in group B the mean crestal bone height measured mesially and distally using CBCT was noted as 1.19 ± 0.50 mm and 1.25 ± 0.54 mm respectively.

The above observation is also in accordance with a study done by Kaminaka et al. 2014[6], who compared soft tissue changes for a period of one year in thick and thin biotype group around implants with different abutment connection designs. Baseline soft tissue thickness as well as crestal bone loss was evaluated using CBCT in the study. They reported more CBL in thin biotype group as compared to thick biotype group. Statistically significant correlations

were observed between initial horizontal bone thickness and changes in vertical bone and soft tissue height and between initial horizontal soft tissue thickness and the change in vertical soft tissue height.

Comparison of crestal bone loss in the two groups

The mean crestal bone loss in group B at the mesial side of the implant at the time of cementation was 0.19 ± 0.80 mm (P value- 0.010) which was significantly higher than the mean crestal bone loss on the mesial side of the implants in group A which was 0.11 ± 0.80 mm (P value-0.016) .

Similarly, the mean crestal bone loss on distal side of the implant in group B was significantly higher, 0.22 ± 0.86 mm (P value 0.009) than the distal crestal bone loss in group A which was 0.10 ± 0.62 mm (P value 0.014)

The results of this clinical study are consistent with those of an animal study by Berglundh et al [13] which showed the potential for thin tissues to cause crestal bone loss during the process of biologic width formation. [13]

Similarly, Linkevicius et al [14,15,16,17] compared thin & thick biotypes and found that the mean CBL values were more in thin biotypes as compared to thick biotype. These studies demonstrated statistically significant less marginal bone loss when thick tissue or augmented thin tissues were present compared to non-augmented thin tissues. Results from these studies presented that both thick and thickened tissues with >2mm thickness as measured perpendicularly form the crest at time of implant placement were with less CBL.

Thus the amount of bone loss was found to be more in thin biotype (Group B) cases as compared to thick biotype (Group A). The difference in mean crestal bone loss between the two biotypes can be attributed to the fact that the thick tissues formed the biologic width by proliferating laterally or coronally, which is unlike to that observed in thin biotype cases wherein the bone around the implants underwent remodelling to accommodate the soft tissue biologic width. [18]

CONCLUSION

This study was designed as a prospective controlled trial to assess the changes in crestal bone height around implants at the time of cementation. Two groups were formulated on the basis of soft tissue thickness at the implant site as Group A with mucosal thickness of ≥ 2mm- thick biotype and Group B with mucosal thickness of < 2mm – thin biotype. The study was conducted in the Department of periodontics & oral implantology, Govt. Dental College & Hospital, Srinagar. Thirteen patients were enrolled for the study after fulfilling the inclusion & exclusion criteria & duly attesting to the informed consent .They were divided into two groups of thick and thin biotype on the basis of tissue thickness at the proposed implant site prior to implant placement. Baseline measurements were made for the soft tissue thickness and crestal bone height (mesially & distally) at the implant placement and were then measured at the time of cementation to evaluate the change in crestal bone height in both the groups using CBCT.It was observed that there was a significant crestal bone loss at both the mesial and distal sides of the implant at the time of cementation in both the groups but group B showed more crestal bone loss as compared to group A. However, on comparing both the groups, nonsignificant difference in crestal bone loss between the two groups was observed till cementation.

Keeping in view these observations, it could be concluded from the study that the tissue biotype plays a significant role in early crestal bone loss around implants till cementation. Since after prosthetic rehabilitation many other factors such as occlusal loading might influence the crestal bone changes. However, there exits certain limitations in the study, the small sample size could have influenced the results. But, a number of earlier published and widely cited clinical trials used very similar [21] or even smaller sample sizes,[18] so it seems that sample size in the current study may be acceptable. Hence, it could be inferred from the study that thick biotype causes less crestal bone loss as compared to thin biotype. Nonetheless, further research needs to be undertaken for evaluating the effect of augmented thin tissues in order to prevent more crestal bone loss around implant, thus achieving implant success.

REFERENCES

1. Misch CE, Perel ML, Wang HL, Sammartino G, Galindo-Moreno P, Trisi P, et al. Implant success, survival, and failure: The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. Implant Dent 2008; 17:5-15.
2. Broggini N, McManus LM, Hermann JS, Medina RU, Oates TW, Schenk RK, et al. Persistent acute inflammation at the implant-abutment interface. J Dent Res 2003; 82:232-7.
3. Cochran DL, Hermann JS, Schenk RK, Higginbottom FL, Buser D. Biologic width around titanium implants. A histometric analysis of the implanto-gingival junction around unloaded and loaded nonsubmerged implants in the canine mandible. J Periodontol 1997; 68:186–198.
4. Berglundh T, Lindhe J. Dimension of the periimplant mucosa. Biological width revisited. J Clin Periodontol 1996; 23: 971–973
5. Stefano Speroni, Marco Cicciù, Paolo Maridati, Giovanni Battista Grossi, Carlo Maiorana. Clinical investigation of mucosal thickness stability after soft tissue grafting around implants: A 3-year retrospective study, Indian J Dent Res, 2010; 21(4).
6. Kaminaka, A., Nakano, T., Ono, S., Kato, T. & Yatani, H. Cone-beam computed tomography evaluation of horizontal and vertical dimensional changes in buccal peri-implant alveolar bone and soft tissue: a 1-year prospective clinical study. Clinical Implant Dentistry and Related Research, 2014; 17: 576–585.
7. Shin YK, Han CH, Heo SJ, Kim S, Chun HJ. Radiographic evaluation of marginal bone level around implants with different neck designs after 1 year. Int J Oral Maxillofac Implants 2006; 21:789-94.
8. Albrektsson T, Zarb G, Worthington P, et al. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. Int J Oral Maxillofac Implants. 1986; 1:11-25.

9. Smith DE, Zarb GA. Criteria for success of osseointegrated endosseous implants. J Prosthet Dent. 1989; 62:567-572.
10. Proskin HM, Jeffcoat RL, Catlin A, et al. A meta-analytic approach to determine the state of the science on implant dentistry. Int J Oral Maxillofac Implants. 2007; 22 suppl: 11-18.
11. Singh P, Garge HG, Parmar VS, Viswambaran M, Goswami MM. Evaluation of implant stability and crestal bone loss around the implant prior to prosthetic loading: A six month study. J Indian Prosthodont Soc 2006; 6: 33-7.
12. Shikha Nandal, Pankaj Ghalau, Himanshu Shekhawat, A radiological evaluation of marginal bone around dental implants: An in-vivo study. National Journal of Maxillofacial Surgery, Vol 5, Issue 2,| Jul-Dec 2014
13. T. Berglundh, Abrahamsson , M. Welander, Niklaus P. Lang Jan Lindhe. Morphogenesis of the peri-implant mucosa: an experimental study in dogs. Clin. Oral Impl. Res. 18, 2007; 1–8
14. T Linkevicius, P Apse, Simonas Grybauskas, Algirdas Puisys , The Influence of Soft Tissue Thickness on Crestal Bone Changes Around Implants: A 1-Year Prospective Controlled Clinical Trial, Int J oral maxillofac implants 2009;24:712–719
15. T Linkevicius, Peteris Apse, Dip Pros et al Influence of Thin Mucosal Tissues on Crestal Bone Stability around Implants with Platform Switching: A 1-year Pilot Study. J Oral Maxillofac Surg, 2010; 68:2272-2277
16. T Linkevicius, A Puisys , L Linkeviciene et al ,Crestal Bone Stability around Implants with Horizontally Matching Connection after Soft Tissue Thickening: A Prospective Clinical Trial, Clinical Implant Dentistry and Related Research, 2013.
17. T Linkevicius, A Puisys, M Steigmann, et al, influence of Vertical Soft Tissue Thickness on Crestal Bone Changes Around Implants with Platform Switching: A Comparative Clinical Study Clinical Implant Dentistry and Related Research, 2014; Volume 17, Number 6.
18. Berglundh T, Lindhe J, Ericsson I, Marinello CP, Liljenberg B, Thomsen P., The soft tissue barrier at implants and teeth.., Clin Oral Implants Res. 1991 Apr-Jun;2(2):81-90.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 26-07-2022; **Accepted:** 28-08-2022; **Published:** 30-09-2022