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Platelet-rich Fibrin – A Wonder Material for Periodontal Regeneration – A Clinical Case Series

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Abstract

The discovery of platelet-rich fibrin has enhanced the possibility of treating periodontal defects with significantly positive results in terms of bone defect fill, probing pocket depth, and clinical attachment level, apart from aiding in healing of wounds in other surgical procedures. This case series describes the use of platelet-rich fibrin (PRF) as a membrane along with allografts, in the treatment of intrabony periodontal defects, and the success of this treatment in eliminating factors such as deep periodontal pockets. The use of PRF in periodontal surgical procedures has been amply supported by various authors in the literature. Hence, it can be concluded from this case series that PRF can be used as an autologous alternative to the artificial materials for specifically treat intrabony periodontal defects with equal or better clinical outcomes.

Keywords: Autologous, Guided tissue regeneration, Intrabony defects, Platelet-rich fibrin, Regeneration

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Introduction

Periodontitis is a progressive inflammatory disease which causes destruction of the tooth-supporting structures.[1] Periodontal therapy aims at controlling disease activity and regeneration of periodontal structures.[2] In periodontium, regeneration involves the reconstitution of new alveolar bone, cementum, and periodontal ligament.[3] One of the main objectives of periodontal therapy is regeneration of the lost supporting periodontal tissues. Periodontal regenerative procedures include soft-tissue grafts, bone grafts, root biomodifications, guided tissue regeneration, and combinations of these procedures.[4] According to the 1996 World Workshop in Periodontics, Guided Tissue Regeneration is defined as "procedures attempting to regenerate lost periodontal structures through differential tissue responses." The main disadvantage of current regenerative biomaterials is that many are avascular, and without a blood supply, they lack the biological basis to achieve complete regeneration of human tissues.[5]

Various biomaterials have been used for periodontal tissue regeneration in addition to autogenous and allogenic bone grafts but not a single graft material is considered as gold standard for the treatment of intrabony defects. The disruption of vasculature during wound healing leads to fibrin formation, platelet aggregation, and release of several growth factors into tissues from platelets through molecular signals which are primarily mediated by cytokines and growth factors. There is evidence that the presence of growth factors and cytokines in platelets plays key roles in inflammation and wound healing.[6] This has led to the idea of using platelets as therapeutic tools to improve tissue repair, particularly in wound healing.

In the past 50 years, there have been great strides to develop materials to aid this healing process, one of which is platelet-rich fibrin (PRF).[7] PRF described by Choukroun *et al*.[8] is a second-generation platelet concentrate which contains platelets and growth factors in the form of fibrin membranes prepared from the patient's own blood free of any anticoagulant or other artificial biochemical modifications.[9] PRF enhances wound healing and regeneration and several studies show rapid and accelerated wound healing with the use of PRF than without it.[10] PRF is superior to other platelet concentrates like PRP due to its ease and inexpensive method of preparation and also does not need any addition of exogenous compounds such as bovine thrombin and calcium chloride. It is advantageous than autogenous graft also because an autograft requires a second surgical site and procedure.[11] Thus, PRF has emerged as one of the promising regenerative materials in the field of periodontics.

While PRF was initially intended for use in oral and maxillofacial surgery, its applications in periodontology are now widespread. PRF can be manipulated into a membrane which allows it to be extensively utilized in surgical procedures. PRF membranes have shown favorable properties when compared to other artificial membranes, such as their capability to release PGDF and other growth factors for up to 28 days following placement.[11]

It is now being widely used in the treatment of intrabony defects, improves healing following harvesting of free gingival grafts from the palate, enhances osseointegration post-implant surgery, sinus lift procedures, regeneration of peri-implant bone defects, preservation of alveolar ridge height, and more.

Case Series

Case 1

A 49-year-old male patient reported to the outpatient department of periodontology with a chief complaint of pain in the lower

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right back teeth region for 2–3 months. Medical history and extraoral examination were non-contributory. The adjacent and contralateral teeth were healthy. On periodontal examination, probing depth of 8 mm was seen with respect to the mesial of 46 and 11 mm was seen with respect to the distal of 46 [Figure 1a]. On radiographic examination, vertical bone loss was observed on the distal side along with radiolucency in the furcation area [Figure 1b]. Regenerative procedure was planned to manage the bony defect. After a full-thickness flap was reflected under local anesthesia, the defect was seen clinically as a three-walled defect. Concurrently, 10 mL of blood was drawn from the patient's antecubital vein and transferred to two vacutainers equally. The tubes were then placed in the PRF machine on opposite sides to maintain balance. The cycle was run for 12 min at 2700 rpm, which resulted in the formation of a red corpuscular base, the fibrin clot (PRF), and the acellular plasma. The fibrin-rich PRF layer was separated from the basal layer and placed under the lid to form the PRF membrane [Figure 1c]. Following debridement and irrigation, the defect was filled with a bone graft material (SyboGraf) [Figure 1d]. On the bone graft, the PRF membrane layer was placed such that it was well-adapted to the contour [Figure 1e]. The flap was then sutured using silk sutures. Post-operative instructions and antibiotics were given to the patient. Regular clinical and radiographic follow-up was done at 1-month intervals for 3 months. At the end of 3 months, the defect showed radiographically complete bone fill in the furcation area [Figure 1f]. There was also significant reduction in the probing pocket depth on both proximal sides along with gain in clinical attachment level.

Case 2

A 35-year-old male patient reported to the department of periodontology with a chief complaint of pain and mobility in the lower left back region of jaw for 2 months. On clinical examination, a pocket depth of 8 mm was observed mesial to 46. Grade I mobility was also observed with this tooth [Figure 2a]. Radiograph showed a vertical bony defect in the same area [Figure 2b]. A similar protocol as stated in Case 1 was followed for preparation of the PRF membrane. After flap reflection, it was concluded to be a three-walled defect [Figure 2c]. Cerabone bone graft material was used to fill the defect [Figure 2d] followed by the placement of the PRF membrane [Figure 2e]. The patient was followed up at regular intervals for 3 months, at the end of which, significant bone fill was observed at the operated site [Figure 2f].

Case 3

A 29-year-old male patient was referred to the department of periodontology from the department of endodontics, for opinion of an endodontically treated 36. On clinical examination, a pocket depth of 7 mm was observed on the distal surface of 36. Radiograph revealed vertical bone loss with respect to distal of 36 [Figure 3a]. On reflection of the flap, a two-walled defect was observed [Figure 3b]. PRF membrane was prepared using a similar procedure as in Case 1. The defect was filled using a xenograft (Cerabone) followed by placement of the PRF membrane over the graft material. The flap was then sutured and the patient completed a 3-month follow-up period. Significant reduction in probing pocket depth along with radiographic bone fill was observed [Figure 3c].

Discussion

Besides their role in hemostasis, platelets secrete a wide number of proteins including platelet-derived growth factor, transforming growth factor-β1, fibronectin, and fibrinogen. Through the release of these proteins, platelets activate and regulate the other cells involved in the aspects of tissue healing. This led to the search for platelet-derived preparations.[8]

Choukroun *et al*.[8] made a remarkable discovery that if a lower centrifugal speed was used in a one stage process (12 min at 2700 rpm), without the use of anticoagulants, then the formulation contained a fibrin scaffold which was termed PRF. The fibrin scaffold acted as a provisional extracellular matrix. This gave the material a semi-solid formulation, which allowed for easy manipulation, but it was also entirely autologous. The fibrin scaffold not only trapped platelets but also leukocytes which released further proteins, many of which were not seen in PRP. Not only this, but leukocytes are naturally one of the first cells to reach a healing surgical site, so PRF leads to a higher initial concentration of these leukocytes, which subsequently has been shown to reduce the incidence of post-operative infections.[5]

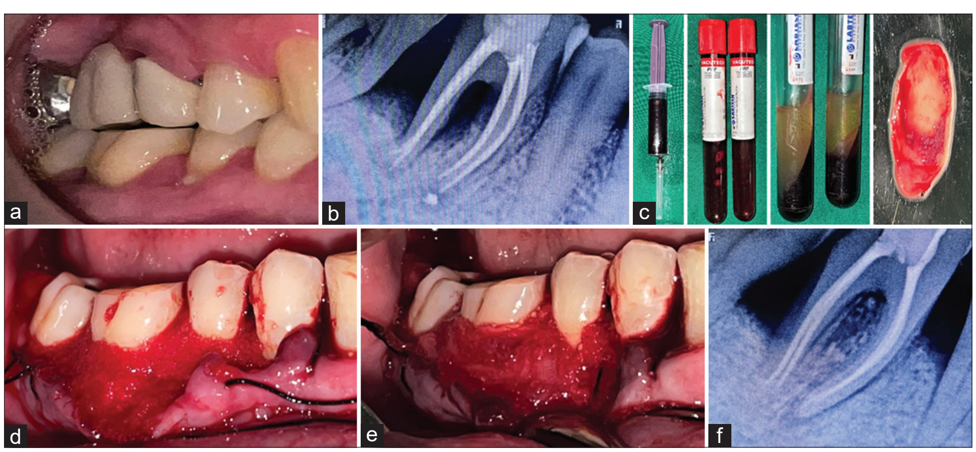

Figure 1: (a) Clinical view of area of interest (tooth 46), (b) radiograph showing bone loss in distal and furcation areas of 46, (c) collection of blood and formation of PRF and its membrane, (d) SyboGraf (bone graft) placed into defect, (e) PRF membrane placed over graft, and (f) follow-up radiograph at 3 months showing complete coverage of furcation defect.

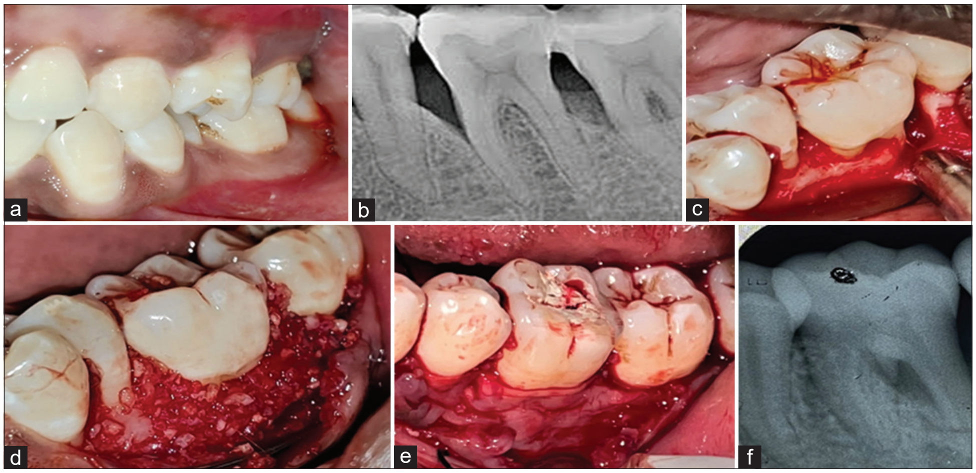

Figure 2: (a) Clinical picture of tooth 36, (b) radiograph demonstrating intrabony defect with 46, (c) defect seen after flap reflection, (d) placement of Cerabone bone graft, (e) PRF membrane placed, and (f) post-operative radiograph at 3 months

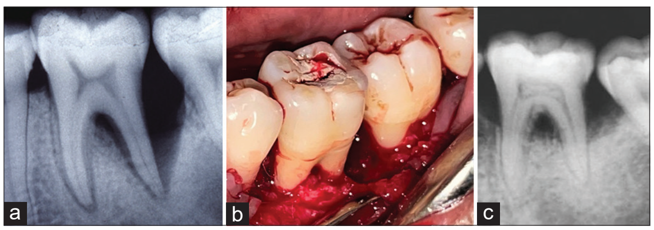

Figure 3: (a) Pre-operative radiograph showing intrabony defect, (b) intraoperative view showing bone defect, and (c) post-operative radiograph at 3 months

Panda *et al*. in 2014, in their case report, demonstrated that an intrabony defect treated using autologous PRF along with a xenograft resulted in significantly reduced probing pocket depth and gain in clinical attachment level, 6 months after surgery. They attributed the success of this treatment to the sustained and simultaneous release of various growth factors from the autologous PRF.[12]

Aggour and El-Hady (2017) evaluated the regenerative capacity of PRF and compared it to collagen membrane for the treatment of intrabony periodontal defects in patients with generalized aggressive periodontitis. They concluded that PRF showed favorable results that are comparable to collagen membrane for the treatment of intrabony periodontal defects in patients with generalized aggressive periodontitis.[13]

Lekovic *et al*., in 2012, examined the suitability of autologous PRF as regenerative treatment for periodontal intrabony defects in humans and demonstrated in their study that PRF can significantly improve clinical parameters associated with human intrabony periodontal defects, especially when used in combination with bovine porous bone mineral, which has the ability to augment the effects of PRF in reducing pocket depth, improving clinical attachment levels, and promoting defect fill.[14]

Liu *et al*., in 2021, stated in their randomized controlled clinical trial that a combination of guided tissue regeneration and bovine porous bone mineral plus PRF complex is significantly more effective clinically, in the treatment of intrabony defects.[15]

Najeeb *et al*. conducted a systematic review of 13 clinical studies in 2017 and found that PRF resulted in better clinical/radiographic outcomes than open flap debridement and augmented therapeutic effects of bone grafts, in majority of these studies. The combination of bovine bone substitutes and PRF resulted in better performance compared to being used alone. Similarly, better outcomes were observed while using PRF in combination with nanohydroxyapatite, metformin, and demineralized freeze-dried bone allograft.[16]

Conclusion

From the discussion and presentation of the above case series, it can be concluded that PRF enhances regeneration in periodontal intrabony defects, even if it is used along with different xenografts (bone graft) materials. It exerts a beneficial effect by prolonging the release of various growth factors at the site of the wound, thus promoting and hastening its healing. Using PRF shows equally significant bone defect filling ability along with reduction in probing depths and gain in clinical attachment level as the use of other allografts. Since it is obtained from the patient's own blood, any uncertainties about acceptance and consequences of the graft by the body are also eliminated.

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