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Original Research

Effect Of Soft Tissue Biotype On Crestal Bone Changes Around Dental Implants: A Prospective Clinicoradiographic Study

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ABSTRACT:

Background: The long term success of implant therapy is influenced by various factors among which the effect of soft tissue biotype around implants remains less elucidated.This study was thus conducted to evaluate the changes in the soft tissue thickness and its effect on the crestal bone levels around dental implants treated in a conventional two-stage implant therapy. **Materials and Methods:** Twenty four subjects were enrolled for the study and divided into two groups with 12 subjects each, based on the tissue biotype at the proposed implant site, Group A –Thick Biotype and Group B-Thin Biotype using an endodontic reamer. Baseline soft tissue measurements were taken using a clear acrylic stent, 3mm apical to the crest bucally, followed by implant placement with a submerged protocol. Baseline CBCT after implant placement were done to measure the crestal bone height at the mesial and distal sides of implants. Subsequent measurements were taken at the time of cementation to evaluate the changes in soft tissue thickness and crestal bone loss in the two groups. **Results:** It was observed that there was a significant reduction in soft tissue thickness till cementation in both groups A & B but more pronounced in Group B (thin biotype) (p-value <**0.003)** .Similarly, 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. Furthermore, there exists a positive correlation between change in soft tissue thickness and mean crestal bone loss (mesial & distal with p-value **0.014 & 0.001**respectively) in both the groups which was statistically significant till cementation. **Conclusion:**It could be concluded from the study that the initial tissue biotype plays a significant role in early crestal bone loss around implants .Since after prosthetic rehabilitation many other factors such as occlusal loading might influence the crestal bone changes. It could be inferred from the study that thick biotype causes less marginal bone changes as compared to thin biotype which evokes more crestal bone loss during the formation of peri-implant seal.

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INTRODUCTION

Dental implants serve as an analogue to the tooth roots and have been successful in replacing the natural tooth both functionally as well as esthetically.The long term success of implants 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]

Among these factors crestal bone stability is of utmost importance for implant success and remains one of the most debated issues in implant dentistry. It is considered that median marginal bone loss of **0.5mm** duringhealing, followed by **≤1.5mm** during first year after loading and **≤0.2mm/ year** thereafter is a major success criteria for implant therapy. [2]

Various factors in turn contribute to the marginal bone loss and among these the influence of soft tissue biotype on crestal bone loss remains less elucidated.

It has been proposed that a minimum of 3mm of peri-implant mucosa is required for a stable epithelial connective tissue attachment to form. [3]Moreover, it is observed that thick tissues undergo less bone resorption in order to establish the biologic width around implantsthan thin tissues which can provoke crestal bone loss during the formation of peri-implant seal. [4]

Keeping in view these postulates the present study was undertaken to first categorize the mucosa into

Thick and Thin Biotypes and then evaluate the change in soft tissue thickness around implants after healing and correlate the same with the change in crestal bone height at the mesial and distal side of the implant at the time of cementation prior to occlusal loading placed in conventional (sub merged placement), two stage implant therapy.

AIMS AND OBJECTIVES

AIM

To evaluate the change in soft tissue thickness & its effect on crestal bone levels around dental implants treated in conventional two stage implant therapy.

OBJECTIVES

1. To assess the tissue biotype before implant placement using endodontic reamer and divide into two groups of **thick biotype** and **thin biotype**.
2. To assess the change in tissue thickness at cementation in two groups.
3. To measure the crestal bone height around implants at baseline and at cementation using CBCT in two groups.
4. To compare the changes in soft tissue thickness in two groups
5. To compare the crestal bone loss in two groups.
6. To correlate the changes in soft tissue thickness with the crestal bone loss.

MATERIALS AND METHODS

(I) THE STUDY DESIGN

This study was designed as a prospective controlled clinical trial to assess the changes in soft tissue thickness after implant placement and correlate the same with the marginal bone changes 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-**THICKBIOTYPE** [3] and Group B with mucosal thickness of < 2mm –**THIN BIOTYPE** [3].

(II) THE STUDY SAMPLE

A sample size of 24 subjects were selected using GPOWER software (Version 3.0.10) with the estimation that the least number of samples required in each group is 12 with 80% power and 5% significance level. Patients visiting the OPD, Dept. of Periodontics and Oral Implantology for the replacement of a single tooth in the maxillary or mandibular region with a single edentulous space surrounded by natural teeth on both the sides were screened. The study wasconducted in the Department of Periodontics & oral implantology, Govt. Dental College & hospital, Srinagarafter getting the approval from the Institutional Review Board. The patients were enrolled for the study after fulfilling the inclusion & exclusion criteria & duly attesting to the informed consent.

INCLUSION CRITERIA

- Presence of healed partially edentulous bone sites & a healthy overlying mucosa (at least 4 months after tooth extraction),
- No bone augmentation procedures before or during implant placement,
- Each site has to be a single missing tooth site bound by natural tooth on both the sides,
- Patients with good general health & no history of any systemic disease,
- Patients not on any medication that would influence the gingival status,
- Non- smokers ,
- Sufficient space for prosthetic rehabilitation.
- Patient willing to participate in the study & give a written informed consent

EXCLUSION CRITERIA

- Systemic or local disease, condition, or medication that would affect blood clotting, post-operative healing and /or osseointegration,
- On calcium channel blockers, anticonvulsants & immunosuppressant that would affect the gingival biotype,
- Untreated periodontal disease, rampant caries,
- Pregnant/Lactating women
- Psychiatric disorders
- Unable or unwilling to return for follow up or unlikely to be able to comply with study procedures according to the investigator's judgement.

(III) METHODOLOGY

The present clinical trial was conducted on 24 patients, as a comparative clinicoradiographicbstudy.Prior to implant placement all patients were prepared following the treatment protocol, first by Phase I therapy (scaling and root planning, restoration of carious teeth, orthodontic evaluation,endodontic treatment if any) and control of any existing periodontal disease. Two weeks following phase 1 therapy, periodontal re-evaluation was performed and patients were scheduled for implant surgery. Patients were allocated to Group A**(Thickbiotype)** and Group B **(Thin biotype)** based on the preoperative mucosal thickness at the proposed implant site. A clear acrylic stent was made for standardization of the measurement of soft tissue thickness buccally 3mm apical to the crest.[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. The intra-examiner reliability and internal consistency was assessed by using Cronbach alpha and was found to be 0.8, which depicted relatively high consistency.

SURGICAL PROCEDURE

All surgical procedures as well as clinical and radiographic measurements were done by a single operator. Following universal precautions, and local anaesthesia (lidocaine HCl with adrenaline 1:80,000) injection, customized clear acrylic stent was placed and using endodontic reamer no.20, [6] the thickness of overlying soft tissue 3mm apical to the crest of the edentulous site was measured as a fixed point for subsequent soft tissue measurements. Patients with thickness of ≥2mm were assigned Group A (thick biotype) and those with thickness of < 2mm were allocated group B (thin biotype).Following this, a mid- crestal incision on 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, soft tissue thickness was again measured using clear acrylic stent at the predetermined site i.e., 3mm apical to the crest using endodontic reamer and crestal bone changes were evaluated at the time of cementation using CBCT.

DATA COLLECTION

A) AT THE TIME OF IMPLANT PLACEMENT

(i) **Measurement of soft tissue thickness:**Baseline soft tissue thickness measurement was done prior to the implant placement**($T.T_b$).** For each patient a clear acrylic stent was made where a point was marked at the centre of the proposed implant site and bucally 3mm apical to it. Then using Endodontic reamer no.20 (yellow) [6] thickness of the soft tissue overlying the bone was measured and calibrated to the nearest millimetre using a stainless steel scale. Sites with mucosal thickness of 2.0 mm or more at the baseline would be categorized as **THICK BIOTYPE[3]**and sites with mucosal thickness of less than 2.0 mm would be categorized as **THIN BIOTYPE.[3]**

(ii) **Measurement of marginal bone levels:** Marginal or crestal bone height at the mesial and distal side of the implant at baseline (CBH_b) was measured using CBCT[7]**(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 bonetoimplant contact. [8] 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:

i) **Measurement of soft tissue thickness:**At the time of cementation of the crown, once the healing cap was removed, buccal soft tissue measurement was again taken with stent in place **($T.T_c$).** The difference between measurements at the baseline and cementation was noted as change in soft tissue thickness.

ii) **Measurement of marginal bone levels:**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 cementationwas designated as crestal bone loss (CBL) in both the groups.

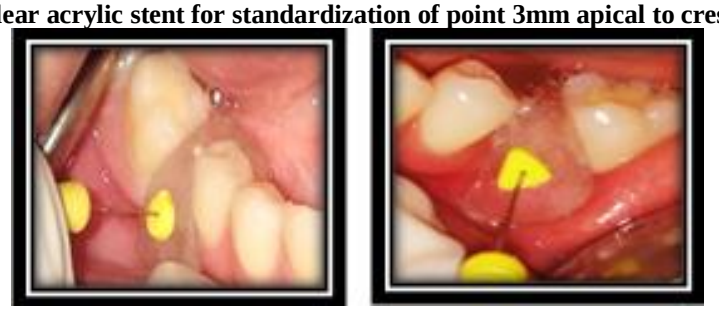
(IV) STATISTICAL METHODS

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. Graphically the data was presented by bar diagrams.A P-value of less than 0.05 was considered statistically significant.

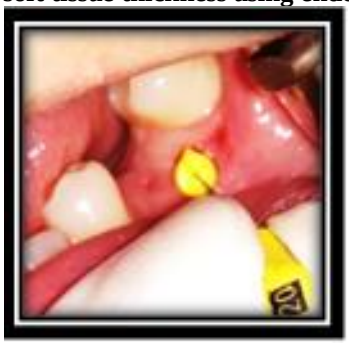
GROUP A: THICK BIOTYPE GROUP B: THIN BIOTYPE

Single edentulous space

Clear acrylic stent for standardization of point 3mm apical to crest

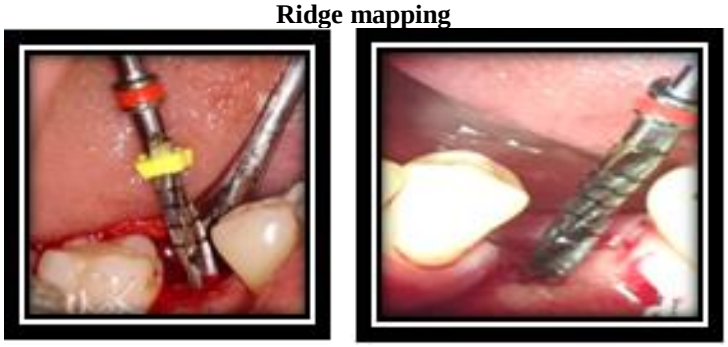


Measuring the soft tissue thickness using endodontic reamer



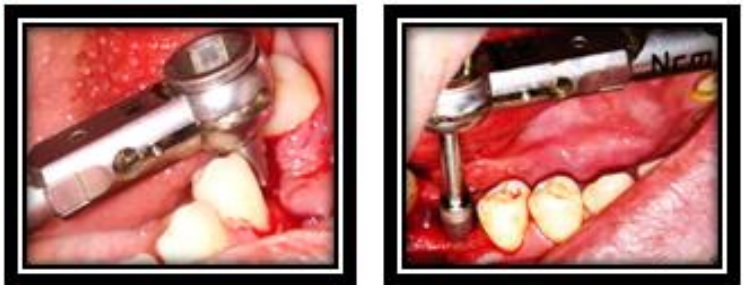
Soft tissue thickness <2mm Soft tissue thickness≥2mm

Ridge mapping

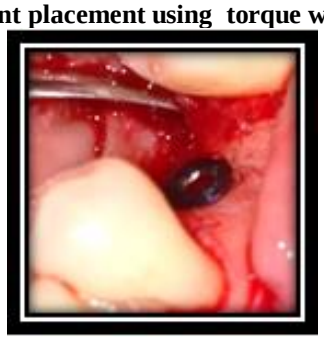


Osteotomy preparation

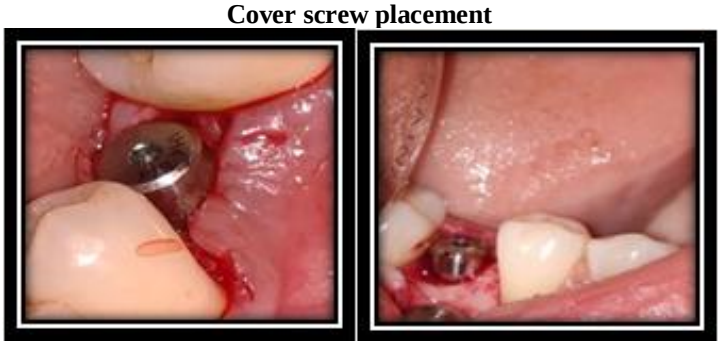
Implant guide pin



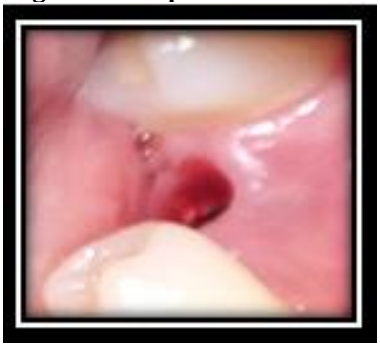
Implant placement using torque wrench



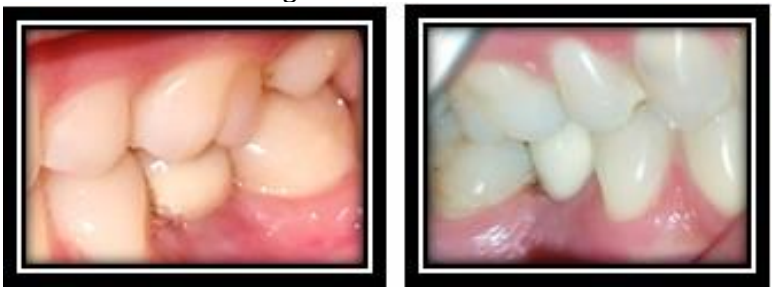
Cover screw placement



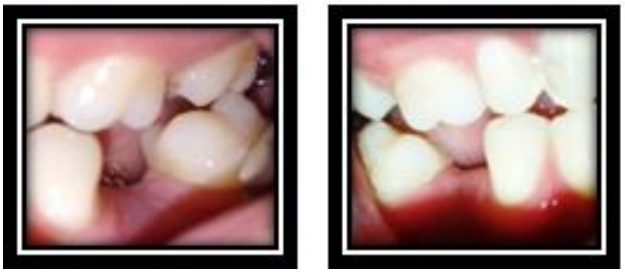
Healing abutment placed at second stage



Gingival contours formed



Cementation of crown

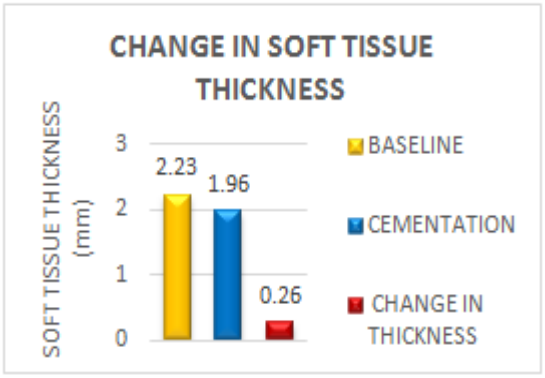


Final restorations in place, compared to pretreatment view

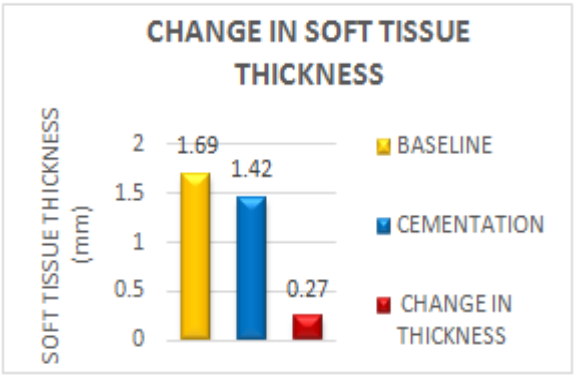
RESULTS

The study included 24 subjects and were divided into two groups of Thick Biotype (≥2mm) **(GROUP A)** and Thin Biotype (<2mm) **(GROUP B),** depending upon the mucosal thickness as measured using endodontic reamer. Both the groups had similar demographic as well as baseline clinical characteristics.**Graph 1** shows changes in soft tissue thickness in group A (Thick Biotype) as measured from baseline ($T.T_b$) i.e. at implant placement upto the cementation ($T.T_c$) is **(0.26± 0.09mm)**. It is observed that there is a significant decrease in mean soft tissue thickness from baseline to cementation which is found to be statistically significant **(P-Value < 0.001).Graph 2**show changes in soft tissue thickness in group B **(0.27 ± 0.20mm)**. A significant decrease in mean soft tissue thickness from baseline to cementation is found to be statistically significant **(P-Value 0.003).Graph 3**depicts 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 as observed from CBCT at the time of cementation and is statistically significant **(P value- 0.016)Graph 4** depicts a mean value of **0.19 ±0.80mm** 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).Graph 5** 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 ± 0.37mm)**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 themean 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).Graph 6** depicts 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).Graph 7**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 ±0.80mm)** was significantly higher than the mesial crestal bone loss of group A **(0.11 ±0.80 mm)** evaluated at the time of cementation.**Graph 8** 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 the distal crestal bone loss of group A **(0.10 ± 0.62 mm)** evaluated at the time of cementation.**Graph 9** show the comparison of change in soft tissue thickness in both groups A & B .Group B had more amount of change in soft tissue thickness (0.27± 0.20)at the time of cementation. However on comparing both the groups no statistically significant difference was seen **(P value-0.538).Graph 10& 11** shows the overall change in soft tissue thickness with the crestal bone loss (mesial & distal) in both the groups, there is a positive correlation betweenchange in soft tissue thickness &crestal bone loss - mesial **(r0.458)**and crestal bone loss-distal **(r-0.858)** with statistically significant **(p values- 0.014 &0.001respectively)** correlation.

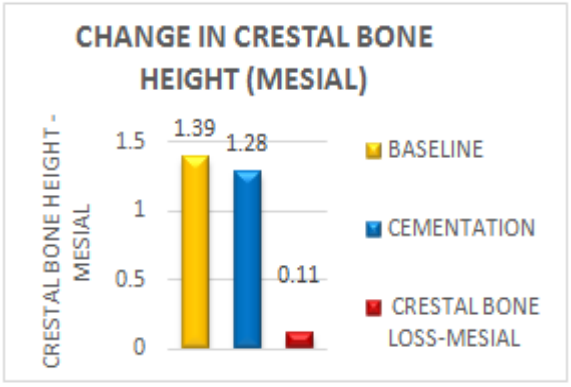


GRAPH 1 **GROUP A (THICK BIOTYPE)**

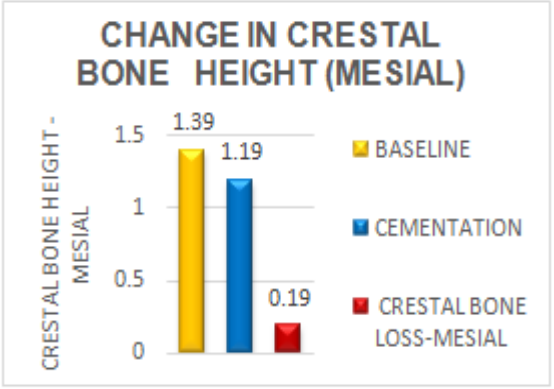


GRAPH 2 **GROUP B (THIN BIOTYPE)**

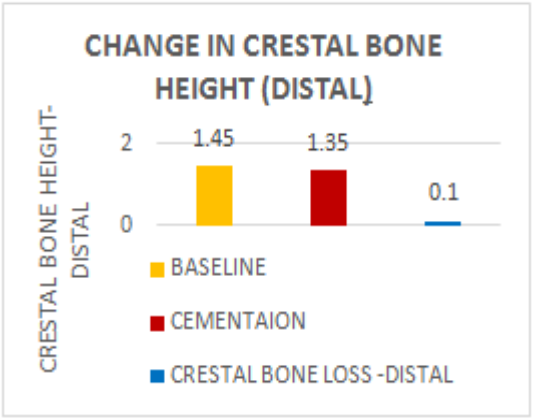
GRAPH 3 **GROUP A (THICK BIOTYPE)**



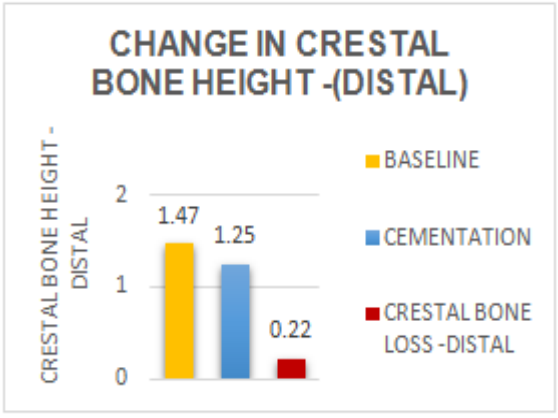
GRAPH 4 **GROUP B (THIN BIOTYPE)**



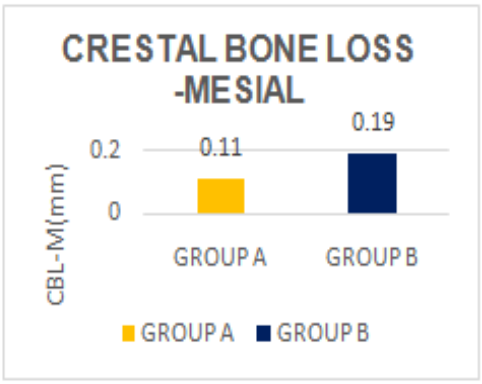
GRAPH -5 **GROUP A (THICK BIOTYPE)**



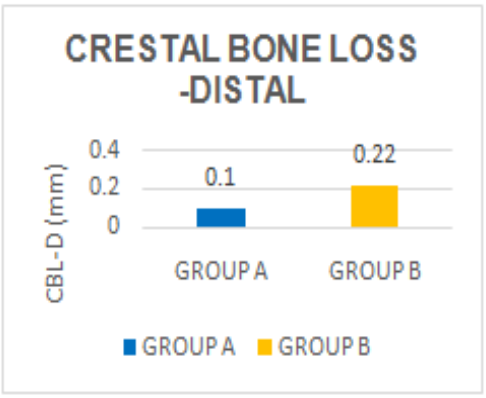
GRAPH -6 **GROUP B (THIN BIOTYPE)**



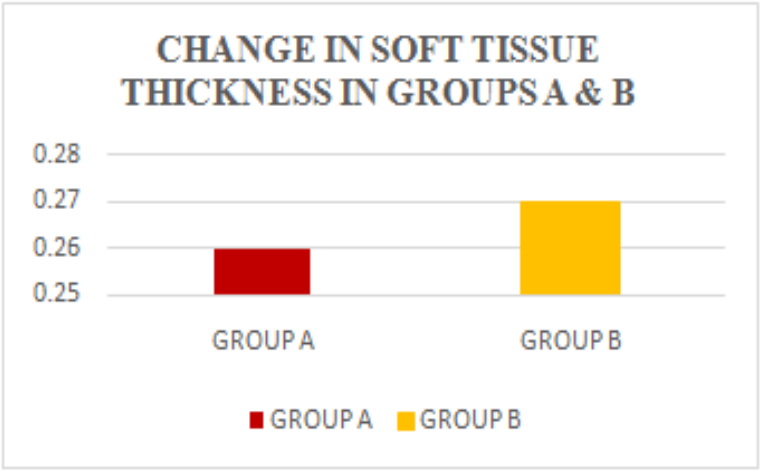
GRAPH 7: COMPARISON OF CRESTAL BONE LOSS-MESIAL IN GROUPS A& B



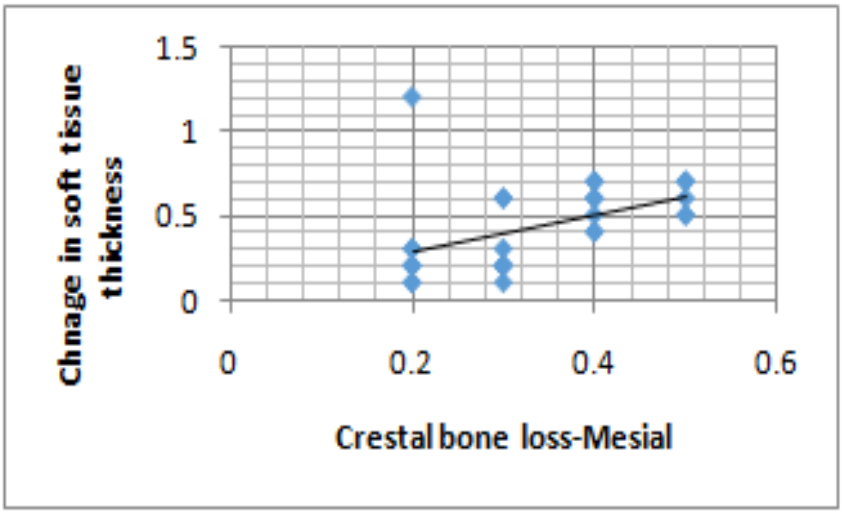
GRAPH 8: COMPARISONOF CRESTAL BONE LOSS- DISTAL IN GROUPS A& B



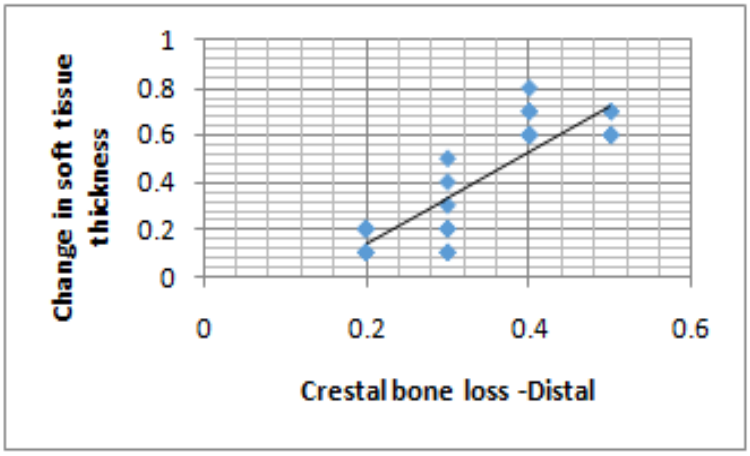
GRAPH 9: COMPARISON OF CHANGE IN SOFT TISSUE THICKNESS IN GROUPS A & B



GRAPH 10: CORRELATION BETWEEN CHANGE IN SOFT TISSUE THICKNESS & CRESTAL BONE LOSS -MESIAL



GRAPH 11: CORRELATION BETWEEN CHANGE IN SOFT TISSUE THICKNESS & CRESTAL BONE LOSS -DISTAL



DISCUSSION

CHANGE IN SOFT TISSUE THICKNESS

A reduction in the tissue thickness in both the thick and thin biotype patients from the baseline to cementation was observed but was more in the thin biotype group.

Group A (thicker biotype cases) showed a lesser reduction in thickness (0.26 ± 0.09mm) from placement to restoration, as compared to the thin biotype cases (0.27± 0.20 mm).Our results are in accordance with a 1- year prospective study done by Bhat, *et al* [9]on the population similar to the one used in the study .They observed that the reduction in tissue thickness was more pronounced in thin biotype cases as compared to thick biotype.The reason for the reduction in tissue thickness :

- The reduction till cementation can be attributed to the surgical intervention at implant placement as well at implant uncovering at second stage **Brisman DL,1996[10]**
- The higher amount of the connective tissue and vascularity in thicker as compared to the thin biotype tissues, and thus the ability of these tissues to re-organize is better than thinner tissues. **T Linkevicius et al,2009[11]**
- The formation and organization of the supra marginal connective tissue, morphology of the peri-implant mucosa, and establishment of the biologic width around the implants, respectively.**Nagpal S et al ,2012[12]**

CHANGE IN CRESTAL BONE HEIGHT

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 at cementation the mean crestal bone height in group A ,mesially and distally was noted as 1.28 ± 0.49 mm and 1.35 ± 0.42 mm respectively.

Similarly, 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 while the mean crestal bone height at cementation measured mesially and distally in group B was noted as 1.19 ± 0.50 mm and 1.25 ± 0.54 mm respectively. A significant decrease in crestal bone height in Group B (thin biotype) than Group A (thick biotype) was observed .

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.

COMPARISON OF CRESTAL BONE LOSS IN THE TWO GROUPS

The mean crestal bone loss in group B at the mesial side of the implant was 0.19 ± 0.80 mm (P value-0.010) which was significantly higher than group A ,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 group A 0.10 ± 0.62 mm (P value 0.014)

Linkevicius et al[14] compared thin & thick biotypes and found that the mean CBL values were more in thin biotypes as compared to thick biotype.

REASON OF MORE CRESTAL BONE LOSS IN GROUP B

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 [13].

CORRELATION BETWEEN CHANGE IN SOFT TISSUE THICKNESS & CRESTAL BONE LOSS

There exists a positive correlation between change in soft tissue thickness &crestal bone loss – mesial (r= 0.458) and crestal bone loss – distal (r=0.858) with

statistically significant (p values- 0.014 & 0.001 respectively) correlationThus it could be interpreted that as more changes in soft tissue thickness occurs, there is more crestal bone loss around mesial & distal side of implant.These results corroborated with studies done by Abrahamson et al, 1996[15]&Kaminaka et al. 2014[7]

REASON FOR POSITIVE CORRELATION

The potential for thin tissues to cause more crestal bone loss during the process of biologic width formation as compared to thick tissues. [16]As a result thin tissues undergo more changes in soft tissue thickness in the establishment of a "biologic width" which correlate with more CBL during wound healing. [17]

SUMMARY & CONCLUSION

It could be concluded from the study that the tissue biotype plays a significant role in early crestal bone loss around implants till cementation. After prosthetic rehabilitation many other factors such as occlusal loading might influence the crestal bone changes.Moreover positive correlation exists between change in tissue thickness &crestal bone loss.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 [18]or even smaller sample sizes,[19] 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 marginal bone changes 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.

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