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CASE REPORT

Alveolar Ridge Preservation with β-TCP Graft and Platelet-Rich Fibrin

MG Triveni, AB TarunKumar, Vinita Jain, Dhoom S Mehta

ABSTRACT

Guided bone regeneration (GBR) procedures, employing non-vital bone grafting materials and membranes, were developed to counteract the significant resorption of alveolar bone following tooth extraction. Alloplastic graft material, consisting of pure phase of β-tricalcium phosphate (β-TCP) in the preservation of ridge volume after tooth extraction and before dental implant placement, is a well-accepted procedure. The healing potential of platelet growth factors has generated interest in using platelet-rich fibrin (PRF) in ridge preservation procedures. In the present case report, β-TCP bone graft was combined with PRF utilizing the principles of guided bone regeneration to build the damaged edentulous ridge to receive dental implant.

Keywords: Platelet rich fibrin, Guided bone regeneration, Socket preservation, Platelet growth factors.

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INTRODUCTION

One of the most important prerequisite for achieving and maintaining successful osseointegrated implant is the presence of sufficient volume of healthy bone at the recipient site. This includes not only bone of sufficient height to allow the insertion of implant of appropriate length but also a ridge of sufficient crest width. An average of 40 to 60% of original height and width is expected to be lost after tooth extraction, with greatest loss occurring within first year.[1] Clinical studies have shown that implants placed in a site with a missing buccal bone wall have a greater rate of soft tissue complications and/or compromised long-term prognosis.[2-6]

The rate and pattern of bone resorption may be further altered, if pathologic and traumatic processes have damaged one or more of the bony walls of the socket. In these circumstances, fibrous tissue will likely to occupy part of the socket, preventing normal healing and osseous regeneration.[7] Hence, preservation of alveolar dimensions after tooth extraction is crucial to maintain adequate bone volume for placement and stabilization of the implants and to achieve optimal esthetic and functional prosthetic results.

The rationale for socket augmentation procedure at the time of extraction is an attempt to reduce crestal bone dehiscences or facial undercut, encourage socket fill, improve bone quality prior to implant placement and ensuring better primary stability.[7] Today, more and more implants are placed with simultaneous guided bone regeneration (GBR) procedure that use barrier membrane combined with bone graft, bone substitute or both. This provides the clinician with successful treatment outcomes despite the presence of localized bone defects at implant site.[8] Alloplastic materials are most often made of different formulation of calcium phosphate in the forms of hydroxyapetite, tricalcium phosphate (TCP) or combination of this, also called biphasic calcium phosphates.[9,10] They are valuable alternatives as bone substitute materials. In majority of the socket augmentation procedures, the use of barrier membranes has been suggested not only to protect the graft materials but also to stabilize the wound.[11,12] Conventionally, nonresorbable and resorbable membranes are used in guided bone regeneration techniques. Because of disadvantage of nonresorbable membrane for its retrival and membrane exposure complication, resorbable membranes are commonly prefered.[13]

In the recent years, the autologous platelet-rich fibrin (PRF) clot has gained importance in the field of surgical implantology, which is a homogenous fibrin network containing platelets, growth factors and cytokines that may enhance the healing potential of bone as well as soft tissues.[14,15] However, there is not enough literature available on the use of PRF in socket preservation.

In the present case report an attempt was made to preserve the alveolar ridge volume by using 100% β-TCP graft in association with PRF and collagen membrane after tooth extraction.

CASE REPORT

A 30-year-old male patient reported to Department of Periodontics, Bapuji Dental College and Hospital, Davangere with a chief complaint of mobile teeth in relation to left lower back tooth region since 1 year and pain associated with the same. On clinical examination, revealed grade III mobile 36 with deep periodontal pocket at all surfaces. Radiographic examination showed diffuse periapical radiolucency in relation to 36 (Fig. 1). As patient desired to go for implant retained restoration, a treatment

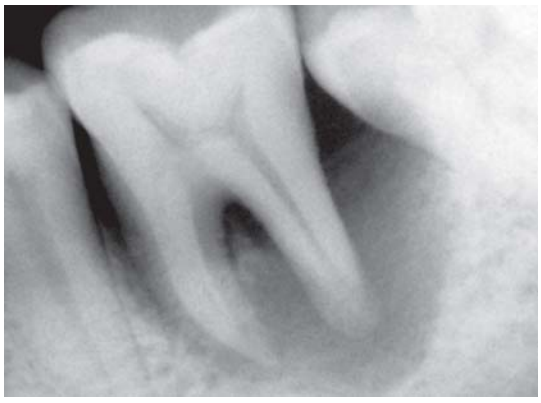

Fig. 1: Preoperative radiographic view of 36

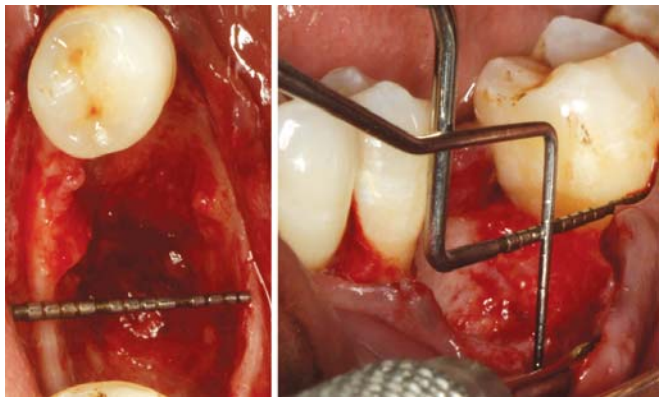

Fig. 2: Defect measurements after extraction of tooth 36

plan was formulated in which atraumatic extraction of 36 followed by socket augmentation procedure with pure phase 100% β-TCP and PRF along with collagen membrane, utilizing the principles of guided bone regeneration. After completion of phase I therapy, the proposed treatment plan was explained and the written informed consent was obtained from the patient.

SURGICAL PROCEDURE

Presurgical rinse of chlorhexidine gluconate 0.12% mouthwash for 2 minutes and extraoral scrub with potassium iodide solution was done as an asepsis protocol. After administration of local anesthesia a full thickness periosteal flap was elevated. Then the incision was extended intrasulcularly to the mesial aspect of two adjacent teeth. The vertical releasing incision made at the mesiobuccal line angle to expose the bone on buccal aspect. Atraumatic extraction of tooth 36 was performed (Fig. 2). After extraction a thorough debridement of the socket was carried out by mechanical means. A close examination was performed to ensure complete removal of soft tissue fragments and infected granulation tissue in the socket. It was observed that resorption of buccal wall was about 8 mm as compared to the adjacent interdental bone. Considering the bone loss on the buccal aspect of 36, a collagen membrane was used as GBR membrane to act as a buccal wall and to support the graft material.

Twenty milliliter of venous blood was withdrawn and centrifugation was done at the rate of 3000 rpm for 12 minutes to obtain PRF. The PRF clot was converted to a membrane of high tensile strength. Scraping the walls of the socket was done with curettes which achieved profuse bleeding; this procedure also triggers the regional acceleratory phenomenon, which is known to stimulate new bone formation. Hundred percent β-TCP was mixed with one part of PRF to enhance the wound healing.

Fig. 3: The extraction socket grafted with a mixture of pure phase β-TCP and finely cut PRF at surgical site

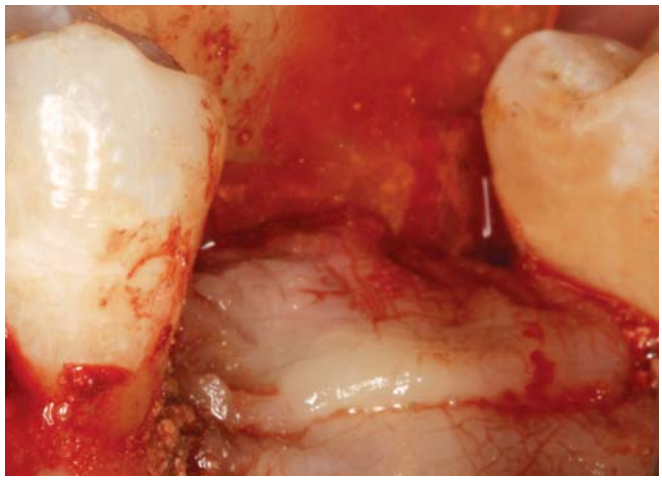

Fig. 4: A resorbable collagen barrier was placed along PRF membrane over the graft material

Stabilizing the collagen membrane acting as a buccal wall, the bone graft material was placed in increments up to the level of the alveolar crest (Fig. 3). The PRF membrane obtained was then carefully placed covering the graft material and was covered with the collagen membrane (Fig. 4). Closure of the surgical site was obtained with

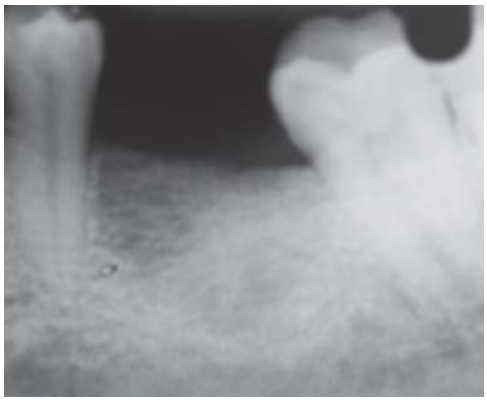

Fig. 5: One year postoperative radiograph

horizontal mattress and interrupted sutures using 5-0 vicryl suture material to provide healing by primary intention. Postoperative care included rinsing twice daily with povidone iodine solution for the first 2 weeks before switching to twice daily rinsing with 0.12% chlorhexidine gluconate mouthrinse for the next 2 weeks. Systemic antibiotic and analgesic regimen included capsule amoxycillin 500 mg TID for 5 days and tablet ibuprofen 400 mg TID for 3 days.

Immediate postoperative radiograph showed complete fill of the socket up to the alveolar crest. Ten days recall showed absence of swelling or pain in the operated area on 15th post-operative day, uneventful healing and almost complete soft tissue coverage over the extraction site was noticed. Radiographically, by the 4th month of follow-up, the alveolar socket was appeared to be filled with radiodense bone except for the most cervical portion of the alveolus. By 12 month postextraction cervical radiolucency had disappeared and uniform radiodense bone was found throughout healing extraction socket (Fig. 5). The postoperative buccolingual width of the ridge was 10 mm and the crestal bone was 2 mm below the cementoenamel junction (CEJ) of adjacent teeth.

IMPLANT PLACEMENT

At 12 months, the patient returned for implant placement. After administering local anesthesia, a crestal incision was given to elevate full thickness mucoperiosteal flap to expose the underlying bone (Fig. 6). The grafted site was examined for presence of any residual graft material. Then the measurements of alveolar ridge were taken to compare preoperative alveolar dimensions. Osteotomy preparation was started with a 3 mm trephine drill to harvest bone core for histology (Fig. 7). An implant of 5.8 mm diameter Bio-Horizons was placed according to manufacturer's recommendations with good primary stability (Fig. 8). Some residual graft particles were visible during surgical procedure which did not affect the primary stability of implant.

HISTOLOGY

Bone core were harvested from the surgical area during the placement of implant were transferred to a fixture containing 10% neutral buffered formalin and sent to the laboratory for histologic evaluation. Histologically, there was evidence of vital bone ingrowth into the extraction socket grafted with pure phase of β-TCP and PRF and collagen membrane. New bone formation was present in intimate contact with surface of graft particle (Fig. 9).

DISCUSSION

Healthy osseous structure of the alveolar ridge maintains the esthetic soft tissue appearance around natural dentition

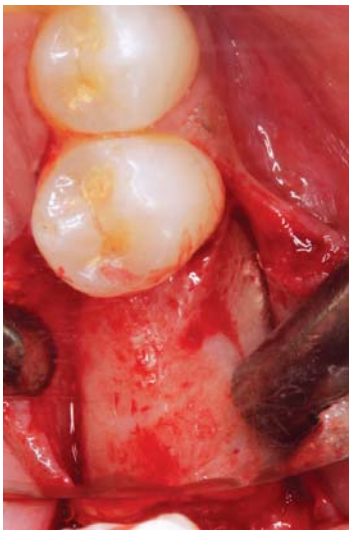

Fig. 6: Occlusal view of the healed ridge while placing implant

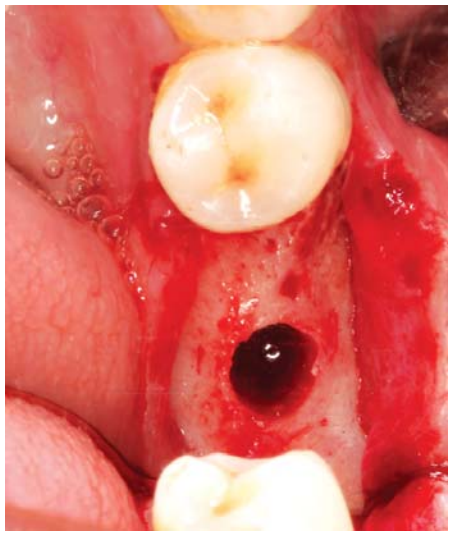

Fig. 7: Occlusal view of the osteotomy site after retrieval of bone core

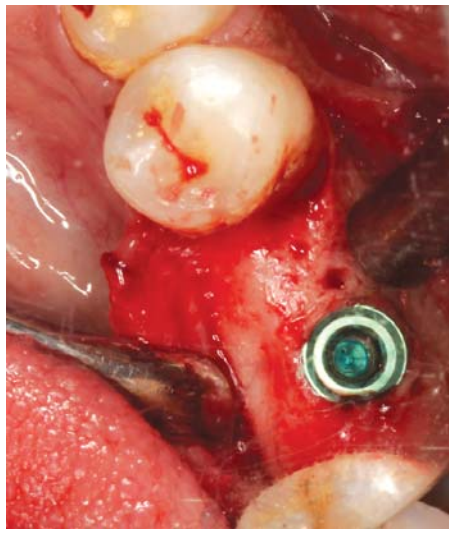

Fig. 8: Occlusal view of the implant placement

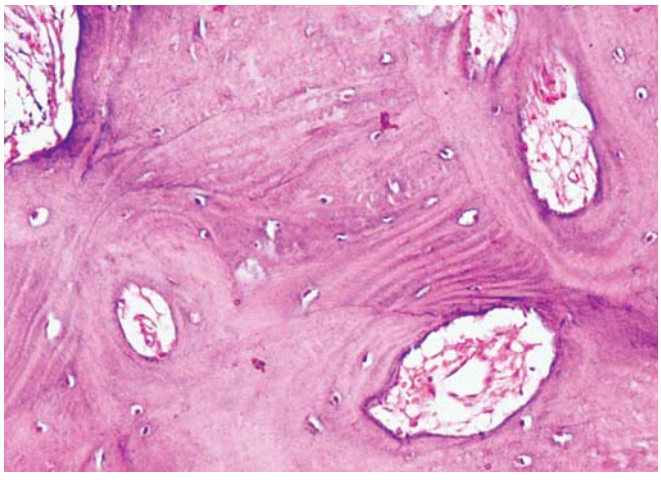

Fig. 9: Histology picture on socket augmentation

and also provides a framework for periimplant soft tissue contours. Lack of alveolar bone due to postextraction bone resorption can result in functional and esthetic problems that necessitate the use of augmenting procedures to reestablish the missing original dimensions.[16] The advent of novel osseous regenerative techniques has significantly increased the functional and esthetic potential of dental implants by restoring alveolar ridge defects to their original dimensions, which allows for optimal implant placement and, in turn, increases the credibility of dental implant therapy as a unique treatment alternative.

In the present case, consequent to the partial resorption of the buccal wall of the extraction socket, there would have been a collapse of the buccal soft tissue leading to marked bucco-oral alterations which was prevented by preservation of alveolar ridge dimensions by the use of pure phase of 100% β-TCP, PRF and collagen membrane. One year results showed effective ridge preservation to nearly original dimensions. A preliminary clinical and histomorphometric case report using β-TCP and type I collagen for extraction socket preservation revealed solid new bone formation 9 months after the procedure. At the time of implant placement, histomorphometric analysis of the biopsied bone showed that it contained 62.6% mineralized bone, 21.1% bone marrow and 16.3% residual β-TCP graft.[17] The healed bone was able to support subsequent dental implant placement and loading.

The PRF is used in various medical fields, particularly in oral and maxillofacial surgery. These concentrates contain high levels of growth factors, including the three isomers of platelet-derived growth factor (PDGF), two of the numerous transforming growth factors (TGF-beta), the insulin-like growth factor (IGF), the epithelial growth factor (EGF) and the vascular endothelial growth factor (VEGF), which are the key elements in wound healing, particularly in bone regeneration.[18] Platelet concentrates are easy to apply in clinical practice and offer potential benefits including rapid wound healing and bone regeneration, and can therefore be considered to be new therapeutic adjuvant. Literature review has shown that in dental implant surgery they are used in bone reconstruction prior or concomitant to implant procedures, and also for dental extraction socket preservation. Their use results in enhanced bone graft density and maturation. They claimed a radiographic maturation rate of bone grafts with platelet growth factors 1.62 to 2.16 times more rapid than grafts without platelet growth factors.[19]

Suba et al[20] suggested that the addition of growth factors within the extraction socket may accelerate bone formation at early time points. In their split mouth study β-TCP combined with PRP placed in extraction socket was compared to contralateral extraction sites grafted with β-TCP alone. β-TCP is a purified, microcrystalline porous form of calcium phosphate whose extensive human and animal study over the past 25 years have demonstrated its biocompatibility, with no adverse reports. One reason for placing a graft of a synthetic biomaterial is to stabilize the coagulum within the socket and avoid possible reduction of the hard tissue volume required for bone regeneration. Another reason for placing a graft into an extraction socket is to provide a scaffold for the in growth of cellular and vascular components to form new bone of acceptable quality and quantity.

Significant resorption of the β-TCP particles is expected 3 to 6 months after placement. Moreover, β-TCP particles become well-incorporated into new bone formation creating a dense cancellous network. This may improve the biologic ability to withstand loading forces transmitted by implants placed in that site. Biodegradation of β-TCP occurs by both osteoclastic activity and chemical dissolution by tissue fluids.[21] It was observed in our case while placing implant postoperatively; a solid new bone formation was present to place an ideal implant body size and able to get adequate primary stability.

Ridge preservation using the guided bone regeneration (GBR) technique has been shown to improve ridge height and width dimensions when compared with tooth extraction alone.[8,22] The principles of guided tissue regeneration and the minimally traumatic removal of teeth and protection of the blood clot have been applied to socket preservation procedures. The membrane maintains the stability of the wound area, and prevents nonbone-forming connective tissue and epithelium from invading the extraction socket. This enables skeletal connective tissue to fill the alveolus and for bone to be formed in the socket.

Since, more rapid bone formation and volumetric stability within extraction sockets are desirable outcomes when planning immediate or early implant placement, and may prove beneficial for implant stability and subsequent

osseointegration, a study examining the effects of growth factors in mediated bone regeneration within extraction sockets at an early time point is appropriate.

CONCLUSION

The present case report showed superior clinical results by the use of β-TCP with PRF as bone replacement graft at the time of tooth extraction which was confirmed radiographically as well as histologically. Further, the addition of PRF to graft and to cover overgraft may enhance the wound healing at early time points.

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