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RESEARCH ARTICLE

POSTEXTRACTION SOCKET GRAFTING USING COMBINATION OF DEMINERALIZED FREEZED-DRIED BONE ALLOGRAFT AND PLATELET RICH FIBRIN (PRF) –A CASE SERIES

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ABSTRACT

Alveolar ridge bone resorption is a biologic phenomenon that occurs following tooth extraction and cannot be prevented. Newer techniques are evolving in restorative dentistry and periodontics to treat these defects to improve the esthetics, form and functions of the dentition. Alveolar bone augmentation remains the holy grail of periodontal tissue engineering.[21]The purpose of this paper was to evaluate the efficacy of β- Tri Calcium Phosphate (β-TCP) and Platelet Rich Fibrin (PRF) in post extraction socket preservation. The patients presented with periodontally compromised tooth due to trauma with no labial cortical bone present which was confirmed by pre operative CBCT and was treated by extractions along with augmentation of the alveolar bone. The patient's blood was centrifuged to obtain PRF. Allograft bone graft was mixed with PRF particles and applied to fill the defect. After 6 months a Cone-Beam Computed Tomography was performed to evaluate bone regeneration. The use of PRF as cover membrane permitted a rapid epithelisation and represented an effective barrier. After 6 months the site appeared precociously healed and the bone volume increased. This new approach represents a predictable method of augmenting deficient alveolar bone.

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INTRODUCTION

The key processes of tissue modeling and remodeling after tooth extraction have been well documented in both animals and humans (Horowitz, 2012). Tooth extraction whether due to caries, trauma or advanced periodontal disease is a traumatic procedure often resulting in immediate destruction and loss of alveolar bone and surrounding soft tissues (Caplanis, 2005). In general, the alveolar bone remodeling that occurs after tooth loss yields diminished alveolar ridge dimensions in both the vertical and horizontal planes up to 40% to 60% bone loss height and width as early as 3 months. On an average, grafted extraction sites have reported a loss of width < 2mm and a loss of height < 0.5mm as compared to non-grafted extraction sites which have reported losses of ridge width from 2-6 mm and ridge height of 1 mm with great variations (Brownfield, 2012). To prevent this clinical situation, different authors have described several surgical procedures, ranging from regenerative techniques for socket preservation to immediate implant placement. Regenerative techniques have been widely tested in controlled and uncontrolled studies with various materials and clinical approaches: bone grafting alone, including autografts, allografts, xenografts, and alloplasts alone or in combination with absorbable or nonabsorbable membrane (Mazor, 2009). Recently, Choukroun *et al*. introduced Platelet Rich Fibrin (PRF), a second-generation platelet concentrate that improves healing of the both hard and soft tissues (Choukroun *et al*., 2006). It consists of high concentrations of the collected platelets, which allow slow release of growth factors (GFs) (Kang *et al*., 2011). These GFs include Vascular Endothelium Growth Factor (VEGF), Platelet-Derived Growth Factor (PDGF), Fibroblast Growth Factor (FGF), Epidermal Growth Factor (EGF), Hepatocyte Growth Factor (HGF), Insulin-Like Growth Factor (IGF), and Transforming Growth Factor-B (TGF-β). All of these play a role in replacing lost tissue, resurfacing of the wound, and restoring vascular integrity, (D M.G.Ara´ ujo, 2009). Compared to other platelet concentrates, PRF releases these factors at a sustained rate over a longer period, thereby optimizing wound healing (Reddy, 2014). Recently, PRF has also been shown to stimulate the growth of osteoblasts and periodontal ligament cells, both of which are significant for the regeneration of periodontal defects (Shah, 2012 and Sharma, 2011). Here, we present a case where PRF was used in combination with Demineralized Freeze-Dried Bone Allograft (DFDBA) for ridge augmentation procedure.

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Case report I

A 18 years old patient reported to the Department of Periodontics and Oral Implantology, Santosh Dental College, Ghaziabad with a chief complaint of root stump in lower front region of the jaw. On clinical examination, it was found that right mandibular central incisor was periodontally compromised with no labial bone as a result of trauma (Fig.1). Radiographic investigation (IOPA, CBCT) of the mandibular anterior region showed labial bone dehiscence (Fig.2). The patient was in good health and had no contraindications to surgical therapy with absence of local inflammation and absence of mucosal disease. A localized ridge augmentation was necessary to obtain an esthetic prosthetic reconstruction and thus it was decided to augment the site using combination of Demineralized Freezed-Dried Bone Allograft (β- TCP) and Platelet Rich Fibrin (PRF).

Fig. 1. Pre-operative view of #41 showing periodontally compromise tooth with no labial bone

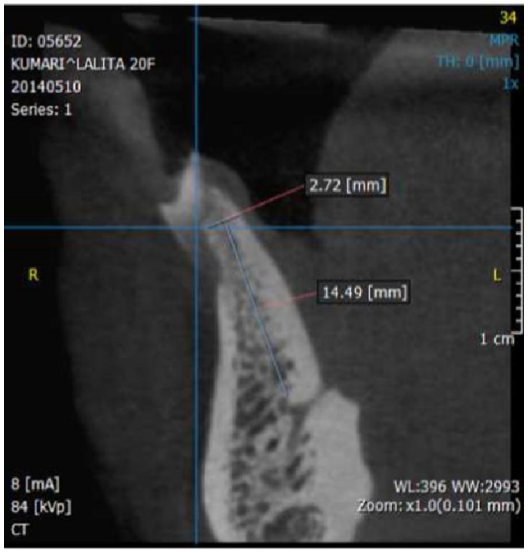

Fig. 2. Pre operative CBCT showing inadequate bone

Case report II

A 22 years old patient reported to the Department of Periodontics and Oral Implantology, Santosh Dental College, Ghaziabad with a chief complaint of root stump in upper front region of the jaw (Fig.3). Radiographic investigation (IOPA, CBCT) of the maxillary anterior region showed labial bone fenestration (Fig.4). A localized ridge augmentation was necessary to obtain an esthetic prosthetic reconstruction and thus it was decided to augment the site using combination of Demineralized Freezed-Dried Bone Allograft (β- TCP) and Platelet Rich Fibrin (PRF). The patient was in good health and had no contraindications to surgical therapy with absence of local inflammation and absence of mucosal disease.

Fig. 3. Pre operative view of tooth #12 showing root stump

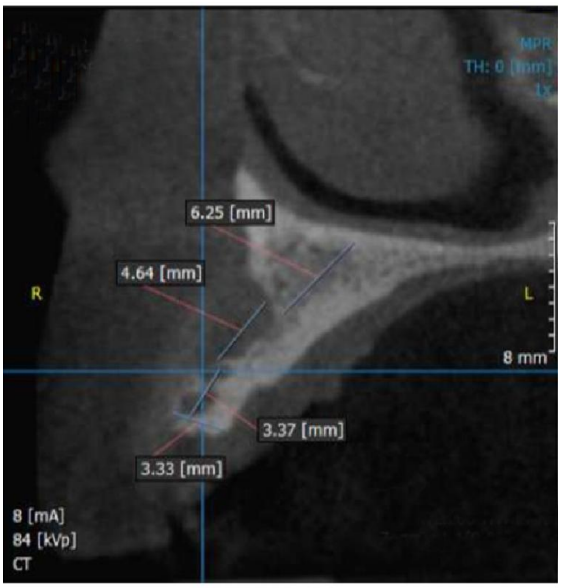

Fig. 4. Pre operative CBCT showing inadequate bone

A written consent from the patients was taken after the whole procedure was explained to them.

Presurgical Procedures

Each individual was subjected to a full diagnostic workup including:

1. A detailed case history record.
2. Study cast and complete clinical photographs.
3. Routine lab investigations.
4. Radiographic evaluation using CBCT.
5. Oral Prophylaxis.

Preparation of Platelet Rich Fibrin (Shah, 2012 and Sharma, 2011)

- The PRF preparation for the test group was done before surgery.
- Nine millilitres of whole blood was drawn by venipuncture of the antecubital vein and was collected into two blood collection tubes without anticoagulant for PRF preparation. The blood collection was performed quickly (Fig.5).
- The tubes were immediately centrifuged at 400g for 10min at the rate of 3000 revolutions per minute with a specific table centrifuge at room temperature (Fig.6).
- Blood centrifugation immediately after collection allows the composition of a structured fibrin clot in the middle of the tube, just between the red corpuscles at the bottom and the acellular platelet poor plasma at the top (Fig.7).
- PRF was easily separated from the red corpuscles base (preserving a small RBC layer) using a sterile tweezer and scissors just after removal of PPP (Platelet Poor Plasma) and then transferred onto a dapen dish (Fig.8).

Fig. 5. Drawing blood (9 ml of blood as per requirement)

Fig. 6. The Centrifuge

Surgical Treatment

A full thickness mucoperiosteal flap was elevated to expose both the labial and palatal/lingual aspects of the alveolar ridge (Fig.9 and Fig.10).

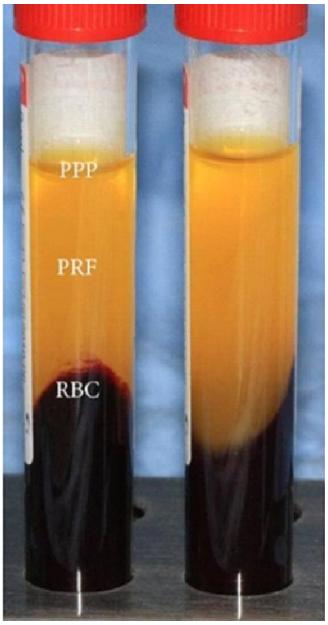

Fig.7. Separated fractions

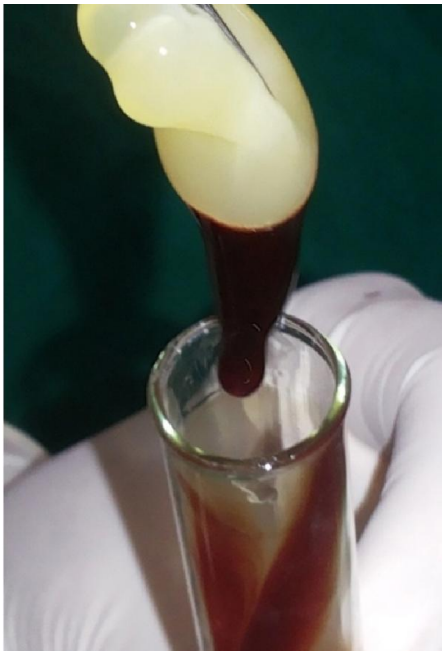

Fig. 8. Activated gel-like PRF easily carried with forceps

Atraumatic extraction using periotome and extraction forceps was performed. The extraction socket was carefully curetted to remove all the soft tissue. After flap reflection, β- TCP bone graft plug along with PRF was inserted up to the level of the crest of the socket (Fig.11 and Fig.12). The labial and palatal/lingual flaps were approximated back into position by giving vertical mattress sutures using a 3-0 mersilk suture in order to prevent any exfoliation of the graft.

Postoperative Care and Evaluation

The patients were put on an antibiotic regime consisting of amoxicillin 500 mg three times a day for 5 days along with a chlorhexidine mouthrinse.

Fig. 9. Conventional flap procedure showing dehiscence of the labial bone #41

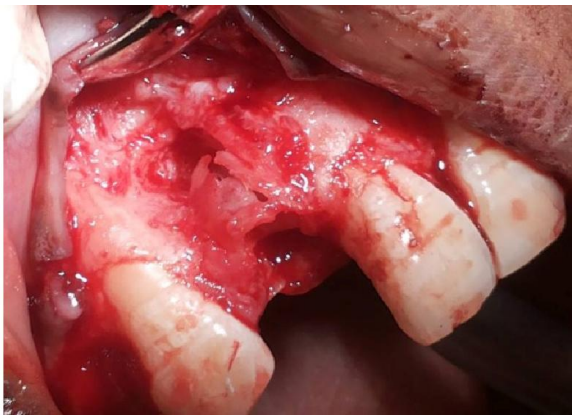

Fig. 10. Conventional flap procedure showing fenestration on the labial bone #12

Fig.11. PRF along with DFDBA was placed in the defect #41

The patients were asked to abstain from brushing on the surgical area for at least 1 week and they were recalled 1 week postoperatively during which sutures were removed and the operated area was evaluated for healing, infection and any signs of ulceration and necrosis. Patients were reevaluated at the end of 6th month (Fig.13 and Fig. 14).

Fig. 12. PRF along with DFDBA was placed in the defect #12

Fig. 13. Post operative width of the alveolar ridge at 6 months # 41

Fig. 14. Post operative width of the alveolar ridge at 6 months #12

RESULTS

During the course of the study, wound healing was uneventful. There were no post operative complication and patient was satisfied with the results. The increase in the amount of tissue present was adequate to permit placing an esthetic fixed restoration. Six months postsurgically, there was 1.39 mm gain in buccolingual width and 1.0 mm gain in vertical dimension

in case I (Fig.15) and 0.94 mm gain in buccolingual width and 6.58 mm gain in vertical dimension in case II (Fig.16).

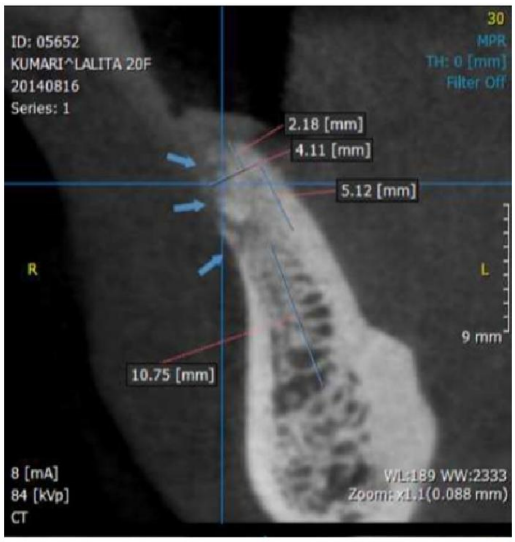

Fig.15 Post oprative CBCT sgowing bone regeneration at 6 months

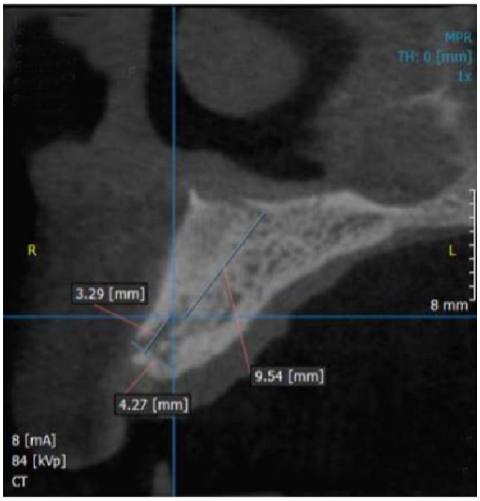

Fig. 16. Post oprative CBCT sgowing bone regeneration at 6 months

DISCUSSION

The importance of healing of an extraction socket cannot be undermined as the internal and external changes that occur, ultimately affect the shape of the alveolar ridge, (Darby, 2009). Majority of the studies indicate that bone is not able to regenerate to the level of bone crest or even to the level of the neighboring teeth, during healing, therefore 100% socket fill does not occur, (Ara´ ujo and Lindhe, 2009). Using an animal model, Araujo and Lindhe showed that in the first 8 weeks following extraction, there is marked osteoclastic activity, resulting in the resorption of the facial and lingual bone walls, especially in the crestal region. They also noted that bone resorption was greater on the facial wall and that any loss of ridge height was accompanied by a horizontal loss on both facial and lingual walls of the extraction site (Araujo and Lindhe, 2009). In 1993 Misch and Dietsh suggested different graft materials and techniques for socket grafts based on the number of bony walls that remained after the tooth is removed. A recent publication showed that the combination of β-TCP and type I collagen used for simple preservation of a maxillary extraction socket without a barrier membrane resulted in new bone formation 9 months after the procedure with 62.6% of mineralized bone and 21.1% of bone marrow. β-TCP resorption occurs concurrently with new bone formation. Horch *et al*. reported that 65% resorption of β-TCP occurred 1 year after being used as a bone substitute in large mandibular cystic defects, alveolar clefts and for maxillary sinus floor augmentations. Simunek *et al*. reported that the mean graft area occupied by β-TCP was 39%, 9 months after sinus augmentation procedures. During the last decade several different ridge augmentation techniques have been developed, most of which include the use of a graft material. This increases the treatment cost as well as increases the risk of disease transmission. Studies also indicate that in many cases, the graft material is not totally incorporated into the newly formed bone and when compared to sites without graft material, they show less vital bone formation.

In some cases it requires the use of collagen membranes. In these cases a 25% membrane exposure rate has been reported, and this directly affects the amount of bone fill that takes place within the socket (Darby, 2009). PRF was first described by Choukroun *et al*., 2006. It is considered a second-generation platelet concentrate and has been used in various surgical procedures in an attempt to enhance wound healing. It is autogenous and is not associated with any issues related to immune reactions or infections. Besides, its gelatinous consistency enhances clot and graft stability. Platelets release cytokines, such as Vascular Endothelium Growth Factor (VEGF), Platelet-Derived Growth Factor (PDGF), Fibroblast Growth Factor (FGF), Epidermal Growth Factor (EGF), Hepatocyte Growth Factor (HGF), Insulin-Like Growth Factor (IGF), and Transforming Growth Factor-B (TGF-B). Choukroun PRF is known to release growth factors for at least 7 days.

Thus this biomaterial presents a specific biology which offers several advantages including promoting wound healing, bone growth and maturation, graft stabilization, wound sealing and hemostasis, and improving the handling properties of graft materials. Based on these characteristics, PRF is simpler and less expensive to prepare, as well as being less risky to patients because it does not expose them to animal-derived anticlotting agents. Owing to its dense fibrin matrix, PRF takes longer to be resorbed by the host, which results in the slower and sustained release of platelet- and leukocyte-derived growth factors into the wound area. Finally, by virtue of containing leukocytes, PRF may exert an antibacterial effect in the wound and work as an abundant source of vascular endothelial growth factor, which is the key player in angiogenesis (Reddy, 2014; Shah and Gujjari, 2013; Shah, 2012; Sharma, 2011). The preparation technique of PRF is simple and requires no special equipment. Blood is drawn into standard glass/silica coated blood collection tubes and centrifuged at a predetermined speed to ensure cell separation. No anticoagulants are used during the procedure and natural coagulation can therefore take place. This unique preparation technique allows PRF to trap at

least 95% of the platelets of the collected blood into a fibrin mesh (Ehrenfest, 2010). The fibrin mesh can then be easily manipulated into a membrane that allows it to be transferred to any surgical site. Recently, PRF has also been shown to stimulate the growth of osteoblasts and periodontal ligament cells, both of which are significant for the regeneration of periodontal defects (Reddy, 2014; Shah and Gujjari, 2013; Shah, 2012; Sharma, 2011). Currently, PRF has been successfully tested in a number of procedures including maxillofacial surgery, periodontal surgery, and implantology. According to a study carried out by Mazor *et al*. PRF was successfully used as the only grafting material in a series of sinus augmentation procedures. They also demonstrated that PRF could stimulate new bone formation in areas that were previously deficient of the amount of bone that is required for implant placement (Shah, 2012).

Conclusion

In the above case series, the successful use of Demineralized Freezed-Dried Bone Allograft combines with Platelet Rich Fibrin (PRF) in a postextraction ridge preservation procedure. The biomaterial acts by releasing high-concentration growth factors to the wound site, thereby stimulating healing and new bone formation. Unlike other procedures, the use of PRF is a simple method that requires minimal cost and reduces the need for specialized grafting material. Because it is a completely autologous product, the risk of disease transmission and graft rejection is negated.

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