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Crestal bone levels around immediately loaded single piece implants using flap and flapless technique: A clinico - radiographic study

[1]Dr. Sindhe Sai Charan, Assistant Professor, Department Periodontics & Implantology, Mahavir Institute of Medical Sciences, Vikarabad

[2]Dr. Likitha Vuppalapati, MDS, Oral Medicine and Radiology, Meghna Institute of Dental Sciences

[3]Dr.Manojna Polkampalli, Sr. Lecturer, Department of Oral Medicine and Radiology, Mallareddy Institute of Dental Sciences

[4]Dr. Harshitha Akkinepally, MDS, Oral Medicine and Radiology, Kamineni Institute of Dental Sciences, Narketpally

[5]Dr. Avinash Vallabhaneni, BDS, Kamineni Institute of Dental Sciences, Narketpally

[6]Dr. Avutu Naveen Kumar Reddy, BDS

Corresponding Author: Dr. Harshitha Akkinepally, MDS, Oral Medicine and Radiology, Kamineni Institute of Dental Sciences, Narketpally

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Abstract

Background: The accelerated treatment time and less surgical intervention via immediately loaded implants and single-stage surgical approach have significantly enhanced patient comfort, satisfaction and acceptance.

Aim: To evaluate crestal bone levels around immediately loaded single piece implants using the flap and flapless method.

Methods: This comparative study evaluated crestal bone loss around implants in 10 partially edentulous sites randomly divided into 2 groups i.e. Group I (Flapless approach) and Group II (Flap approach). Changes in crestal bone loss was evaluated using radiovisiography (RVG) at baseline, 3 months and 6 months postoperatively.

Results: Though, both the procedures resulted in significant crestal bone reduction, the mean values showed lesser bone loss in flapless group than flap group. Conclusion: Flapless group in the present study showed substantial improvement in clinical and radiographic parameters compared to flap group. The intact blood supply from soft tissue facilitates adequate

healing, a critical factor in preventing early bone loss around implants.

Keywords: Dental Implant, Alveolar Bone Loss, Immediate Dental Implant Loading, Radiographic

Introduction

The field of implant dentistry has evolved significantly in recent decades, with substantial changes in principles, hypotheses, and treatment methods. Dental implants offer numerous treatment options, high success rates, and are a reliable solution for replacing missing teeth, regardless of any issues with the stomatognathic system. One innovative change in recent years is the use of single-stage implant placement with a flapless (FL) surgical approach, which has shown promise in managing edentulism.[1]

The single-piece implant (SPI) design is unique because abutment is attached to the implant which makes it a single unit. Thus, this design of SPI eliminates the micro gap between abutment and implant. The SPI placement procedure can be either flapless or by raising the flap.

In the flapless surgical technique, soft tissue from the implant site is removed with the help of a tissue punch or the osteotomy is directly prepared through the soft tissue.[2] Whereas, with the flap approach, an incision in the mucosa or the mucobuccal fold is made and then a flap is reflected to expose the underlying bone. The implants are then placed and the flaps are repositioned with sutures.

The Flapless technique is one of the latest minimally invasive surgical methods of implant placement without the need to raise a mucoperiosteal flap. This procedure has many advantages for the patients and the surgeon these include a shorter surgical treatment time, minimal bleeding, and less postoperative discomfort for the patient.[1]

Aims and Objectives

The study aimed to evaluate crestal bone levels around immediately loaded single piece implants using flap and flapless method. The objectives of the study are:

1. To assess crestal bone loss radiographically of immediately loaded single-piece implants performed by flap technique at baseline, 3 and 6 months.
2. To assess crestal bone loss radiographically of immediately loaded single-piece implants performed by flapless technique at baseline, 3 and 6 months.
3. To compare crestal bone loss radiographically of immediately loaded single-piece implants performed by using flap and flapless technique at baseline, 3 and 6 months.

Subjects and Methods

This comparative study evaluated crestal bone loss around implants in 10 partially edentulous sites randomly divided into 2 groups i.e. Group I (Flapless approach) and Group II (Flap approach). Changes in crestal bone loss was evaluated using Radiovisiography (RVG) at baseline, 3 months and 6 months postoperatively. Institutional ethical clearance was obtained (MDC_KT_19201103002D). Informed consent was taken from all the participants before commencing the study.

The subjects who are included in the study are those who were aged between 30 and 50 years, with good oral hygiene and those who were requiring a replacement of the missing teeth. Adequate bone volume to accommodate an implant of appropriate dimension and cooperation from the subject in terms of willingness for the surgery and proper follow-up visits were a part of the inclusion criteria for the study.

Those subjects who are medically compromised, those with insufficient bone quantity, or parafunctional habits or a history of alcohol, drug dependency, smoking and poor oral health were excluded from the study.

Patients who met the inclusion criteria were examined under good illumination with the help of a mouth mirror, periodontal probe, a tweezer and pellets of cotton. All the patients were explained in detail about the possible treatment plan and the patients voluntarily signed the informed consent before commencement of the study. After a thorough initial clinical examination of the edentulous site, CBCT was advised for all patients. Impressions were recorded with alginate impression material and diagnostic casts poured. A haematological profile was carried out for all the subjects.

A detailed history was taken and a clinical examination was done along with a preoperative radiographical assessment under strict aseptic conditions.

Clinical Parameters

The following clinical parameters were evaluated at baseline 3 and 6 months

1. Modified sulcus bleeding index (mSBI)

The bleeding tendency of the marginal peri-implant tissues was evaluated at six sites (mesiolabial, labial, distolabial, mesiolingual, lingual and distolingual) at baseline, 3 and 6 months. The scoring criteria were followed according to the parameters given by Mombelli A & Lang NP,1994.[3]

II. Probing pocket depth (PPD)

It refers to the distance from the gingival margin to the bottom of the sulcus. Probing in the peri-implant sulcus will be made with light force to avoid undue tissue damage and over-extension into the healthy tissues. Probing depth was evaluated at the implant site using with UNC 15 plastic probe at six sites as mentioned above at baseline, 3 and 6 months.

Radiographic parameters

Radiographic bone-level changes were measured on standardized CBCT.

The lower corner of the straight cylindrical portion (Junction between abutment and implant neck) of the implant was used as reference point [Fig 1]. Interproximal height of bone measured from the apical end of the first thread of the implant to the crest of the bone [Fig 1]. Bone levels were measured on the mesial and distal sides of each implant, at baseline, 3rd and 6th month follow up crestal bone loss for both groups were evaluated by using RVG. AUTO CAD software was used to assess the marginal bone levels at baseline, 3 and 6 months.

Surgical therapy

In Group I patients, flapless procedure was performed. Tissue punch was used at the site of implant placement. [Figure 1,2] For patients in Group II, full thickness mucoperiosteal flap was raised before placing the implant. [Figure 3] Mid crestal incision was given at the site of implant placement using 15 no. Bard parker blade. A full-thickness mucoperiosteal flap was raised using Periosteal elevator. The osteotomy site was prepared to the desired width and depth using sequential drilling. Implant of selected dimensions was placed at the site. [Figure 4] Single-piece implants were inserted into desired position and after 48 hours, provisional restorations were cemented using zinc phosphate cement. Patients were recalled at 3 months and 6 months after surgery, to evaluate clinical parameters and crestal bone loss.

Post-operative medication (antibiotic and NSAIDs) was given for five days. The patients were instructed to have a soft diet for 24 hours. To maintain oral hygiene, the patients were instructed to gently rinse with 0.12%

chlorhexidine gluconate solution twice daily for 2 weeks.

Results

The present study evaluated crestal bone loss around implants in 10 partially edentulous sites randomly divided into 2 groups i.e. Group I (Flapless approach) and Group II (Flap approach). Changes in crestal bone loss were evaluated using Radiovisiography (RVG) at baseline, 3 months and 6 months postoperatively. [Figure 5,6].

The crestal bone level changes were evaluated by using AUTO CAD software.

The difference in mean mSBI score at 0-3 months at group I was 0.43 ± 0.18 and in group II was 0.17 ± 0.17 which was statistically significant difference (p<0.05). Mean difference in mSBI score at 3-6 months at group I was 0.28 ± 0.16 and in group II was 0.23 ± 0.09 which was statistically non-significant (p>0.05). Mean difference in mSBI score at 0-6 months at group I was 0.72 ± 0.24 and in group II was 0.40 ± 0.11 which was statistically significant difference (p<0.05). In other words, there was a statistically significant reduction in mean mSBI score in flapless group (group I) compared to flap group (group II) from baseline to 6 months. [Figure 7]

The difference in mean PPD at baseline to 3 months at group I was -0.26 ± 0.28mm and in group II was 0.28 ± 0.26mm; at 3 to 6 months for group I was -0.21 ± 0.41mm and for group II was 0.12 ± 0.22mm; and at baseline to 6 months at group I was -0.46 ± 0.65mm and in group II was 0.40 ± 0.14mm. All the differences in mean PPD at various time intervals were statistically significant (p<0.05). [Figure 7]

On the mesial surface, mean difference in crestal bone loss at 0-3 months in group I was 0.12 ± 0.05mm and in group II 0.24 ± 0.12mm which is highly statistically significant difference (p<0.001). Mean difference in crestal bone loss at 3-6 months in group I was 0.11 ± 0.04mm and in group II was 0.13 ± 0.28mm. Similarly, mean crestal bone loss at 0-6 months in group I was 0.23 ± 0.07mm and in group II was 0.37 ± 0.38mm. [Figure 8]

On mesial surface mean difference in crestal bone loss at 3-6 and 0-6 months were statistically significant (p<0.05). Thus, there was a statistically significant crestal bone loss on the mesial surface in group II compared to group I more so from the baseline to 3 months interval (p<0.001**). [Figure 8]

On the distal surface, mean difference in crestal bone loss at 0-3 months in group I was 0.11 ± 0.05mm and in group II was 0.50 ± 0.13mm and this difference was statistically significant (p<0.05). Mean difference in crestal bone loss at 3-6 months in group I was 0.12 ± 0.01mm and in group II was 0.08 ± 0.10 and mean crestal bone loss at 0-6 months in group I 0.22 ± 0.04mm and in group II was 0.58 ± 0.12mm. On distal surface mean crestal bone loss at 3-6 and 0-6 months were highly statistically significant difference (p<0.001). Thus, there was more crestal bone loss on the distal surface in group II than in group I and this difference between the groups was statistically significant (p<0.05).

Discussion

The clinical replacement of lost natural teeth by osseointegrated implants has been represented as one of the most significant advances in dentistry. Compared to all other dental disciplines, implant dentistry has enjoyed far more innovation and progressive developments in recent years mainly in the development of new implant systems, the propagation of new and improved diagnostic procedures and the introduction of novel surgical techniques.[4]

When it comes to the design of the implant, there are two types: two-piece or single-piece implants. A two-piece implant, also known as a bone-level implant (BLI), positions the implant neck at the critical level of the alveolar ridge and consists of an endosseous implant and a transmucosal abutment. The healing abutment can be placed at the same time as the implant or during a second-stage surgical entry. Various modifications and designs to the abutment are available to improve the aesthetic outcomes of the prostheses. However, in two-piece implants, there is a possibility of microleakage and micromovement of the prosthetic abutment, which can lead to local inflammation of the soft tissue around the implant.[5]

In addressing the drawbacks associated with two-piece implants, a novel design was proposed to integrate the abutment with the implant, creating a single unit. This single-piece design, incorporating the transmucosal abutment as an intrinsic component of the implant, eliminates the structural vulnerabilities present in a two-piece implant system. As a result, the single-piece implant, provided it possesses adequate mechanical strength, can be manufactured with a smaller diameter, enabling placement in areas with limited bone volume and interdental space. Furthermore, the single-piece implant design eliminates the need for manipulation of peri-implant soft tissue after the initial healing period.[6]

The surgical protocol for placement of implants includes flap and flapless procedures. Supporters of the flap procedure in implant placement argue that direct visualization of the surgical field with flap elevation may reduce the risk of bone fenestration and dehiscence. However, flap elevation is associated with some degree of patient morbidity and discomfort. Furthermore, flap surgery for implant placement may negatively influence implant aesthetic outcomes, especially in the anterior maxilla. One of the main reasons for the flapless surgical technique being used as an alternative to the conventional flap technique is that it maintains proper blood supply over the surgical site.

In the present study, clinical parameters i.e., mSBI and PPD were recorded at baseline, 3 and 6 months, to check patient compliance and oral hygiene status. Over all there was statistically significant decreased mean mSBI scores from baseline to 3 months and 6 months in both groups. These results were similar with studies conducted by Buser D et al [7] in 2013 and Zaki SA et al [8] in 2017, and Chappius V et al [9] in 2018.

The PPD was decreased from baseline to 3 and 6 months in group I. whereas an increase mean PPD from baseline to 3 and 6 months were observed in group II which was statistically significant. The results are similar to the studies done by Dereka X et al in 2012 [10] and Anumala D et al in 2019 [1] who observed reduction in mean probing pocket depth in group I overtime. In group II by reflection of a full thickness flap (open flap approach) leading to more apically positioned junctional epithelium which is directly related to an increase in probing depth around implant.

In the present study crestal bone levels were measured at mesial and distal sides of implant site with RVG, which were taken immediately after implant placement (baseline), 3 and 6 months. Crestal bone levels were measured by taking the lower corner of the straight cylindrical portion of the neck of the implant as reference and; the marginal bone levels were measured on mesial and distal sides of the implant using AUTO CAD software which was similar to the protocol used in the study by Singla N et al. [2]

In the present study, the mean crestal bone levels showed a statistically significant increase from baseline to 3 and 6 months in both the groups. When compared to group I (flapless), group II (flap approach) showed more mean CBL which was statistically significant. These results were in accordance to the studies done by Tonneti MS et al (1994) [11] , Job Set al (2008) [12] , Sennerby L et al (2008)[13], Sunitha RV et al (2013) [14] , Tsoukaki M et al (2013) [15], Bashutski JD et al (2013) [16], Wadhwa et al (2015) [17],Gupta R et al (2018) [18], Pahuja SK et al (2021) [19]. Previous studies have suggested that compared to flapped surgical procedures, flapless surgery allows minimum disruption of peri-implant tissues, thereby reducing changes in crestal bone levels, probing depth, and inflammation. The intact blood supply from soft tissue facilitates adequate healing, a critical factor in preventing early bone loss around implants.

In contrast to the present study, studies done by Malo P et al (2008) [20], Froum SJ et al (2011) [21] showed more marginal bone loss on the flapless group. Inadequate visualization of the ridge and its effect on implant positioning, different implant designs and different loading protocols followed by a higher number of implants placed in the posterior region maybe some of the reasons which were stated to influence the difference in bone loss in these studies.

Conclusion

This research aimed to assess the levels of bone surrounding immediately loaded single-piece implants using both flapless and flap methods. The results revealed that the flapless group exhibited significant improvements in both clinical and radiographic parameters compared to the flap group. Although both procedures led to notable crestal bone reduction, the mean values indicated less bone loss in the flapless group compared to the flap group. This suggests that the flapless procedure may be a preferable treatment option for implant placement, particularly when precise preoperative radiographic evaluation is feasible. However, it is important to note that further long-term studies with larger sample sizes are necessary to fully evaluate the success of single-piece implants using both flapless and flap techniques.

Figure 1: Tissue punch placed i.r.t 36 (Group I Flapless Approach)

Figure 2: Implant placed i.r.t 36 (Group I Flapless Approach)

Figure 3: Flap elevation i.r.t 36 (Group II Flap Approach)

Figure 4: Implant placed and suturing done i.r.t 36 (Group II Flap Approach)

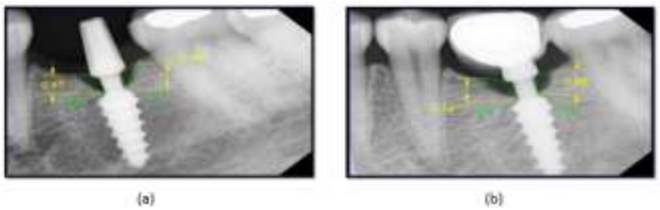

Figure 5: Crestal bone loss evaluation of Group I implant placed in i.r.t #36 at baseline b) 6 months

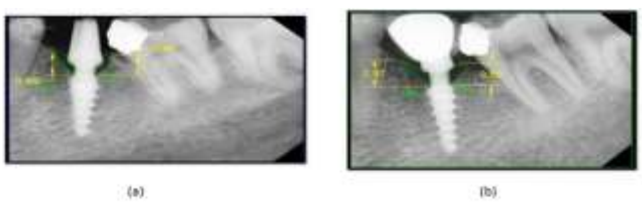

Figure 6: Crestal bone loss evaluation of Group II implant placed in i.r.t 36 at a) baseline b) 6 months

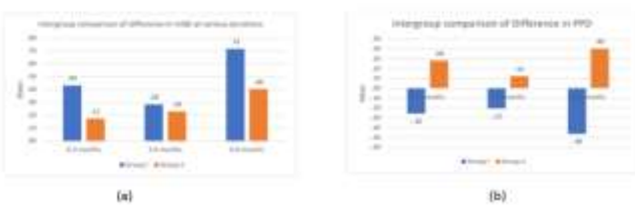

Figure 7: a). Intergroup comparison of difference in Msbi b). Intergroup comparison of difference in PPD

Figure 8: Intergroup comparison of mean difference in crestal bone loss on mesial and distal side between the groups at various time intervals

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