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COMPARATIVE EVALUATION OF BONE CHANGES AFTER IMPLANT PLACEMENT AND LOADING WITH AND WITHOUT FLAP ELEVATION-AN INVIVO STUDY

Prosthodontics

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ABSTRACT

BACKGROUND: For the implant treatment modality to be successful, maximum attention should be focused on minimizing the trauma to the supporting bone and surrounding soft tissues.
The aim of the study: To compare and evaluate the crestal bone changes after implant placement using flap elevation and flapless technique.
MATERIALS AND METHODS: This study comprised of 30 implants placed in 15 subjects. In each subject, one implant was placed with "flapless" and other using "flap elevation" technique. Radiographic assessment of crestal bone height was carried out using standardized intraoral periapical radiograph of the site at baseline, 3 months, 6months, 9 months after implant placement. Data was checked for normality using one way ANOVA test, compared using paired t test, independent t test on both mesial and distal sides separately.
RESULTS: There was statistically significant difference in bone loss among two groups.
CONCLUSION: Both techniques showed a reduction in CBH with time but the flapless technique showed a lesser reduction. Therefore, the flapless technique can be considered as a better treatment approach for placement of implants, especially where adequate width and height of available bone are present.

KEYWORDS

Crestal Bone Loss, Flapless Procedure, Flap Elevation Procedure, Delayed Loading

1. INTRODUCTION

Implant dentistry is rapidly evolving in recent times and considerable emphasis is being placed on predictable treatment planning with maximum patient comfort [1]. Dental implants have been successful in preventing the physical and cosmetic consequences associated with tooth loss by serving as an artificial tooth root [2].

The longevity of dental implants relies on the integration between implant components and intraoral tissues (hard and soft). Radiographically bone loss was observed in the first year of function, which is mainly due to the breakdown of implant tissue interface at the crestal level region of the bone which is characterized by the term "Saucerization" [3]. 1.5 mm of bone loss during the first year and 0.2mm of bone loss every year annually at the crestal level of implant are considered normal i.e., within the limits of a normal physiologic process. Continued crestal bone loss following osseointegration may result in increase in the mobility and subsequent failure of the dental implant [4].

Factors which are responsible for crestal bone loss after implant placement include delayed vs immediate implant placement, staging, timing of implant loading, requirement of bone graft at the implant site, presence of infection, medical conditions that compromise wound healing, smoking, status of oral hygiene, location of implant placement, and size of the implants. Other factors such as periosteal elevation during surgery, overheating of the instrument resulting in osteonecrosis, occlusal trauma,

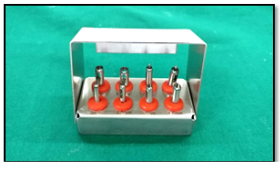

Fig 1: Tissue punch kit

Aim of this study was to evaluate and compare the changes in crestal bone height around implants placed with Flapless and with Flap elevation techniques after 3 months, 6 months, 9months of implant placement.

2. PATIENTS AND METHODS

A double blinded, randomized controlled trial (RCT) was done including the subjects selected from the outpatient Department of Prosthodontics, Crown and Bridge and Implantology, Meghna institute of dental sciences, mallaram, Nizamabad. Inclusion criteria includes subjects with a)missing mandibular posterior teeth, b)within age group of 25-35 years, c) adequate bone width and height, Bone density- D1,D2, adequate interocclusal clearance & adequate mesio-distal (m- d) space in edentulous area, Subjects with soft tissue thickness of minimum 2 mm were included in the study. Exclusion criteria include subjects with smoking habits, debilitating diseases and immunocompromised, Para-functional habits. Ethical approval was obtained from the Institutional Ethics Committee with approval no.MIDS-MDS 2017-2 and written informed consent was obtained from all selected subjects. The subjects were divided into two groups: Group I i.e. implants were placed by following conventional surgical protocol using flap elevation technique, Group II- implants were placed by following conventional surgical protocol using flap less technique.

Initially, 37 sites were selected for the study, but during treatment planning procedure, three subjects were excluded after diagnostic impressions and radiographic investigations as soft tissue thickness was not adequate in edentulous area for implant placement, two subjects dropped out after CT scan procedure and two subjects were excluded from the study after implant placement due to implant failure. So, a total of 15 implants for each group i.e.., 15 – control group

(Flap elevation technique),15 – Experimental group (Flapless technique), with in age range 25-35 years. Patient's medical and personal history was recorded, the complete dental examination was performed. The initial radiographic assessment was done using intraoral periapical (IOPA) radiograph and orthophantomograph, CBCT were evaluated for planning of appropriate implant sizes.

Diagnostic impressions were made using irreversible hydrocolloid impression material and casts were poured using type III dental stone. Centric records were made using functional manipulation following Dawsons technique with Alu wax. Eccentric records (protrusive) were made. Diagnostic casts were mounted to semi adjustable articulator using facebow transfer. Programming of articulator was done. Centric and eccentric interferences are marked on the articulator using red and blue colored articulating papers respectively. These interferences are removed intraorally by performing enameloplasty. New set of Preliminary impressions were made, casts are poured and the articulation was done by making a new centric bite registration. Crown height space was evaluated and cases with the crown height space ranging from 8-12mm were selected. Bone mapping was done to evaluate soft tissue thickness (fig-2).

Diagnostic wax up was done using acrylic teeth. A 2mm soft thermoplastic sheet was heat pressed on to the mandibular cast. The entire thermoplastic sheet except the teeth adjacent to the edentulous span was cut using BP blade No.12. A three unit thermoplastic sheet along with acrylic teeth is used as a stent for the surgical placement of implant.

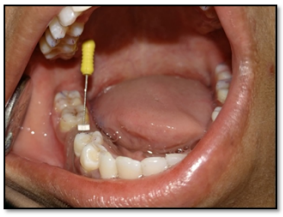

Fig.2-Bone mapping

SURGICAL PROCEDURE:

All the patients were subjected to complete surgical profile. A standard surgical protocol was followed for osteotomy procedure. All patients received prophylactic antibiotic therapy. The areas were anesthetized by local infiltration using 2% lignocaine with 1:200000 adrenaline. Initially bone caliper (fig-3) was used to measure the bucco-lingual dimensions of the bone at approximately three different point's i.e.., the top of the ridge, near where the center of the implant will be positioned, and near where the apex of the implant will be positioned.

Fig.3- Bone caliper measuring width

These measurements will reveal the presence of any undercuts in the bone. If an undercut of more than 15 degree is detected, traditional flap reflection is recommended to allow for greater visibility when placing the implant. If no significant undercut exists flapless procedure was carried out.

For control group (F) a longitudinal mid-crestal incision and sulcular incision was given, mucoperiosteal flap was raised. Using surgical stent and following drilling protocols implant placement was done. Minimum of 35–45 Ncm of torque was achieved which ensured a good primary stability of the implant. Now fixture mount was removed and cover screw was placed. Mucoperiosteal flap was closely approxi mated by using non resorbable suture material.

For experimental group, flapless (FL), surgical site was marked with probe by using the thermoplastic stent. After marking, rotary tissue punch of 1mm greater than the desired implant diameter was secured to the hand piece and was positioned over the osteotomy site at 300 rpm speed to create an outline of the punch and soft tissue plug was removed using curette and preserved in normal saline. Subsequent drilling was done to prepare the site according to the selected implant size. Implant was inserted with the help of a torque wrench and cover screw was placed. Surgi glue was applied onto the tissue plug and repositioned into the osteotomy site and sutures were placed on the other side. (fig-4,5).

Fig.4-Surgie glue application

Fig.5-Sutures irt 36, surgie glue irt 46

POST OPERATIVE CARE:

After surgery, cold and soft diet was recommended for 7 days. Patients were instructed to use chlorhexidine mouthwash 0.2% for 1 minute twice a day for 12 days. Patients were recalled after 3 days of implant placement to evaluate the surgical site and any postoperative complications. And again, patients were recalled after 10 days of implant placement for suture removal (when needed) in control group and oral hygiene instructions were given.

FABRICATION OF PROSTHESIS:

At 3-4 months interval, second stage surgery was performed using tissue punch and healing abutment was placed. After 10 days, Open tray impression was made using a autopolymerising acrylic custom tray. Centric and protrusive bite registrations were made. Cast is poured using die stone. Facebow transfer, mounting procedures, programming of articluator were done. Extra oral milling of abutment is done using milling machine. A temporary crown is fabricated using auto-polymerizing acrylic resin with putty index in indirect method. The temporary crown was luted with zinc oxide eugenol cement. After two weeks of interval, temporary crowns were removed; permanent crowns were fabricated and cemented using type 1 glass ionomer cement (fig-6).

Fig.6-Final prosthesis

Interference free occlusion is provided for all the cases in order to prevent non-axial forces on implant which will lead to crestal boneloss. Patients were demonstrated oral hygiene maintenance and were recalled every month to evaluate plaque control and oral hygiene maintenance.

Fig.7-Paralleling cone technique

Intra oral periapical radiographs of the sites with parallel cone technique (long cone) using re-positionable film holders were taken (fig-7).

Radiographs were scanned using dual lens scanner(*Epson V 700*) and the images were inverted in Vista Dent Data base server[Digital cephalometric analyzing tool, version 4.2.1929)] and uploaded in Image J software (fig-8). Two standard reference lines were used to measure the crestal bone loss i.e..,Reference 1: lowest point of marginal bone around the implant at the bone level, Reference 2: Apical corner of the implant. After the images were uploaded in the software the distances between two lines were measured with the Image J analysis tool (distance was measured to the nearest 0.01 mm in this software).Bone levels were measured on the mesial and distal aspects of the implants. A positive value indicated a level coronal to the first reference line and a negative value indicated a level apical to the first reference line. The readings were recorded at baseline, 3rd month, 6th month, 9th month after implant placement and then analyzed statistically. These measurements were done after calibrating the software to avoid any error in the values. All measurements were done by two examiners who were blinded to the methods used in the study. Measurements were repeated in case of any mismatch. This gave us the measurement of the crestal bone loss around an implant with time.

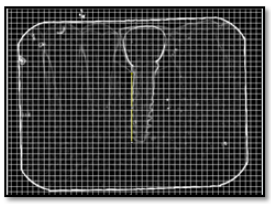

Fig.8-Measuring bone height

3.RESULTS:

The data entered in excel sheet was checked for normality using ANOVA one-way test. Paired t test was done to evaluate intragroup comparisons. Independent t test was done to evaluate intergroup comparisons. . When comparing the two surgical techniques, there was a statistical significance ($P < 0.05$). Crestal bone loss increased from baseline to 9 months mesially (11.60±0.16 to − 15.20±0.05) for the Flap elevation technique and increased (4.00±0.61 to 9.40±0.37) for the flapless technique. On the distal side, it decreased (11.30±0.39 to 15.50±0.22) for the Flap technique and also decreased (1.55±0.25 to 6.00±0.47) with the flapless technique.

Independent sample t test is conducted in control group on distal side, % of change was -8.89 from Baseline to 3rd month and it is -9.21 from Baseline to 6th month and -12.20 from Baseline to 9months.In case of experimental group the % of change was -1.13 from Baseline to 3rd month and -1.52 from Baseline to 6months and -4.36 from Baseline to 9months which gives statically significant P value.(Figure 9, Figure 10)

Table-1 Mean difference comparison between Experimental and Control group at Mesial side.

Time interval	FLAP ELEVATION		FLAPLESS		P value
	Difference MEAN±SD	% of change	Difference MEAN±SD	% of change	
Baseline to 3rd month	11.60±0.16	-9.35	4.00±0.61	-3.12	0.000 S
Baseline to 6th month	11.00±0.11	-8.87	5.00±0.75	-3.90	0.000 S
Baseline to 9th month	15.20±0.05	-12.26	9.40±0.37	-7.33	0.000 S

Table-2 Mean difference comparison between Experimental and Control group at Distal side

Time interval	FLAP ELEVATION		FLAPLESS		P value
	Difference MEAN±SD	% of change	Difference MEAN±SD	% of change	
Baseline to 3rd month	11.30±0.39	-8.89	1.55±0.25	-1.13	0.000 S
Baseline to 6th month	11.70±0.49	-9.21	2.09±0.42	-1.52	0.000 S
Baseline to 9th month	15.50±0.22	-12.20	6.00±0.47	-4.36	0.000 S

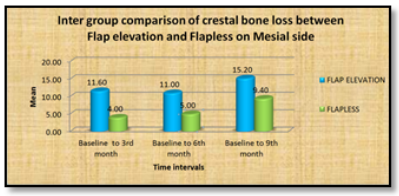

Figure-9

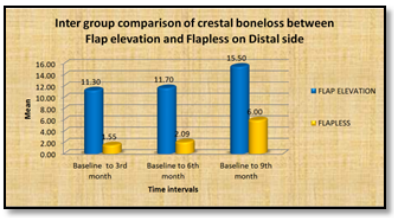

Figure-10

When comparing the two groups, the FL method showed decreased bone loss when compared with the flap elevatioon method and it was statistically significant ($P < 0.05$) [Tables 1 and 2].

4. DISCUSSION:

The success of dental implants is highly dependent on integration between the implant, intraoral hard and soft tissue and also on the precision, experience of implant surgeon as there is a learning curve which affects the success rate of flapless implants. In addition to these, surgeons must have knowledge of indications and techniques used for management as well as augmentation of periimplant tissues [3],[11]. When flapless technique was relatively new, the success rate of flapless implant placement was relatively low and increased considerably, from 74.1% in 1990 to 100% in 2000. Becker *et al*., stated that there was 98.7% success rate at 2 year follow-up with the flapless approach. Al-Ansari *et al* (1998), noted 100% success rate with the flapless approach in 20 implants. Rousseau, in a randomized controlled trial, found the success rate of 98.3% with flapless technique while 98.5% with traditional flap technique. Similarly, Van de Velde *et al*., reported success rate of 97.3% with flapless method compared to flap technique in which 100% success rate was seen in a randomized trial. On the other hand, Chrcanovic *et al.*, concluded that there is a increased possible risk Ratio of 1.75 in implants placed through flapless implant technique [11].

The elevation of periosteum is considered as one of the possible contributing factors for crestal implant bone loss in conventional flap technique. When periosteum is stripped, the osteogenic layer immediately adjacent to the bone surface is destroyed, and the blood supply of the underlying compact bone is compromised and active angiogenesis is induced leading to osteoclastic activity. Minimal stripping, consistent with sound surgical principles of access and soft tissue management, is an important consideration in implantology [5],[7],[8].

Wide keratinized tissue band has an important role in formation of a resistant barrier against mechanical trauma during oral hygiene procedures. This clearly indicates the significance of maintenance of the soft tissue configuration around the implant placed [8],[12]. Branemark 1985; Ten Cate 1985; Berglundh 1993 stated that the maintenance of stability and function of the load carrying implant is dependent on a well-functioning soft-tissue barrier. It is commonly claimed that there is a need for an “adequate” zone of keratinized mucosa around dental implants to prevent soft-tissue recession and to facilitate oral hygiene measures (Schroeder et al. 1981; Buser et al. 1990; ten Bruggenkate et al. 1991; Rapley et al. 1992). Deepak Moses Ravindran et al concluded that flapless implant surgery using either immediately loading implants or DL implants, demonstrate enhancement of implant esthetics [13].Tomas Linkevicius et al concluded that platform switching does not prevent crestal bone loss if, at the time of implant placement, mucosal tissue is thin. In thick soft tissue, use of platform-switched implants maintained crestal bone level with minimal remodeling [14]. Algirdas Puisys stated that augmentation of thin soft tissues with allogenic membrane during implant placement could be way to reduce crestal bone loss [15].

In the present study, loading was done at 3-4 months interval following Branemarks protocol [16]. After osseointegration, mechanical stresses

and strains beyond the physical limits of hard tissue have been suggested as the primary cause of both initial and long-term bone loss around implants. Occlusal overload is often regarded as one of the main causes for peri-implant bone loss and implant prosthesis failure, because it can cause crestal bone loss. Prior to the evaluation of occlusion on implant reconstruction, the occlusion should be evaluated and all occlusal prematurities should be eliminated during maximum intercuspation and centric relation [17].In the present study all the premature occlusal contacts are removed prior to the implant placement.

Miyata et al speculated that occlusal overload from excessive lateral forces may act as one of the factors causing marginal bone loss and implant failure [18]. As stated by Lundgren & Laurell, working and non-working interferences should be avoided in posterior restorations during lateral excursions. Weinberg in 1998, Curtis et al. in 2000 proposed key factors to control bend overload in posterior restorations: a) reduced inclination of cusps, b) centrally oriented contacts with a 1– 1.5mm flat area, c) a narrowed occlusal table, and d) elimination of cantilevers. In an in vivo study, conducted by Morneburg & Proschel it was reported that narrowing the bucco-lingual width of the occlusal surface by 30% and chewing soft food significantly reduced bending moments on the posterior three-unit fixed prosthesis. The study also suggested that soft diet and reduction of the buccolingual, occlusal surface need to be considered in unfavorable loading conditions, such as immediate loading, initial healing phase, and/or poor bone quality [19].

In the previous studies conducted, the surgical site of implants placed using flapless technique was exposed to oral cavity which lead to food lodgement and periimplantitis..So the present study uses surgie glue to close the surgical site, thus preventing periimplantitis that may cause early implant bone loss or failure and may give false results.

In the present study, all possible etiological factors causing early implant bone loss were eliminated by selecting cases with soft tissue thickness, minimum of 2mm, all the implants were placed at the crestal region to prevent microgap, and also reformation of biological width which may lead to cretal bone loss to violate the errors that may occur on evaluation of bone loss in both groups. Implant protective occlusion was given and all the occlusal modifications were made in the final prosthesis so that the factors that may contribute to the crestal bone loss are avoided. The prosthesis was fabricated with no interferences on lateral and protrusive moments.

It is noticed that there is only minimal amount of bone loss noticed on mesial side of experimental group from baseline to 3months, 6months, 9 months follow up and the degree of bone loss was more on mesial side of control group from baseline to 3rd month, when compared to baseline to 6thand 9th month.

On the distal side of control group there is significant amount of bone loss occurred when compared to that of experimental group. Significant difference was found from baseline to 3rd month when compared to other time intervals.The reason for this can be the type of surgical technique used in the study i.e.., flapless technique of implant placement which minimized the initial crestal boneloss from base line to 3months period, because the present study eliminated all the possible etiological factors that might cause the crestal boneloss.

LIMITATIONS OF THE STUDY INCLUDED:

Only ideal cases with adequate bone volume and normal bone contour, ideal soft tissue thickness were selected for the study. In this study, bone loss was measured only on mesial and distal sides of the implants. For more predictable results, total bone loss including that on buccal and lingual sides should also be measured. Small sample size and short observational period were also the limitations of our study.

5.CONCLUSION:

Within the limitations of study, it can be concluded that the bone loss was more in control group when compared to experimental group from base line to 3months follow up period. There after the amount of bone loss was almost same in both control and experimental groups from 3months – 9months.There is only minimal amount of bone loss observed on mesial side of experimental group (Flapless) than control group (Flap elevation).On the distal side of control group (Flap elevation) there is significant amount of Bone loss occurred when compared to that of experimental group (Flapless) from baseline to 9months follow up.

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