Case Report

Application of Platelet-Rich Fibrin in Periodontal Regeneration – A Case Series

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Abstract

Platelet-rich fibrin (PRF), also known as second-generation platelet concentrate or Choukroun's PRF, is obtained by Choukroun's technique. This biomaterial has healing properties that concentrate in a single autologous fibrin membrane and can be prepared without adding any artificial biochemical modification. Very little data are present on the use of PRF for the treatment of periodontal regenerations as sole graft and in combination. This case series present the clinical and radiographic changes of patients who had undergone periodontal regenerative therapy using PRF. In Case 1, tooth no. 36 was having furcation involvement and was filled with PRF and bone graft. In Case 2, tooth no. 26 and 27 was having intrabony defect and was filled with PRF and bony shavings. In Case 3, tooth no. 33 was having recession defect and was treated with PRF as a sole graft material. The primary outcomes evaluated in this study included changes in probing depth (PD), attachment level, and radiographic bone fill between baseline, 6 and 9 months postoperatively. The results showed that the application of PRF as the sole grafting material and in combination with bone graft exhibited change in PD and gain in clinical attachment after 6 months and 9 months. PRF as has shown promising results in the management of the periodontal defects when used alone or in combination.

Keywords: Furcation defect, Growth factors, Intrabony defects, Periodontal regeneration, Platelet-rich fibrin, Recession.

Introduction

Periodontal disease is a complex, multifactorial, and polymicrobial disease characterized by the loss of connective tissue attachment, along with destruction of periodontal tissues. Periodontal regeneration is a complex process involving biologic events such as cell adhesion, migration, proliferation, and differentiation in an orchestrated sequence. Regenerative procedures include guided tissue regeneration, bone grafts, root biomodifications, soft-tissue grafts, and combinations of these procedures.[1]

Regenerative potential of platelets introduced by Ross *et al.,*[2] in 1974, were among the pioneers who first described growth factor from platelets. Growth factors released following activation from the platelets are trapped within fibrin matrix and have been shown to stimulate the mitogenic response in the periosteum for bone regeneration during wound healing.[3]

Platelet-rich fibrin (PRF) was introduced by Choukroun *et al*.[4] in 2001. It is a second-generation platelet concentrate which contains platelets and growth factors in the form of fibrin mesh, which is prepared from the patient's own blood and is free of any anticoagulant or other artificial biochemical modifiers.[1] After processing, it allows us to obtain a fibrin mesh which is full of growth factors.[5] PRF looks like a fibrin network and helps in efficient cell migration and proliferation. This unique inter-mixed structure acts as a medium for carrying progenitor cells that are essential for tissue regeneration.

In addition, the PRF membrane which is obtained from compressing the PRF in Xpression box serves as a resorbable membrane for guided tissue regeneration. Many growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor-β (TGF-β), and vascular endothelial growth factor (VEGF), are released from PRF which enhances wound healing and regeneration.[1]

Case Report

Case 1: PRF application in furcation management

A 35-year-old female patient reported with complain of pain in the lower left back tooth region since 3 months. On eliciting

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history, the pain was localized, dull, and gnawing with no aggravating factors. The patient noticed swelling with pus discharge from the lower left back tooth region for the past 1 month for which she did not take any medication. The patient had undergone for root canal treatment with respect to 36, 2 years back. Medical and dental history was nil relevant (Figure 1a and b).

Intraoral examination revealed fractured composite restoration, along with presence of supragingival plaque and calculus and sinus tract in the mid-buccal region with purulent discharge in 36. Gingival findings revealed generalized inflamed marginal gingiva with soft and edematous consistency and presence of bleeding on probing. On eliciting fremitus test, positive Grade 1 test was present suggestive of trauma from occlusion.

Periodontal examination exhibited probing depth (PD) of 7 mm (mid-buccal) using Naber's probe with Grade II furcation involvement irt 36 (Figure 1a). Intraoral periapical radiograph (IOPAR) revealed radiolucency in furcation area extending until the apex of mesial root, suggestive of bone loss in 36 (Figure 1b). Based on clinical and radiographical evaluation, a diagnosis of localized chronic periodontitis with Grade II furcation involvement irt 36 was made.

All clinical parameters such as clinical attachment level (CAL), PD, and gingival marginal level and intraoral radiographic records were recorded at baseline. The initial therapy included full-mouth scaling and root planing followed by oral hygiene instructions and selective occlusal grinding (Figure 1a and b). Subsequently, treatment protocol was planned for regenerative therapy using PRF as a membrane along with use of bone graft.

The surgical procedure included an envelope flap which was reflected extending from distal of tooth 34 to mesial of 37. Debridement of furcal defect was carried out with a combination of curettes (Hu-Friedy) and ultrasonic instrumentation. The defect was, then, filled with dried mineralized bone graft (Xenograft) (Figure 1c-e).

PRF was prepared as per Choukroun's protocol[6] by collecting 9 ml of patient's own blood from the median cubital vein using a 10 ml syringe and centrifuged at 400 g-force (Figure 1f). After centrifugation, the superficial fibrin clot was immediately transferred to PRF Xpression box to prepare PRF membrane.

Following bone fill, the PRF membrane was placed over the graft material and the flap was repositioned using sling suture. It was secured with 4–0 silk simple sling suture to obtain primary closure (Figure 1g and h). Periodontal pack was placed and post-operative instructions were given to the patient.

A clinical and radiographic evaluation was done at the end of 9 months. There was a marked reduction of the PD to 4 mm, whereas gain in CAL was evaluated. Radiographically, IOPA radiograph revealed radiopacity in the furcation area suggestive of new bone fill when compared to baseline (Figure 1i and j).

Case 2: PRF application in periodontal bone defect

A 46-year-old male, systemically healthy, non-smoker reported with chief complain of dull pain in the upper left back tooth since 5 months. Intraoral examination revealed generalized marginal and papillary gingival inflammation. On probing with UNC-15 periodontal probe, a PD of 7 mm wrt 26 (mesially) and 6 mm wrt 27 (mesially) were recorded. IOPAR was taken which established arc-shaped radiolucency in mesial aspect of 26 and 27 suggestive of intrabony defect wrt 26 and 27 (Figure 2a and b).

On basis of clinical and radiographical findings, a diagnosis of Stage III Grade B localized chronic periodontitis was made.

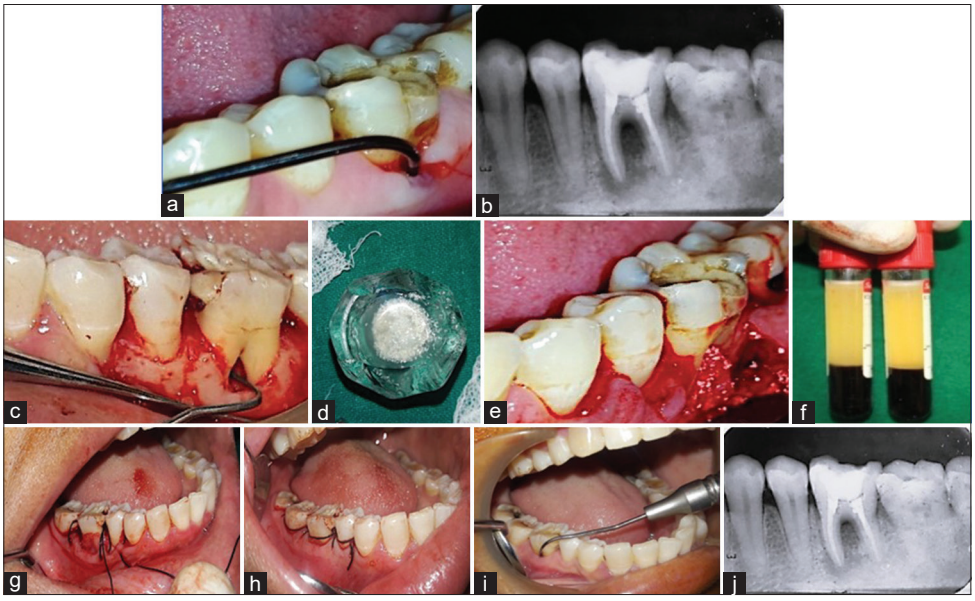

Figure 1: (a) Pre-operative – Furcation involvement, (b) pre-operative IOPAR, (c-e) intraoperative – flap elevation, defect debridement, and placement of bone graft, (f and g) intraoperative – prf prepared, membrane sutured, and (h) intraoperative – sling suture, (I and J) post-operative – probing depth-4 mm, post-operative IOPAR suggestive of new bone Fill w.r.t 36

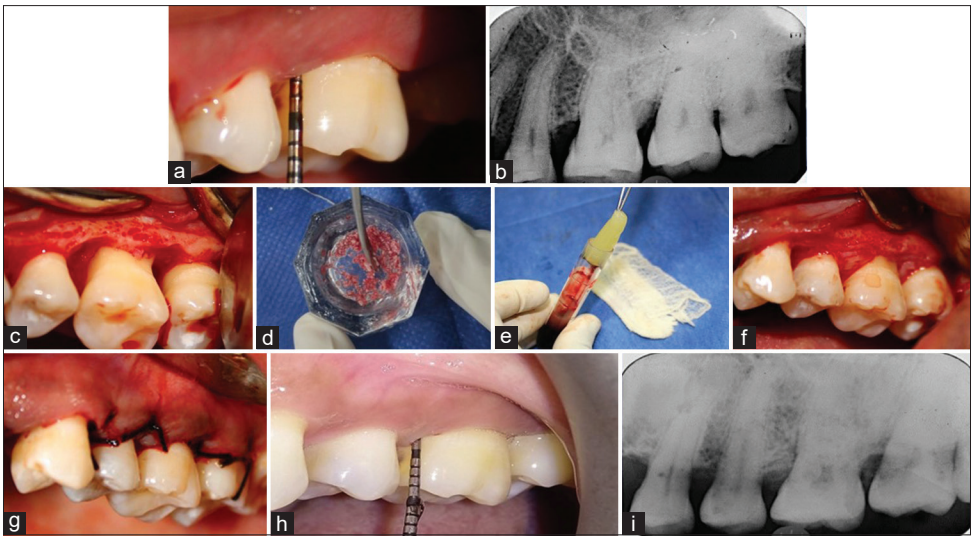

Figure 2: (a and b) Pre-operative – probling depath-7 mm, IOPA reveals intrabony defect mesial and distal w.r.t 26, 27, (c-e) intraoperative – flap elevation, bone shavings, and PRF prepared, (f) intraoperative – membrane placed, and (g) intraoperative – flap sutured, (h and i): post-operative – probing depth-4 mm, post-operative – IOPAR suggestive of new bone fill

Initial therapy included scaling and root planing using ultrasonic instruments followed by oral hygiene instructions. After phase 1 therapy, full-thickness mucoperiosteal flap was reflected exposing the defect. The defect was debrided of granulation tissues. During debridement, bone shavings were collected and were compacted, along with PRF membrane over the area (Figures 2c-f). 3–0 silk suture was placed and the flap was repositioned back (Figure 2g).

The patient was put on strict recall visits every 2nd week during the first 2 months postoperatively. Post 9 months, clinical and radiographical assessment was done and a gain of 3mm of CAL was observed. IOPAR revealed increased radiolucency in the defect area suggestive of new bone fill (Figure 2h and i).

Case 3: PRF application in root coverage

A 30-year-old male patient, systemically healthy, non-smoker came with a chief complain of hypersensitivity and elongation of tooth in the lower left front tooth region. On clinical examination, intraorally, localized gingival inflammation with bleeding on probing was present in 33. Gingival recession of 3 mm depth and 5 mm width was measured using William's periodontal probe i.r.t 33 (Figure 3a-c). On basis of clinical and radiographical findings, a diagnosis Cairo's RT-1 wrt 33 was made.

Initial therapy included scaling and root planing using ultrasonic instruments followed by oral hygiene instructions. After Phase I therapy, baseline measurements were taken. Under local anesthesia, a full-thickness mucoperiosteal flap was reflected (Figure 3d and e). PRF was prepared as per Choukroun's protocol.[4] The prepared membrane was adapted on the denuded root and alveolar bone (Figure 3f and g). The flap was coronally sutured with 4–0 silk suture (Figure 3h).

Post-operative measurements were taken at 3rd month and 6th month. After 6 months, there was reduction in recession by 1 mm and a marked keratinized tissue gain of 2 mm irt 33 (Figure 3i).

Discussion

PRF is a second-generation platelet concentrate and has shown to accelerate the healing of soft and hard tissues in periodontal regeneration.[6] PRF has the property of enhancing cell migration through its fibrin scaffold, which is an important role in wound healing.[7] The platelets present in the matrix are involved in the production of significant amounts of growth factors.[8] Various granules in platelets contain thrombospondine, fibronectine, serotonin, von Willebrand factor, factor V, osteonectin, and antimicrobial proteins.[9] When platelets come in contact with collagen of damaged blood vessels, degranulation and sequential release of cytokines take place, which, further, aid in hemostasis.[10] Being autologous in nature, PRF does not produce an immune reaction at the site of application.

Dohan *et al*.,[11] in his study, concluded that PRF has immunological properties and a high concentration of growth factor like VEGF, which plays a direct and important role in angiogenesis and endothelial cell growth.[12] In a split-mouth randomized controlled clinical trial by Patel *et al*.,[13] they demonstrated that the use of PRF as an adjunct was advantageous for the treatment of intrabony defects, along with open flap debridement.

The rationale for using PRF membrane in this case series was based on the following observations:

a. PRF can be formed and converted to different shapes for better manipulation and adaptation to site
b. PRF acts as a hemostatic agent. Wikesjö *et al*.[14] and Haney *et al*.,[15] in their studies, have stated that, for regeneration to occur, the clot formed should adhere

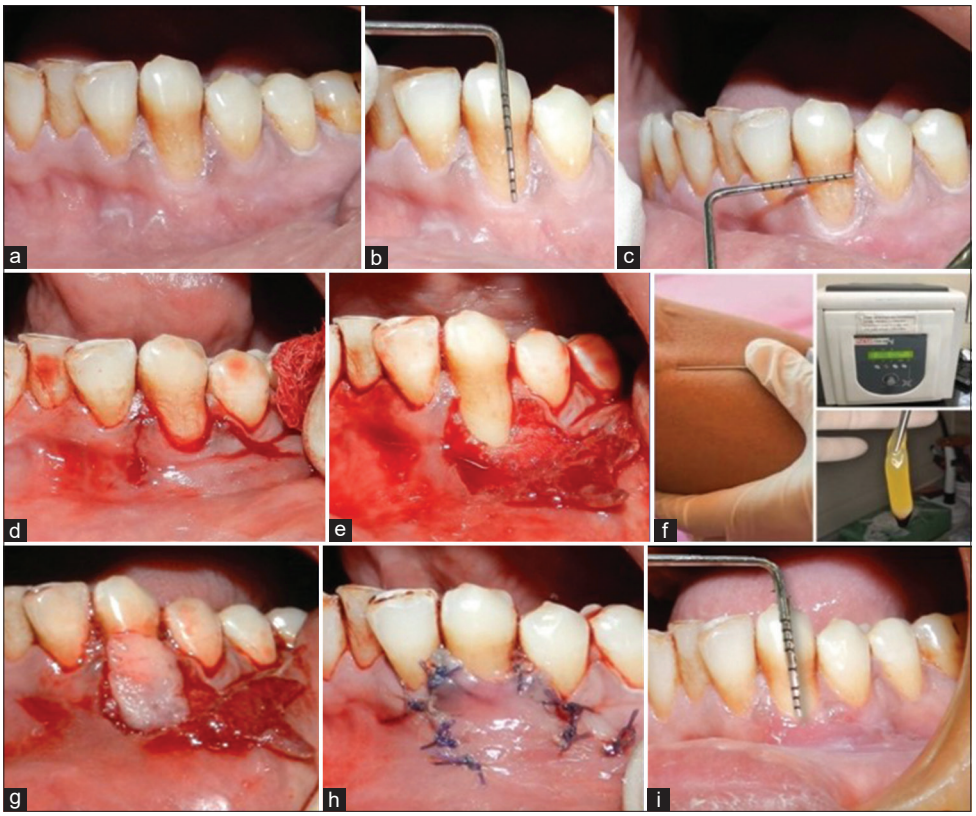

Figure 3: (a-c) Pre-operative – recession of teeth, recession depth-3 mm, and recession width-5 mm, (d-f) intraoperative – incision, flap elevation, and PRF prepared, (g) intraoperative – membrane placed (h) intraoperative – CAF sutured, and (i) post-operative – recession reduced to 1 mm keratinized tissue gain of 2 mm

to the surface of the root, thereby facilitating complete wound maturation

c. The newly formed vessels in fibrin matrix of membrane acts as a bed for migrating periodontal ligament fibroblasts
d. PRF has property to enhance cell migration of fibroblasts.

In this study, PRF has been used alone and in combination with bone graft for various modalities of periodontal regeneration such as furcation defect, intrabony defect and Miller's Class II recession. These results could be explained by the fact that PRF, when used as a membrane, creates a space that facilitates important cellular events in periodontal regeneration[16] such as the proliferation of osteoblasts, cells of the periodontal ligament, growth factors, and also acts as a barrier that inhibits the oral epithelial cell growth.[17]

PRF is a boon in regenerative dentistry and also has few drawbacks.[18] The main drawback is its storage. PRF membranes should be used immediately after preparation as it will shrink resulting in dehydration and altering the structural integrity of the fibrin mesh. Dehydration also affects growth factor content and leukocyte viability will be adversely affected. PRF should not be stored for longer duration as there may be a risk of bacterial contamination. These shortcomings can be avoided by following standard protocols mentioned for preparation, application, and preservation of the PRF.[19]

Conclusion

Periodontal management of hard- and soft-tissue defects has always been a challenge to treat. PRF as a membrane has shown promising results in the management of these defects. The biological properties of this material offer great potential during wound healing.

The main advantage of PRF is that its preparation utilizes the patient's own blood reducing or eliminating disease transmission through blood. The complex architecture of the matrix provides the PRF membrane with increased density, elasticity, flexibility, and strength that help in handling, manipulation, and suturing.

PRF releases various growth factors such as PDGF, TGFβ1 and β2 (TGF-β2), fibroblast growth factor (FGF), VEGF, and insulin-like growth factor which stimulate cell proliferation, matrix remodeling, and angiogenesis.

Furthermore, studies are required, for other clinical applications and healing benefits of this second-generation platelet concentrate.

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