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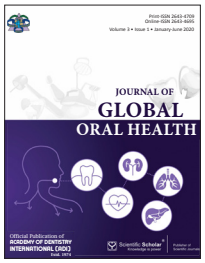

*Review Article*

# Platelet-rich fibrin: A promising regenerative material

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## ABSTRACT

Periodontal regeneration is a process involving biological events such as cell adhesion, migration, proliferation, and differentiation in an orchestrated sequence. It is well known that platelets play a key role in hemostasis and the wound healing process. Platelets were introduced as regenerative potential. Choukroun *et al.* (2001) first described platelet-rich fibrin (PRF). It is the second generation of platelet concentration. It consists of a natural fibrin matrix. It is autogenous fibrin made up of the patient's blood free from anticoagulants. It is three-dimensional architecture consisting of the specific composition of leukocyte and platelet-rich fibrin biomaterials. Various technique has been used in the preparation of PRF but Choukroun's PRF technique is the most common and easy technique developed in France. The patient's blood was taken at around 5 ml which is collected in each of the two sterile vacutainer tubes with a 6 ml capacity without anticoagulant and centrifugation. PRF is used in various fields such as endodontics, oral and maxillofacial surgery, periodontics, and tissue engineering. It is more economical and easy preparation than other grafts. PRF should be handled properly before it shrinks and gets dehydrated. It is the most successful periodontal regenerative material.

**Keywords:** Platelet-rich fibrin, Regeneration, Platelets

## INTRODUCTION

Periodontal disease is a multifactorial disease that is characterized by the loss of connective tissue attachment with the destruction of periodontal tissue leading to tooth loss. The goal of periodontal therapy is to eliminate the inflammatory process, prevent the progression of the disease, and regenerate lost periodontal tissues. Periodontal regeneration is a process involving biological events such as cell adhesion, migration, proliferation, and differentiation in an orchestrated sequence. The procedures include soft-tissue grafts, bone grafts, root biomodifications, guided tissue regeneration, and combinations of these procedures. Various regenerative materials have been used as autogenous bone grafts and allogenic bone grafts, but no one has a proven gold standard.[1]

Healing is a greater challenge in periodontal surgery. It is a complex process that leads to cell organization, chemical signals, and extracellular matrix for tissue repair. It is well known that platelets play a key role in hemostasis and the wound healing process. The rupture of blood vessels leads to fibrin formation, platelet aggregation, and the release of growth factors that play a role in wound healing.[2]

Platelets were introduced as regenerative potential. The platelets are used in concentration as platelet-rich plasma (PRP) and platelet-rich fibrin (PRF). Whitman *et al.* introduced PRP which enhances osteoprogenitor cells in host bone. PRP used should take precautions due to the risk of

bovine thrombin, which may generate antibodies to factors V, XI, and thrombin leading to coagulopathies.[3]

Choukroun *et al*. first described PRF. It is the second generation of platelet concentration. It consists of a natural fibrin matrix. It is autogenous fibrin made up of patient blood free from anticoagulants. Its advantages are easy preparation with fewer chemical additives such as bovine thrombin and calcium chloride. Thus, this summarizes the relevant literature available on PRF as a promising regenerative biomaterial which focuses on the preparation of PRF, its clinical application, advantages and disadvantages.[4]

## WHAT IS PRF?

PRF is a Choukroun's PRF that was first developed in France and used in oral and maxillofacial surgery.[5] It has a three-dimensional architecture consisting of the specific composition of leukocyte and PRF biomaterials. PRF has various dense fibrin networks with leukocytes, cytokines, structural glycoproteins, and also growth factors such as transforming growth factor β1, platelet-derived growth factor, vascular endothelial growth factor, and glycoprotein such as thrombospondin-1 during P7 day. The concentration of leukocytes in the PRF scaffold plays a role in growth factor release, immune regulation, anti-infectious activities, and matrix remodeling during wound healing and slow polymerization takes place.[6,7]

According to the content of leukocyte and fibrin architecture, the platelets concentration was recently classified mainly in four available techniques: (1) Pure Platelet-Rich Plasma - Vivostat PRF, Anitua's Plasma rich in growth factors (PRGF); PRGF-Endoret, or E-PRP all were in liquid suspension without leukocytes before activation. It can be activated and transformed into a gel form, (2) Leukocyte and Platelet-Rich Plasma, Curasan, Regen, Plateltex, SmartPReP, PCCS, and Magellan all were in liquid suspension with leukocytes before activation. It can be activated and transformed into a gel form, (3) Pure PRF - Fibrinet is a solid fibrin material without leukocytes, and (4) Leukocyte and PRF - Choukroun's PRF; Advanced PRF, and injectable i-PRF, (Duo Process, Nice, France); L-PRF (Intra-Spin, IntraLock, Boca Raton, FL, USA); and Concentrated Growth Factors, a solid fibrin material with leukocytes.[8]

## PROTOCOL FOR PREPARATION OF PRF

Various techniques have been used in the preparation of PRF but Choukroun's PRF technique is the most common and easy technique developed in France. It is a second-generation platelet concentrate because of natural fibrin without any anticoagulants. The patient's blood was taken at around 5 ml which is collected in each of the two sterile vacutainer tubes with a 6 ml capacity without anticoagulant. The vacutainer tubes are then placed in a centrifugal machine at 3000 revolutions/min for 10 min and immediately formed into three layers; upper straw-colored cellular plasma and the middle fraction containing the fibrin clot, the red lower fraction containing red blood cells. Mazor *et al*.[9] stated that after centrifuge, the fibrin clot gets transformed into a membrane formed when it is squeezed as shown in [Figures 1-3].

The upper part contains concentrated fibrinogen in the presence of thrombin and converts it into fibrin as shown in Figure 4. Blood starts converting into coagulation form in contact with glass surface due to lack of anticoagulant. When the silica surface contact, the clot polymerization process takes place. In this way, PRF is formed in glass-coated tubes which are easy to handle and quickly apply in the clinical area without any cytotoxicity.[10]

## HANDLING AND PLACEMENT OF THE PRF

Platelet-rich fibrin (PRF) is then placed in the PRF box for the formation of membrane which is then cut and squeezed at the site according to its application in certain procedures. PRF can be mixed with other regenerative materials based on its requirement like bone graft or it can be used as a membrane to cover the graft placed.

## CLINICAL APPLICATION

### Endodontic applications

- In the treatment of open apex
- For regeneration of pulp-dentin complex
- In combination with MTA to create root end barriers in apexification procedures to prevent extrusion of material
- In regenerative pulpotomy.

### Oral & maxillofacial surgery applications

- Filling material in avulsion sockets and bony defects
- Bone augmentation in sinus lifts for posterior maxilla augmentation for implants.

### Periodontology applications

- Ridge preservation-guided bone regeneration
- For the treatment of intrabony defects, treatment of gingival recession, and treatment of GTR and periapical lesion
- Thorat *et al*. investigated the clinical and radiological effectiveness of PRF in intrabony defects in chronic periodontitis. The result was observed to be more reduction in probing pocket depth, gain in clinical attachment level, and greater bone fills at the tested site with PRF and open flap debridement alone in control sites.[11]

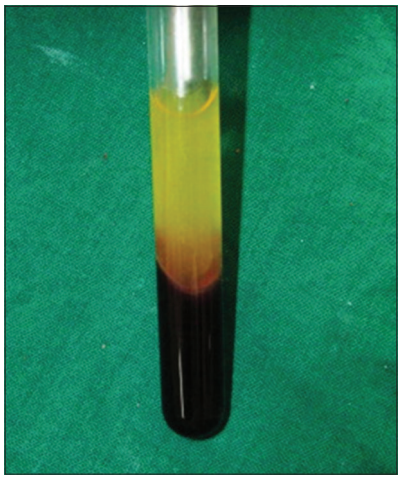

**Figure 1:** Platelet-rich fibrin after centrifugation of blood.

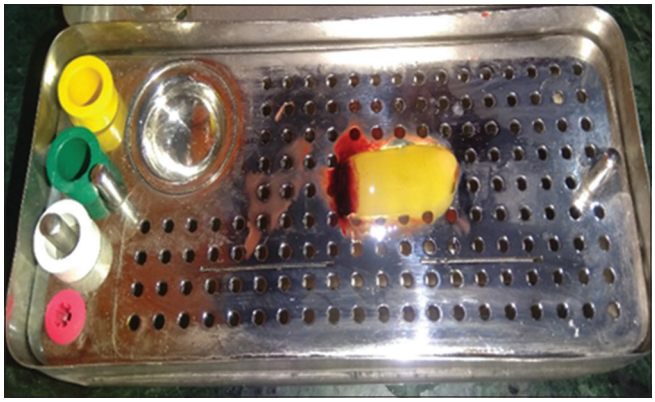

**Figure 2:** Platelet-rich fibrin membrane box.

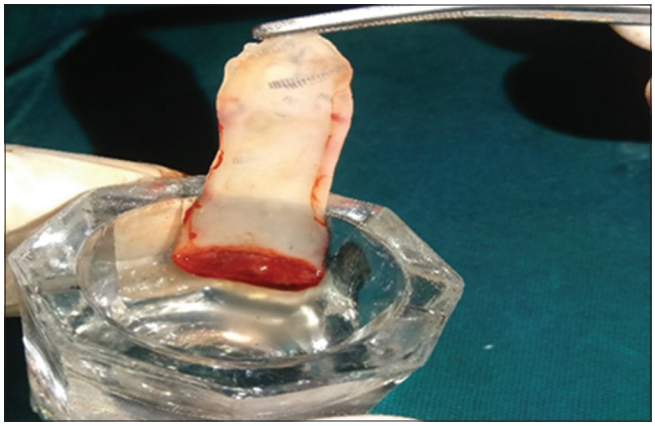

**Figure 3:** Platelet-rich fibrin membrane after squeezing between gauze.

- Parikh *et al.* conducted a study to evaluate the success of the use of PRF in combination with pouch and tunnel technique for multiple gingival recession with a 6-month follow-up.[12]
- Ustaoğlu *et al.* conducted a study to assess the adjunctive use of t-PRF in intrabony defects with open flap debridement in comparison with guided tissue regeneration as a gold standard and OFD alone as a control. They concluded that t-PRF may give similar successful results as GTR in the treatment of IBDs with endoperio lesions.[13]
- Chenchev *et al.* conducted, a study to evaluate the stability of dental implants placed after socket preservation with allograft or PRF as a sole grafting material and conclude that formation of new bone cells around the implant surface increases the biological stability of the dental implant.[14]
- PRF use as scaffolds in tissue engineering have been investigated by many researchers. Kang *et al.* conducted an *in vitro* study stating PRF as a bioscaffold and reservoir of growth factors for tissue regeneration.[15]

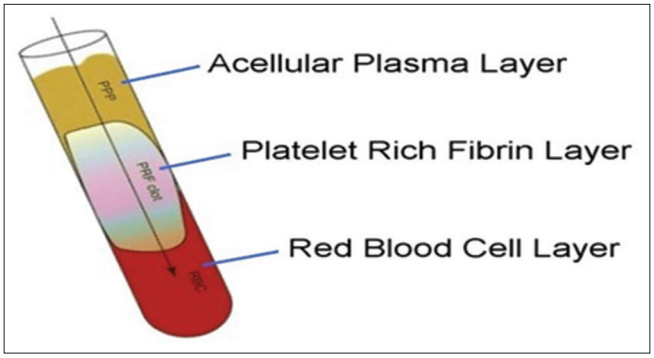


**Figure 4:** PRF follows the preparation protocol and is divided into three parts: (1) Upper part – Acellular plasma layer, (2) Middle part – Platelets-rich fibrin, (3) Lower part – Red blood cell layer.

## ADVANTAGES OF PRF

1. It is an easily prepared and simple technique with centrifugation
2. It is a purely autogenous blood sample
3. It does not require any additional chemical composition such as thrombin and without any immunological reactions
4. It can be used with a combination of bone grafts
5. It will rapidly be healed
6. It is economical and quickest option other than bone grafts
7. It is used as a membrane which reduces patients' discomfort.[16]

## DISADVANTAGES OF PRF

1. PRF success depends on mainly handling, related to blood collection time, and its transfer to the centrifuge machine
2. Use of glass-coated tubes for cloth polymerization
3. The clinician should be well experienced in the manipulation of PRF

4. PRF should be used immediately before it shrinks which dehydrates the structural integrity and decreases the growth factor content in PRF8.

## CONCLUSION

PRF is a simple technique. It is the most successful regeneration of periodontal tissues. In the future, PRF and its applications in the field of soft tissue and bone regeneration have enormous therapeutic implications, but the role in dentistry may need more studies of randomized trials and standardized PRF processes that will enhance therapeutic outcomes.

### Declaration of patient consent

Patient's consent not required as there are no patients in this study.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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