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ORIGINAL RESEARCH

Comparison of crestal alveolar bone loss in relation to immediate implants with and without platelet rich fibrin and hydroxyapatite graft in maxillary anterior teeth

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ABSTRACT

Introduction: Tooth loss can occur as a result of dental caries, periodontal disease, or trauma due to road traffic accidents. Replacement of missing teeth is an important need for patients attending clinics because it restores normal contour, function, comfort, aesthetics, speech, and health by restoring the defective tooth with a prosthesis that provides functional efficiency, structural balance, and aesthetic harmony.

Materials and methods: A total of 30 patients were divided into two groups - Group I (implant placed with PRF and HA graft) and Group II (implant placed without PRF and HA graft). The patients were prospectively evaluated clinically and radiographically using digital radiography.

Results: It was observed that patients in Group I had less crestal bone loss, which aids in achieving an aesthetic outcome and better patient acceptance.

Conclusion: Immediate implants with PRF and HA graft causes stimulation and acceleration of bone regeneration. It is recommended to use PRF and graft as a viable option in improving success.

INTRODUCTION

Tooth loss can occur as a result of dental caries, periodontal problems, or trauma from road traffic accidents. Replacement of missing teeth is an important need for patients attending clinics because it restores normal contour, function, comfort, aesthetics, speech, and health by substituting the defective tooth with a prosthesis that provides functional efficiency, structural balance, and aesthetic harmony.

With the introduction of implants, no abutment teeth must be prepared, avoiding the risk of any endodontic treatment, discomfort due to hypersensitivity, difficulty in plaque control, and so on, while the patient is highly satisfied with aesthetic and restoration of function[1]. A dental implant is an alloplastic and biocompatible material that is placed into (endosseous) or onto (subperiosteal) the jawbone to support a fixed prosthesis or stabilize a removable prosthesis[2].

Most clinicians prefer dental implant placement
due to its high success rate, shorter treatment duration, and increased patient comfort[1]. Depending on the peri implant soft tissue and bony architecture, implant placement can be either immediate or delayed. Immediate implant placement is widely regarded as a reliable treatment option for restoring function and aesthetics in fresh extraction sockets[3]. It aids in the preservation of alveolar volume, the prevention of initial bone loss, the placement of wider and longer implants, bone preservation by improving the crown implant ratio, and the reduction of surgical procedures. As a result of this it increases bone implant surface area and increases its success rate[4].
The placement of an immediate implant in a fresh extraction socket creates a circumferential gap coronally, the size of which is determined by the implant diameter, socket morphology, and tooth type[5]. Small gaps are filled with new bones, either with or without the use of graft material. Autograft, allograft, and alloplastic graft materials all provide better osseointegration. However, a large gap necessitates the formation of connective tissue between the coronal portion of the implant and the peri-implant bone. To fill the peri-implant area, platelet concentrates (platelet rich fibrin) and graft were used.
PRF, which was first introduced by Choukroun et al, allows for rapid angiogenesis and aids in the easier remodeling of fibrin into more resistant connective tissue[6]. It is high in key coagulation and healing molecules, as well as growth factors such as TGF-, VEGF, A- PRF, and PDGF. When used in conjunction with a bone graft, PRF aids in wound healing, bone growth and maturation, graft stabilization and hemostasis, as well as improving the handling properties of graft materials and increasing bone density[7].
Bone grafts act as a filler and scaffold to promote bone formation and wound healing. Grafts are bioresorbable, have no antigen-antibody reaction, and act as a mineral reservoir, facilitating new bone formation. Allograft, autograft, calcium sulphate, ceramic, hydroxyapatite, polymer, and other graft materials are available[8].
Hydroxyapatite (HA) has a chemical composition and crystalline structure like bone[9], and its bioactivity is based on osteoconductive properties which allow apposition and migration of osteoblasts at the material surface[10]. HA has been shown to bond directly to bone [11] and can be combined with an auto/allo/xenograft to improve clinical success rates in maxillofacial surgery to induce alveolar bone regeneration.[11,12.]
The aim of our study was to evaluate the efficiency of platelet rich fibrin with bone graft around immediately placed implants when compared with immediate implants without platelet rich fibrin or any graft material.

MATERIALS AND METHODS

CASE SELECTION

The patients for this study were selected from the Department of Oral and Maxillofacial surgery, Government Dental College Thiruvananthapuram. Patients with age ranging from 18 to 45 years who were indicated for extraction of the teeth and immediate placement of implants meeting the eligibility criteria were selected.
Study sample of 30 patients were divided into two groups - Group I (implant placed with PRF and HA graft) and Group II (implant placed without PRF and HA graft . Inclusion criteria were teeth with intact buccal plate of bone without periapical lesion requiring immediate implant placement in maxillary anterior region and tooth lost due to trauma . Patients with uncontrolled systemic condition ,poor oral hygiene , traumatic occlusion, presence of parafunctional habits, traumatically extracted tooth, tooth without adjacent teeth, smokers & tooth with thin gingival biotype were excluded from the study.

PROCEDURE

Patients requiring single tooth implant placement who reported to the department were examined to see if they met the research criteria, and a routine blood examination, blood sugar level, viral markers, and CBCT (to assess the length and size of the implant) were performed prior to the procedure. Phase I therapy was performed, including scaling and root planning, oral hygiene instructions were given, and a 0.2% chlorhexidine mouthwash was recommended.

Based on the available dimensions, threaded titanium root-form endosseous implants (ranging in length from 10 to 15mm and diameter from 3.6 to 5mm) were selected. The PRF was prepared right before it was placed at the surgical site. 5ml of whole blood was drawn via antecubital vein venipuncture and collected in blood collection tubes. In a tabletop centrifuge, the tubes were first centrifuged for 10 minutes at 3000 rpm. Using sterile tweezers, the PRF was separated from the red corpuscles base and transferred to a sterile dappen dish.

After administration of local anesthesia (2% lignocaine with 1:2 Lakh adrenaline) and extraction of teeth was done, the site was thoroughly degranulated using curettes; the extraction socket was thoroughly irrigated with normal saline and carefully examined to be certain that the socket walls were intact, and they are the most ideal position for implant placement. The length and width of the extracted root were measured with a UNC-15 probe to determine the length and diameter of the implant; the osteotomy site was prepared through sequential drilling for both the groups, with maximum use of bone apical to the extraction sockets.

Figure 1: Local infiltration to the surgical site

Figure 2: Measuring the length of extracted tooth

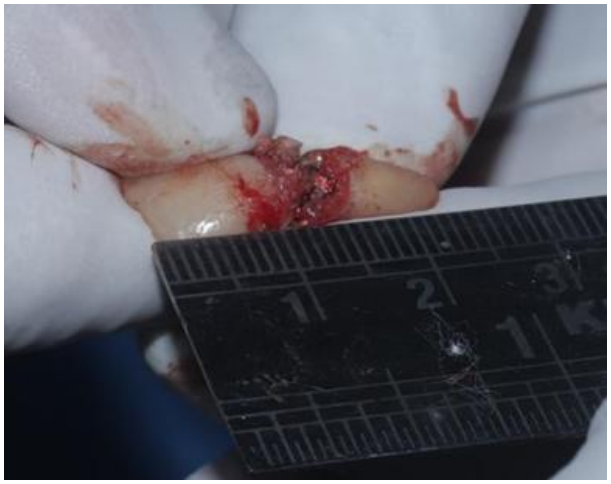
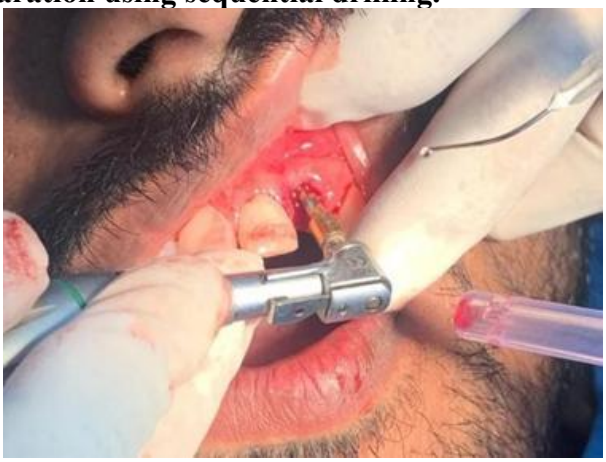


Figure 3: Socket preparation using sequential drilling.



Under copious irrigation, sequential drilling was carried out at speeds ranging from 500 to 1200 rpm. The drill was extended 3 to 4mm beyond the socket's apex. A sterile saline solution was used to irrigate the socket. The implant mount was then used to place the single-stage implant into the prepared socket, with the implant head parallel to the incisal edge of the adjacent tooth. When the implant was stable in the site, the mount (implant holder) was removed and the fixture insertion tool was engaged to the implant; the implant was tightly screwed into the bone with gentle pressure (40-55Ncm) by hand or using a Hex ratchet until the threaded portion of the implant disappeared into the alveolar bone and the collar of the implant came into alignment with the crest of the alveolar bone.

The residual gap between the socket wall and implant threads was grafted with hydroxyapatite bone graft and PRF in the patients placed under group I and implant alone in patients falling under category of group II. The flap was then sutured in position. Digital radiograph was obtained to confirm the complete placement of the implant and check its parallelism with the adjacent teeth.

Figure 4 Implant placed without PRF and HA graft.

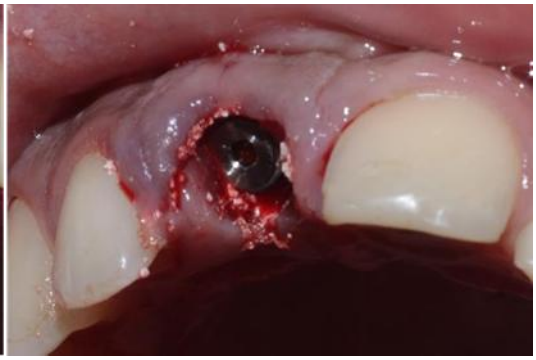


Figure 5 Implant placed with PRF and HA graft

POSTSURGICAL PROCEDURE

The patients were prescribed appropriate antibiotics and analgesics. Patients were recalled after seven days for suture removal, and oral hygiene was reinforced. The patients were checked at regular intervals. The final crowns were made 3 months after surgery. The soft and hard tissue changes were evaluated at baseline at the time of implant placement and three months post operatively.

METHODS OF EVALUATION

Digital radiograph was obtained by using a paralleling technique for measurement of bone level on the mesial and distal surfaces of the implant. Categorical and quantitative variables were expressed as frequency (percentage) and mean ± SD respectively. The independent t test was used to compare quantitative parameters between groups. Chi-square test was used to find association between categorical variables. The paired t test was used to compare quantitative parameters before and after intervention. For all statistical interpretations, $p<0.05$ was considered the threshold for statistical significance. Statistical analyses were performed by using a statistical software package SPSS, version 20.0.

Figure 6: Digital radiographic assessment of crestal alveolar bone loss

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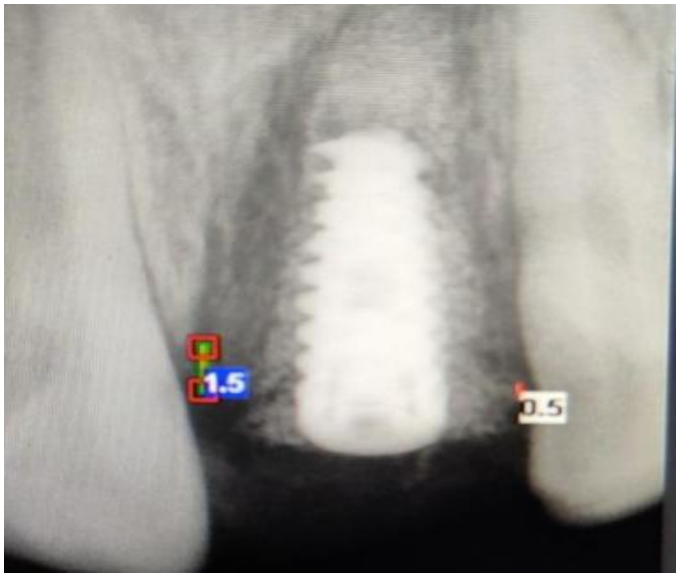


RESULTS

All patients satisfying the research criteria who reported to the Department of oral and maxillofacial surgery for extraction and immediate implant placement were included in this study. A total of 30 implants were placed in two groups (15 implants in Group I and 15 implants in Group II) .

Comparison of Mesial marginal bone loss and Distal marginal bone loss at 3 months in Group 1 and Group II .The crestal bone levels were evaluated in Group I and found that a statistically significant crestal bone level changes were noted within three months with a mean change of 0.27 mm mesially and 0.34mm distally (table 1 and table2).

Table 1: Comparison of Mesial marginal bone loss at 3 months in group 1

Mesial marginal bone loss	Mean	SD	N	Mean Difference	Paired t	p
Baseline	2.93	0.37	15	0.27	14.32	p<0.01
After 3 months	3.20	0.35	15			

Table 2: Comparison of Distal marginal bone loss at 3 months in group 1

Distal marginal bone loss	Mean	SD	N	Mean Difference	Paired t	p
Baseline	2.94	0.32	15	0.34	9.92	p<0.01
After 3 months	3.28	0.39	15			

Crestal bone levels were evaluated in group II and found that statistically significant crestal bone level changes were noted within three months with a mean change of 0.58 mm mesially and 0.58 mm distally (table 3 and table 4).

Table 3: Comparison of Mesial marginal bone loss at 3 months in group 2

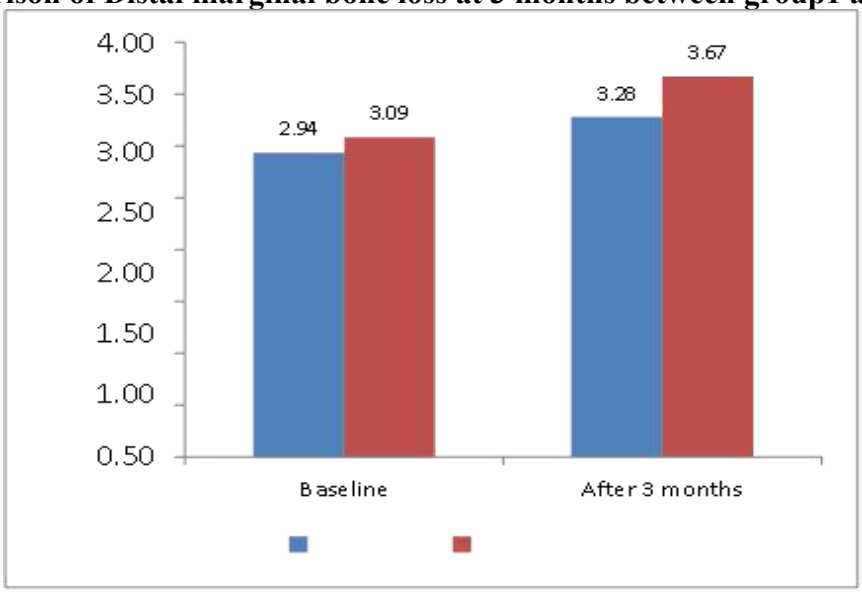
Mesial marginal bone loss	Mean	SD	N	Mean Difference	Paired t	p
Baseline	2.92	0.48	15	0.58	16.51	p<0.01
After 3 months	3.51	0.46	15			

Table 4: Comparison of Distal marginal bone loss at 3 months in group 2

Distal marginal bone loss	Mean	SD	N	Mean Difference	Paired t test	p
Baseline	3.09	0.56	15	0.58	8.07	p<0.01
After 3 months	3.67	0.64	15			

Fig: Comparison of Mesial marginal bone loss at 3 months between group 1 and group 2

Fig: Comparison of Distal marginal bone loss at 3 months between group1 and group 2



DISCUSSION

The crestal alveolar bone loss in immediate loading implants with and without graft (HA) material was investigated in this study. A total of 30 patients who presented to the department of oral and maxillofacial surgery were divided into two groups: group I received an implant with PRF and HA graft, and group II received an implant alone. Patients with intact buccal bone, no periapical pathology, and a single tooth replacement in the maxillary anterior region were chosen. When compared to the implant group alone, there was less mean marginal bone loss in the PRF and HA groups. When crestal alveolar bone levels in groups I and II are compared, there is statistically significant crestal bone level changes with less bone loss in Group I both mesially and distally when compared to Group II.

Priyanka Boora et al. reported less mean marginal bone loss in PRF group in a randomized controlled trial comparing PRF and non PRF group, evaluated clinically and radiologically after one and three months for peri implant soft tissue and crestal bone loss[5]. Similarly, there was less bone loss in PRF group in this study after three months.

Immediate implants with PRF lead to stimulation and acceleration of bone regeneration and show tendency toward rapid soft tissue regeneration and reduced peri- implant pain and inflammation[13].

Arora.s et al in their study placed 20 implants , 10 implants with PRF and 10 without any adjunct and concluded that test group there is rapid soft tissue regeneration and diminished vertical bone loss. Immediate implants with PRF stimulate bone regeneration and it contributes for success rate of implants[14].

Very less crestal bone loss in implant placed with PRF and HA graft material favours rapid soft tissue regeneration, very less bone loss, and shows improvement with early wound closure, which helps in achieving an esthetic outcome and better patient acceptance.[13]

Additionally, PRF improves implant stability during the initial stages of osseointegration, ridge size, bone regeneration, and soft tissue recovery.[15]

Bone grafts, such hydroxyapatite, are used as a
filler and scaffold to aid in the formation of new bone and accelerate the healing of wounds. These grafts have no antigen-antibody response and are bioresorbable. These bone grafts serve as a mineral reservoir that promotes the deposition of new bone.[8]
Immediate implants with hydroxyapatite nanoparticles that are utilized to fill in the space between the implant and socket result in stability and bone development. By expanding the surface area of the implant and the area where the implant and bone make contact, hydroxyapatite nanoparticles promote implant durability.[16].
Since HA was employed in our study as a graft material along with PRF, it works as a scaffold into which new bone development occurs, filling the gap created in the peri-implant area and reducing crestal alveolar bone loss to a greater extent than implant alone. Assessment of marginal bone levels has become an integral part of the evaluation of the implant patient. Stimulating the regenerating ability of surrounding tissue can enhance the quality and quantity of peri-implant bone and soft tissue. Different growth factors that are secreted throughout various stages of tissue healing may function as therapeutic agents to encourage the repair of both peri-implant soft and hard tissues. A significant part of the development of peri-implant bone is played by platelet rich fibrin and hydroxyapatite.
Numerous growth factors, such as platelet-derived growth factors (PDGF), transforming growth factors 1 and 2 (TGF-1, TGF-2), vascular endothelial growth factors (VEGF), platelet-derived endothelial growth factors, interleukin 1&2, basic fibroblast growth factor (-FGF), and platelet activating factor 4 (PAF-4) are present in high concentrations in platelet rich fibrin (PRF). The released growth factors enhance matrix construction, cell growth, osteoid generation, and collagen synthesis.[5].
When implants are immediately placed at the time of tooth extraction, there is discrepancy between the walls of the alveolus and the implant, which affects implant stability, amount of osseointegration, and soft and hard tissue support. Bone augmentation procedures are performed with immediate implant placement to reduce such discrepancies.In this study there was no statistically significant data supporting the age and sex of the patient with immediate implant placement. Within limitations of the study, data suggests that need for immediate implants are more among males (60 %) than females and more than 40% of the age group is below 30 years.

CONCLUSION

Today, immediate implants are frequently used to replace lost teeth. Even though it addresses the patient's cosmetic concerns, it does not give appropriate bone support and aesthetics for the long term. The amount of bone loss around the implant is reduced to a larger extent when PRF is used in conjunction with graft material to bridge the gap in the peri implant area.
The combined effect and clinical efficacy of PRF and hydroxyapatite graft on bone development surrounding dental implants in the maxillary anterior region have been noticed based on the findings of this study. Based on this, the information available suggests that combining PRF and HA during implant placement has a significant stimulating effect on bone development and helps to reduce the crestal alveolar bone loss.

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