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Platelet Rich Fibrin In Dentistry- A Review Article

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Abstract

A second-generation platelet concentrate called platelet rich fibrin (PRF) has autologous leukocyte-rich fibrin matrix and a tetra molecular structure made up of cytokines, growth factors, stem cells, and platelets. It combines the fibrant sealing characteristics with growth factors, creating the perfect environment for tissue regeneration and wound healing. PRF functions as a biodegradable scaffold that encourages the migration of epithelial cells and the creation of the microvasculature. It also aids in the sustained release of growth factors (1–4 weeks)

Due to its ability to speed up wound healing and promote tissue regeneration, PRF has recently become more significant in a number of dental specialties. In order to better understand the development of PRF protocols, their nature, qualities, and applications in the field of oral health research, a review paper has been written. With these developments, PRF's future appears even more bright.

Keywords: Platelet rich fibrin, Platelet concentrates, Growth factors, Dentistry, Wound healing.

Introduction

A range of biomaterials have been introduced in dentistry during the past several decades that can fill up osseous deformities and speed up the healing of wounds. Tricalcium phosphate, bioactive glass, freeze-dried bone transplant, hydroxyapatite, and other substances have all been extensively utilised and investigated for their role in the regeneration of both soft and hard tissues. [1,2]

In 1970, the use of fibrin glues or fibrin sealants, formed by polymerizing fibrinogen with thrombin and calcium, marked the beginning of utilizing blood-derived products for wound healing. [3,4] The regenerative potential of platelets was introduced in 1974 when Ross et al. identified platelet-derived growth factor (PDGF) as a growth factor for fibroblasts, smooth muscle cells, and glial cells. [5] It is now well-documented that platelets contain a diverse range of growth factors such as PDGF-AB, TGF-Beta1, VEGF, and connective tissue growth factor, providing a rich pool for healing processes.

A number of platelet concentrates have recently been created and have demonstrated promising outcomes. Marx came up with the concept of Platelet Rich Plasma (PRP) in 1998.[6] PRP is a first-generation platelet concentrate that had positive results, but owing to the complicated production process and cross-infection caused by bovine thrombin, platelet rich fibrin, a second-generation platelet concentrate, was developed. [7]

PRF was developed in France by Joseph Choukroun et al. in 2001[8]. They used PRF to improve bone healing in cases of implants. It is a fibrin matrix in which platelet cytokines, growth factors and cells are trapped and may be released after a certain time and that can serve as a resorbable membrane. Growth factors are released after activation from the platelets trapped within fibrin matrix, and have been shown to stimulate the mitogenic response in the periosteum for bone repair during normal wound healing. Since its introduction in the early 2000s, it has found wide applications in the fields of oral health. Due to its beneficial qualities, including enhanced wound healing, biocompatibility, and cost-effectiveness, to mention a few, it is commonly utilized in dentistry.

The advantages and functions of platelet-rich fibrin in dentistry are further discussed in this article.

Figure 1:Platelet rich fibrin

Classification

1st Generation–PRP (Depending on the presence or absence of leukocytes and the activation or not of the PRP) Mishra et al, 2009 [9]

• Type 1, PRP is a L-PRP solution

• Type 2, PRP is a L-PRP gel

• Type 3, PRP is a P-PRP solution

• Type 4, PRP is a P-PRP gel

2nd Generation–PRF (Based on their fibrin architecture and cell content) Dohan Ehrenfest 2009 [10]

- Leukocyte poor or pure platelet-rich fibrin (P-PRF)
- Leukocyte and platelet-rich fibrin (L-PRF)-Choukroun's PRF
- Leukocyte poor or pure platelet-rich plasma (P-PRP)
- Leukocyte & platelet-rich plasma (L-PRP)
- Advanced platelet rich fibrin (A-PRF)
- Injectable platelet rich fibrin (i-PRF)

Type of PRF	Proposed by	RPM	Time	Tube
Leukocyte & platelet rich fibrin (l- PRF)	Choukron (2004)	2700	12	Glass coated
Advanced platelet rich fibrin (a- PRF)	Ghanaati (2014)	1300	14	Patented
Injectable platelet rich fibrin (i- PRF)	Mourao (2015)	700	3	Non-coated
Titanium PRF		2800	12	Titanium tubes

Preparation of PRF

Choukron's protocol: Protocol by Choukroun et al. in 2001 requires 10 mL of blood sample to be collected without anticoagulant in glass-coated plastic tubes,

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which is immediately subject to centrifugation at 2,700 rpm (around 400 g) for 12 min. [7]

This creates 3 distinct layers:

- Upper straw-coloured acellular plasma
- Middle fraction containing the fibrin clot
- Red-coloured lower fraction containing red blood cells (RBCs)

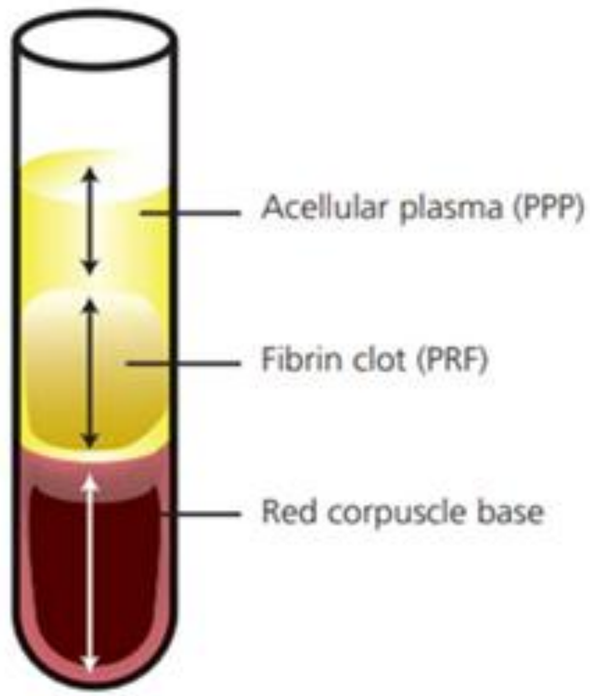

Figure 2: ozina/istock/getty images plus

The obtained PRF is usually termed as Choukroun's PRF or leukocyte and PRF (L-PRF).

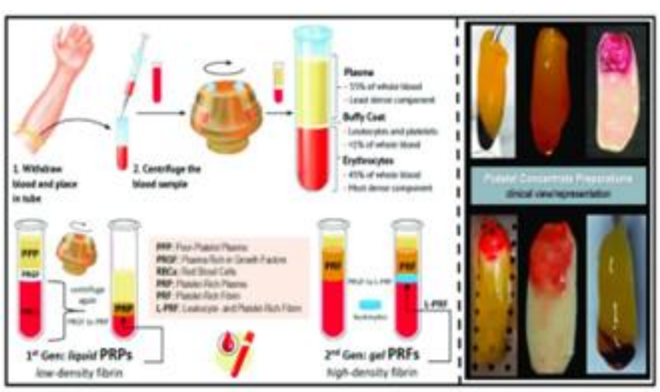

Figure 3: Source- [43]

Contents of PRF & Their Role

Platelets are small, anucleate blood cells vital for hemostasis and wound healing. They become activated upon encountering damaged blood vessels or exposed collagen, resulting in the release of growth factors and cytokines. These substances promote cell proliferation, angiogenesis, and ECM synthesis, critical for wound healing. Platelets release platelet-derived growth factor (PDGF), a primary growth factor that stimulates the proliferation of fibroblasts, endothelial cells, and smooth muscle cells. [12]

Fibrin is a protein polymer that forms a thread-like network during coagulation. PRF is created by centrifuging and clotting whole blood, resulting in a fibrin matrix that captures platelets and white blood cells. This matrix serves as a scaffold, slowly releasing growth factors and cytokines over several days, promoting prolonged and effective healing. The sustained release of these substances from PRF stimulates angiogenesis and tissue regeneration, making it valuable for medical and dental treatments. [13,14]

Leukocytes, or white blood cells, are vital for immune response and wound healing. They are found in PRF and help modulate inflammation, a critical step in healing. Neutrophils and monocytes, two types of leukocytes in PRF, release antimicrobial peptides and growth factors, contributing to the healing process.

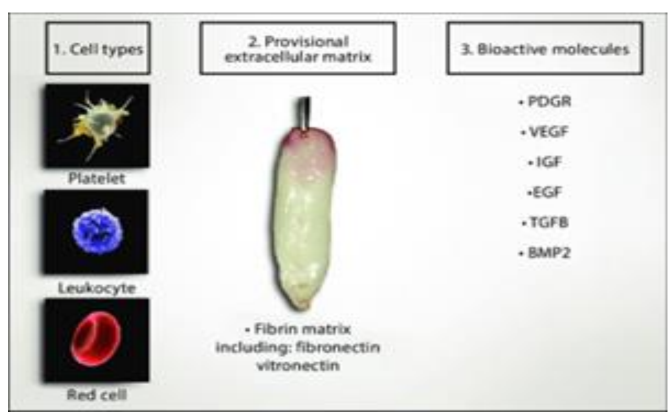

Figure 4: Major components of PRF a) cell types such as red blood cells, platelets and leukocytes b) matrix scaffold, and c) Growth factors and bio-active molecules. Source: [44]

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Figure 5: Growth Factors In PRF

Applications of PRF In Dentistry

In recent years, much study has been conducted on PRF, and various cases involving the usage of PRF clots and PRF membranes have been recorded.

Oral Surgery

PRF has discovered novel uses in oral and maxillofacial surgery. According to research, PRF when used as a filler material in extraction sockets, acts as a stable blood clot for neovascularization.

This helps immunocompromised and diabetic people heal their wounds faster. PRF can also be utilised as an adjuvant in patients on anticoagulant medication since it increases coagulation (through thrombospondin) and wound healing. [15]

Studies have shown that there is a decline in the frequency of dry socket following the application of PRP [18,19]. PRF is effective in reducing the pain followed by early epithelization in an established dry socket [20]. In a retrospective study has indicated that there is a 90% decline in localized osteitis followed the placement of PRF as a preventive measure [21]

Many clinical trials have been carried out to determine the effect of PRF on the post-extraction healing of socket is shown to have to preserve role on alveolar ridge width following the extraction. The newly formed bone appears to be more mature [22] and having more bone fill and an increase in its density. [22,23]

Periodontics

In periodontics, PRF has been used to treat gingival recession, intrabony defects and periapical lesions. Some case reports show the use of a combination of PRF gel, hydroxyapatite graft and guided tissue regeneration membrane to treat intrabony defect.

PRF membrane has been found its applicability in the effective treatment of grade II furcation involvement [25]. Superior root coverage in sites treated with the PRF is noted in the Miller’s Class I and Class II recession when used with conventional flap techniques like coronally advancement flap [26,27].PRF membrane has found its application as a periodontal dressing to safeguard the fresh wound zone of the depigmented site to fasten the healing and patient comfort [28]

Orthodontics

There is virtually little information on the orthodontic use of PRF.

Muoz 2016 performed the first study that assessed the influence of L-PRF on post-operative pain, inflammation, and stability of periodontally accelerated osteogenic orthodontics (PAOO), and the findings were positive [29].

Tehranchi et al. recently investigated the use of L-PRF to accelerate orthodontic tooth movement and concluded that the effect on tooth movement was due to a combined approach of surgery and orthodontics. [30]

A study on the rate of tooth movement using PRP found that local administration of PRP increased the rate of tooth movement after orthodontic force application synergistically. Throughout the research period, PRP dramatically lowered OPG and boosted sRANKL levels in the GCF. [31]

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A study on the stability of mini-implants found that PRF coating offers a good effect in terms of implant stability. As a result, the stability of mini-implants can be strengthened chairside using a minimally invasive treatment using PRF. [32]

PRF has also been shown to enhance bone regeneration around teeth. A study conducted by Sharma et al. (2019) demonstrated that the use of PRF in conjunction with bone grafts resulted in a significant increase in bone density and improved bone regeneration around implants.[33]

The use of PRF in orthodontics has shown promising results in accelerating tooth movement, reducing orthodontic treatment time, and enhancing bone regeneration around teeth.

Endodontics

PRF has shown promising results in the field of endodontics in terms of its potential to promote healing and regeneration of periapical tissues. A study conducted by Pradeep et al. (2019) found that the application of PRF in the root canal of teeth with periapical lesions significantly improved the healing process and reduced the size of the lesion.[34] The study concluded that PRF can be considered as a viable treatment option for periapical lesions.

Another study conducted by Agrawal et al. (2019) investigated the effectiveness of PRF in the treatment of teeth with open apices and found that the application of PRF in the root canal of teeth with open apices resulted in the formation of a hard tissue barrier, indicating the potential of PRF to promote dentinogenesis and apexogenesis.[35]

Use of PRF in regenerative pulpotomy procedures have also been documented where coronal pulp is removed and the pulp wound is covered by PRF followed by sealing it with MTA and GIC. [36,37] Pulpotomies are successfully managed with PRF and mineral trioxide aggregate (MTA) matrix due to their combined osteoinductive and osteoconductive qualities. [38]

PRF shows a promising option in association with peri-apical surgeries, where it has shown to significantly improve early wound closure and postoperative morbidities. [39,40]PRF might serve as a potentially ideal scaffold in revascularization of immature permanent teeth with necrotic pulps as it is rich in growth factors, enhances cellular proliferation and differentiation, and acts as a matrix for tissue ingrowth.

Tissue Engineering

PRF has also shown potential in the field of tissue engineering, particularly in the regeneration of bone and soft tissues. A study conducted by Miron et al. (2018) found that PRF can enhance the proliferation and differentiation of mesenchymal stem cells, which are essential for tissue regeneration. The study concluded that PRF can be considered as a promising biomaterial for tissue engineering applications.[41]

Furthermore, a study conducted by Liao et al. (2019) investigated the potential of PRF in the regeneration of periodontal tissues. The study found that the application of PRF in periodontal defects resulted in improved periodontal tissue regeneration and attachment. The study concluded that PRF can be considered as a potential treatment option for periodontal defects.[42]

Thus, PRF is a potential tool in tissue engineering but clinical aspects of PRF in this field requires further investigation.

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