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Original Research Article

Platelet- Rich Fibrin in Dentistry: A Narrative Review

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Name of Author:

Dr Supriya Prathipati[1], Dr Rugma Krishnan[2], Dr Cheranjeevi Jayam[3], Dr Anila Bandlapalli[4], Dr Chaitanya Iruvaram[5], Dr Muni Srikanth I[6], Dr Harideep Yellamilli[7] and Dr Prasad G[8]

Affiliation: *[1]Senior Resident, Dept of Dentistry, AIIMS Mangalagiri*
[2]Junior Resident, Dept of Dentistry, AIIMS Mangalagiri
[3]Additional Professor, Dept of Dentistry, AIIMS Mangalagiri
[4]Professor, Dept of Conservative Dentistry & Endodontics, SIBAR Dental college.
[5]Additional Professor, Dept of Immunohematology and Blood Transfusion, Assistant Professor, AIIMS Mangalagiri
[6]Additional Professor, Dept of Orthopedics, AIIMS Mangalagiri
[7]Assistant Professor, Dept of Emergency Medicine, AIIMS Mangalagiri
[8]Assistant Professor, Dept of Emergency Medicine, AIIMS Mangalagiri.

Corresponding Author:

Dr Supriya Prathipati

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Abstract: A popular autologous biomaterial in dentistry, platelet-rich fibrin (PRF) is known for its healing and regenerative qualities. PRF, which was first introduced by Joseph Choukroun, is made by centrifuging a patient's blood without the use of anticoagulants. This produces a fibrin matrix that is high in growth factors, leukocytes, and platelets. These biological elements are essential for angiogenesis, tissue regeneration, and wound healing.

In dentistry, PRF has been extensively applied in oral and maxillofacial surgery, periodontology, implantology, and endodontics. It enhances soft tissue healing following extractions, supports bone regeneration in intrabody defects and sinus lift procedures, improves osseointegration around dental implants, and aids in regenerative endodontic procedures. Compared to Platelet-Rich Plasma (PRP), PRF offers advantages including simplified preparation, absence of biochemical additives, cost-effectiveness, and a more sustained release of growth factors.

The goal of this narrative review is to present a clear and thorough summary of PRF in dentistry, covering its biological foundation, clinical uses, and preparation techniques. PRF has been effectively used to promote soft tissue healing, increase bone regeneration, and support regenerative operations in periodontology, implantology, endodontics, and oral and maxillofacial surgery. PRF is regarded as being safe, affordable, and simple to make in comparison to other platelet concentrates.

Keywords: shopping mall, perceived wellbeing, strategic operation, shopper's preference.

INTRODUCTION

Regenerative dentistry has witnessed remarkable progress with the introduction of biologically active materials that enhance tissue healing and repair. Among these, platelet concentrates have gained significant attention due to their ability to accelerate wound healing and promote regeneration through the release of growth factors and cytokines.

Platelet-rich fibrin (PRF) is defined as a second-generation platelet aggregate that consists of platelet-rich plasma (PRP) within a fibrin matrix, prepared without anticoagulants, and is characterized by a simpler, faster preparation method. It promotes the release of growth factors and cytokines, making it useful in applications such as dental surgery and wound healing.1

Platelet-rich fibrin (PRF), first introduced by Dr. Joseph Choukroun and colleagues in 2001, represents a second-

generation platelet concentrate that is entirely autologous and prepared without the addition of anticoagulants or artificial biochemical agents. This simplicity of preparation, combined with its biological effectiveness, has positioned PRF as a promising biomaterial in modern dental practice.2

The regenerative potential of platelets has been recognized since the 1970s, when platelet-rich plasma (PRP) emerged as the first-generation platelet concentrate. Although PRP demonstrated encouraging clinical outcomes, its complex preparation protocol and the use of bovine thrombin raised concerns regarding safety and practicality. These limitations led to the development of PRF, which offers a more natural fibrin matrix enriched with platelets, leukocytes, and a sustained release of growth factors such as platelet-derived growth factor, transforming growth factor-β, vascular endothelial growth factor, insulin-like growth factor, fibroblast growth factor, connective tissue growth factor, and epidermal growth factor. This unique biological composition enables PRF to support both hard and soft tissue regeneration, either as a standalone material or in combination with bone substitutes.3

In recent years, PRF has been increasingly explored across various dental specialties, including oral surgery, periodontology, implantology, endodontics, and regenerative procedures. Its ease of preparation, autologous nature, and favorable biological properties have contributed to its widespread clinical

adoption. This narrative review aims to provide a comprehensive overview of the biological basis, clinical applications, advantages, limitations, and future perspectives of PRF in dentistry, highlighting its evolving role in regenerative therapeutic strategies.

Biological aspect of PRF

Compositional analysis of platelet-rich fibrin (PRF) demonstrates that it is a fibrin-based biomatrix enriched with platelets, leukocytes, immunomodulatory cytokines, and circulating stem cells.4

Although platelets and leukocytes are the primary contributors to the biological activity of PRF, the fibrin matrix plays a crucial role in determining its therapeutic efficacy. The conversion of fibrinogen to fibrin occurs through thrombin-mediated polymerization, and the mode of polymerization significantly influences the biological properties of the fibrin matrix. Unlike PRP, which undergoes rapid polymerization due to exogenous thrombin and calcium chloride, PRF is formed through slow and physiological fibrin polymerization. This results in a flexible fibrin network with equilateral junctions, allowing sustained entrapment and gradual release of intrinsic growth factors and cytokines, thereby promoting long-term regenerative effects.5

Platelets, as the dominant cellular component of PRF, serve as the main source of growth factors and cytokines involved in wound healing and tissue regeneration. These bioactive molecules, stored primarily in alpha granules, include TGF-β, PDGF, IGF-1, VEGF, and EGF, along with immune cytokines such as IL-1β, IL-4, IL-6, and TNF-α, (TABLE 1)which collectively regulate inflammation, angiogenesis, and tissue repair.6

Interleukin-1β (IL-1β)	Upregulates the expression of adhesion molecules on endothelial cells, stimulates helper T cells and lymphocyte chemotaxis, and activates osteoblasts
Interleukin-6 (IL-6)	Promotes B-cell differentiation and antibody production, and drives the differentiation of naive T cells into cytotoxic T lymphocytes.
Tumor necrosis factor-α (TNF-α)	Enhances neutrophil cytotoxicity, promotes cell survival and proliferation, and improves fibroblast remodeling capacity.
Interleukin-4 (IL-4)	Induces B-cell differentiation into plasma cells, promotes B-cell class switching to IgE, and drives differentiation of naive helper T cells into Th2 cells.
Transforming growth factor-β (TGF-β)	Promotes angiogenesis and enhances fibronectin and collagen synthesis, inhibits collagen degradation, stimulates chemotaxis of fibroblasts and immune cells, and suppresses osteoclast formation and bone resorption
Platelet-derived growth factor (PDGF)	Stimulates the migration and proliferation of mesenchymal cell lineages, promotes angiogenesis, enhances macrophage chemotaxis and activation, and induces TGF-β secretion from macrophages
Insulin growth factor-1 (IGF-1)	Enhances chemotaxis and activation of osteoblasts, promotes bone formation, and induces differentiation and mitogenesis of mesenchymal cells
Vascular endothelial growth factor (VEGF)	Initiates angiogenesis, increases vascular permeability, and stimulates endothelial cell proliferation and migration.
Epidermal growth factor (EGF)	Promotes angiogenesis, stimulates proliferation and differentiation of epithelial cells, and enhances cytokine secretion in both epithelial and mesenchymal cells.

TABLE 1. dominant cellular component of PRF

DIFFERENT TYPES OF PRF AND PREPARATION PROTOCOLS

Choukroun method of preparation

The original PRF preparation protocol, introduced by Choukroun et al. in 2001, involves collecting 10 mL of blood without anticoagulant in glass-coated plastic tubes, followed immediately by centrifugation at 2,700 rpm (~400 g) for 12 minutes. The resulting PRF is commonly referred to as Choukroun's PRF or leukocyte-rich PRF (L-PRF).7 Advanced methods of PRF preparation

Since high centrifugal forces tend to push cells to the bottom of the tube, reducing centrifugation speed was proposed to minimize cell loss and increase leukocyte content in the PRF matrix. Advanced PRF (A-PRF) was developed using a lower centrifugal force of 1,500 rpm (~230 g) for 14 minutes in glass-based vacuum tubes. Later, it was suggested that A-PRF could also be obtained at 1,300 rpm (~200 g) for the same duration.8

Compared to L-PRF, A-PRF contains a higher total number of viable cells, including neutrophils, lymphocytes, and platelets. The presence of immune cells contributes to macrophage differentiation and maturation, which promotes bone and soft tissue regeneration primarily via growth factors released from macrophages. 9

Consistently, previous studies have shown that macrophages are essential for osteoblast differentiation and bone formation. Moreover, the total release of growth factors (TGF-β1, VEGF, PDGF, EGF, and IGF-1) is generally higher in A-PRF than in L-PRF. However, some reports have noted lower growth factor release from A-PRF compared to L-PRF. Despite extensive research, available data remain limited, and further studies are needed to clarify the comparative advantages and limitations of A-PRF and L-PRF.8-10

Advanced PRF +

Advanced PRF Plus (A-PRF+) is a modified form of A-PRF made by reducing centrifugation speed and time (1,300 rpm, 8 min) to keep more cells in the PRF. A-PRF+ releases higher levels of growth factors (TGF-β1, VEGF, PDGF, EGF, IGF-1) than A-PRF and L-PRF. It also improves migration and growth of gingival cells and increases collagen I production in fibroblasts, supporting better wound healing and tissue regeneration.8

Injectable PRF

PRF is usually a gel and cannot be injected, unlike PRP. To solve this, injectable PRF (i-PRF) was developed. It is made by centrifuging blood at 700 rpm for 3 minutes in plastic tubes. The top yellow layer can be collected and injected. i-PRF releases growth factors faster at first and increases TGF-β, PDGF, and collagen I in cells more than

PRP, suggesting stronger regenerative effects.11

Titanium PRF

Titanium-PRF (T-PRF) is prepared by centrifuging blood at 2,800 rpm (~400 g) for 12 minutes using medical-grade titanium tubes. Studies show that T-PRF forms a thicker and more extensive fibrin network than L-PRF, suggesting it may persist longer in the tissues.12

Concentrated growth factors (CGFs)

These are based on the i-PRF protocol and are considered a variant of the same platelet concentrate. Blood is centrifuged in plastic tubes at speeds ranging from 2,400 to 3,300 rpm with controlled acceleration and deceleration. This separates plasma and platelets at the top, which can be collected and used in injectable form.13

TABLE 2. Differences in types of PRF's

PRF Type	Centrifugation Speed & Time	Tube Type	Form	Key Features / Advantages
Choukroun's PRF (L-PRF)	**2,700 rpm (~400 g), 12 min**	**Glass-coated plastic**	**Gel**	**Original PRF; leukocyte-rich; standard fibrin matrix**
Advanced PRF (A-PRF)	**1,500 rpm (~230 g), 14 min or 1,300 rpm (~200 g), 14 min**	**Glass vacuum**	**Gel**	**Higher number of viable cells (neutrophils, lymphocytes, platelets); promotes macrophage differentiation, bone & soft tissue regeneration; more growth factors than L-PRF**
Advanced PRF Plus (A-PRF+)	**1,300 rpm (~200 g), 8 min**	**Glass vacuum**	**Gel**	**Even higher growth factor release; improves gingival cell migration & proliferation; increases collagen I in fibroblast**
Injectable PRF (i-PRF)	700rpm ,3min	Plastic	Injectable liquid	Can be injected; faster early growth factor release; increases TGF-β, PDGF, collagen I compared to PRP
Titanium PRF (T-PRF)	**2,800 rpm (~400 g), 12 min**	**Medical-grade titanium**	**Gel**	**Thicker and more extensive fibrin network; may last longer in tissues**
Concentrated Growth Factors (CGFs)	**2,400–3,300 rpm, controlled acceleration/deceleration**	**Plastic**	**Injectable**	**Variant of i-PRF; plasma and platelets separated for injection; retains regenerative potential**

APPLICATIONS OF PRF IN DENTISTRY

In Oral and maxillofacial surgery

Over the past few years, extensive research has focused on the applications of platelet-rich fibrin (PRF) in oral and maxillofacial surgery, with numerous cases reported regarding the use of PRF clots and PRF membranes. PRF has gained attention due to its ability to enhance wound healing, promote bone regeneration, and reduce postoperative complications.

In oral surgery, the most common applications of PRF include bone augmentation, socket preservation, sinus lifts, and periodontics for the management of intra-bony defects, gingival recession, and periapical lesions. PRF has also been used in regenerative pulpotomies, periapical surgeries, and guided bone regeneration (GBR), where it stabilizes and protects bone graft material.

Extraction Socket and Socket Preservation:

PRF can be placed directly in the extraction socket as a filling material, promoting faster healing and reducing alveolar ridge resorption. When combined with bone grafts, PRF accelerates healing and enhances bone formation. It is particularly beneficial

in diabetic or immunocompromised patients, where it aids in the rapid healing of oral and facial wounds. Moreover, PRF stimulates blood coagulation and can be safely used in patients on anticoagulant therapy.14,15

Sinus Lift Procedures:

PRF has shown efficacy as a sole or adjunctive material in various sinus lift procedures, including osteotome-mediated sinus floor elevation, bone-added sinus floor elevation, and minimally invasive antral membrane balloon elevation. Its use promotes bone regeneration and provides a natural scaffold for new bone formation.16

Guided Bone Regeneration (GBR) and Membrane Applications:

PRF membranes can be used to cover extraction sockets, especially when primary closure is difficult, protecting the site, promoting re-epithelialization, and merging wound margins more rapidly. The membranes are strong, elastic, and can be sutured easily, providing stability to underlying bone grafts. PRF favors key aspects of healing, including immunity, angiogenesis, and epithelial coverage, thereby enhancing microvascularization and guiding epithelial cell migration.17

Soft Tissue and Facial Wound Healing:

PRF has demonstrated promising results in facial wound healing. Placement of PRF membranes allows the concentration of platelets and natural clotting factors over wounds, accelerating closure and tissue regeneration. Studies have shown that PRF enhances wound healing velocity and promotes complete epithelial coverage, making it useful for avulsive or traumatic wounds.18

Other Regenerative Applications:

Beyond oral and maxillofacial surgery, PRF has been applied in treating alopecia. Injectable PRF (i-PRF), an advanced liquid form containing stem cells, has shown regenerative potential for hair restoration, including in Type VI and Type VII alopecia, which are traditionally challenging to treat. PRF has also been explored for small otologic surgeries, necrotizing fasciitis, and other soft tissue regenerative procedures.

IN PERIODONTICS

Platelet-rich fibrin (PRF) has emerged as a versatile regenerative material in periodontics, addressing a variety of periodontal conditions including gingival recession, intrabony defects, periapical lesions, and periodontal bony defects. Its autologous origin, ease of preparation, and sustained release of growth factors make it an attractive option for enhancing tissue regeneration.

In the management of gingival recession, PRF membranes can be used in conjunction with a coronally advanced flap as a substitute or adjunct to subepithelial connective tissue grafts. This combination promotes soft tissue coverage, improves vascularization, and accelerates healing, leading to predictable root coverage outcomes.19

For intrabony defects (IBD), PRF gel can be combined with bone graft materials, such as hydroxyapatite, and a guided tissue regeneration (GTR) membrane to enhance periodontal regeneration. This triad allows simultaneous promotion of osteogenesis, periodontal ligament regeneration, and alveolar bone fill, resulting in significant clinical improvements in probing depth reduction and clinical attachment level gain.20

PRF also plays a key role in peri-implant bone regeneration. It can improve osseointegration and facilitate the regeneration of peri-implant bony defects, particularly in cases of peri-implantitis or immediate implant placement where the surrounding bone is deficient. When combined with bone grafts, PRF fills the peri-implant defect, enhances vascularization, and supports faster bone maturation, reducing the risk of implant failure.21

Overall, PRF serves as a biologically active scaffold, providing a sustained release of growth factors such as PDGF, TGF-β, and VEGF, which modulate cellular proliferation, angiogenesis, and osteogenesis. Its use in periodontal therapy has consistently shown improved clinical outcomes, reduced healing time, and minimal complications, making it an essential adjunct in contemporary regenerative periodontics.

IN CONSERVATIVE DENTISTRY AND ENDODONTICS

Periapical Healing: Platelet-Rich Fibrin (PRF) has been studied as an adjunct in periapical healing due to its ability to deliver a fibrin matrix rich in growth factors that can stimulate osteoblast activity and bone repair. Clinical evidence suggests that when PRF is applied in periapical surgical sites or defects, it may enhance early bone healing and reduce postoperative symptoms such as pain and swelling compared with conventional surgery alone, likely by providing a scaffold that supports angiogenesis and tissue regeneration.22Controlled clinical trials and systematic reviews have shown improvements in patient recovery and some radiographic evidence of bone fill, although results vary and more high-quality studies are needed to fully quantify its effect on bone regeneration.23

Regenerative Endodontic Procedures (REPs): In regenerative endodontics, PRF serves as a biologically active scaffold that supports the recruitment of stem cells and subsequent tissue regeneration in necrotic immature teeth. Studies comparing traditional blood

clot scaffolds to injectable PRF (i-PRF) in regenerative protocols have reported faster reduction in periapical lesion size, more complete radiographic healing, and improved clinical outcomes with PRF scaffolds, suggesting enhanced regenerative potential. These effects are attributed to the sustained release of growth factors and cytokines that stimulate cell migration and proliferation, leading to root maturation, apical closure, and periapical healing in treated teeth. 11

Endodontic Surgery: PRF is also used in surgical endodontics (e.g., apicoectomy or microsurgery) to aid hard- and soft-tissue healing at surgical sites. Case reports and clinical trials indicate that the placement of PRF membranes in periapical bone defects during endodontic surgery can contribute to improved early bone regeneration and radiographic bone fill, likely through growth factor-mediated stimulation of osteogenesis.22

IN PEDODONTICS

In vital pulp therapy, PRF can be used as a scaffold for pulp capping or pulpotomy in primary teeth, promoting reparative dentin formation and enhancing pulp healing while minimizing post-operative inflammation and discomfort. Its autologous nature and biocompatibility make it safe and well tolerated in pediatric patients, who often present with higher healing potential and need for minimally invasive interventions.24-26

PRF has also been applied to extraction sites in children to accelerate soft tissue closure and alveolar bone healing, reducing post-operative pain, swelling, and the risk of complications such as dry socket. Moreover, in immature permanent teeth with necrotic pulp, PRF serves as a scaffold in regenerative endodontic procedures (REPs), supporting stem cell recruitment, angiogenesis, and continued root development (apexogenesis). Injectable PRF (i-PRF) has further facilitated minimally invasive approaches suitable for pediatric patients, enhancing compliance and clinical outcomes.27,28

In addition to endodontic and surgical applications, PRF has shown promise in pediatric periodontal therapy, such as mucogingival procedures, by promoting faster soft tissue healing and reducing post-operative discomfort. While current evidence is encouraging, most studies in pediatric populations are small-scale clinical trials or case reports, and standardized protocols for blood collection and PRF preparation in children remain limited. Future research focusing on larger randomized trials and pediatric-specific protocols will help establish evidence-based guidelines for PRF use in this population.

PRF IN ORAL MUCOSAL LESIONS

Platelet-Rich Fibrin (PRF) has emerged as a promising autologous biomaterial adjunct in the management of oral mucosal lesions due to its reservoir of growth factors (e.g., PDGF, TGF-β, VEGF) and cytokines that enhance angiogenesis, fibroblast proliferation, and epithelial regeneration. When applied to mucosal defects—such as traumatic ulcers, lichen planus erosions, or surgical wounds—PRF membranes create a fibrin scaffold that accelerates healing, reduces postoperative pain, and may modulate inflammation, thereby improving clinical outcomes compared with conventional care alone.29

Advantages of PRF

- Autologous and biocompatible material with minimal risk of immune reaction.
- Rich source of growth factors promoting angiogenesis and tissue regeneration.
- Enhances soft tissue healing and bone regeneration.
- Simple, safe, and cost-effective preparation without additives.
- Reduces postoperative pain, inflammation, and infection.
- Biodegradable with sustained release of growth factors.
- Versatile applications in periodontology, implantology, oral surgery, and mucosal lesions.

Disadvantages of PRF

- Technique-sensitive preparation requiring precise centrifugation.
- Limited quantity obtained from blood samples.
- Quality varies depending on patient factors.
- Short working time after preparation.
- Limited mechanical strength and rapid resorption.
- Lack of standardized protocols.
- Not sufficient alone for large defects; often needs combination with grafts.

Limitations of PRF

- Variability in preparation methods and clinical outcomes.
- Patient-dependent biological differences.
- Limited volume and stability for extensive regenerative procedures.
- Need for venipuncture and immediate clinical use.
- Lack of long-term, large-scale clinical evidence.

CONCLUSION AND FUTURE DIRECTIONS

Platelet-Rich Fibrin (PRF) represents a significant advancement in regenerative dentistry due to its

autologous nature and ability to enhance both soft and hard tissue healing.
Its biologically active fibrin matrix, enriched with growth factors and cytokines, has demonstrated promising clinical outcomes across various dental specialties, including periodontology, implantology, oral surgery, endodontics, and management of oral mucosal lesions.

The simplicity, safety, and cost-effectiveness of PRF make it an attractive adjunct to conventional regenerative approaches.

Future directions of PRF research focus on the optimization and standardization of preparation protocols, development of advanced PRF formulations (A-PRF, i-PRF, T-PRF), and integration with biomaterials and tissue engineering strategies. Well-designed randomized clinical trials and long-term studies are essential to establish evidence-based guidelines and expand its clinical applications.

With ongoing innovations and scientific validation, PRF is poised to play a pivotal role in personalized regenerative dentistry and biologically driven therapeutic strategies, ultimately improving patient outcomes and clinical predictability.

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