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# PLATELET CONCENTRATES- PREPARATION PROTOCOLS AND RECENT ADVANCES

Dental Science

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## ABSTRACT

Autologous blood derivatives are surgical biologic additive that are prepared by manipulation of autologous blood. Platelet rich fibrin is one of the most commonly used blood derivatives in dentistry. Blood derivatives have several advantages such as being 100% autogenous, cost effective, less time consuming, simple to perform and with superior & prolonged release of growth factors. Since inception there has been evolution of various techniques, in-depth research regarding its biological actions, clinical applications. Several modifications have been advocated in the conventional protocol like the advanced PRF, injectable PRF, PRF lysate and Titanium-prepared PRF. Hence, the aim of this article is to review various types and properties of blood derivatives and the advancement in the PRF technology since its inception.

Furthermore, platelet concentrates are safe, reliable and cost-effective means to accelerate tissue healing and for improving the efficiency of tissue repair after injury.

## KEYWORDS

Platelet Rich Fibrin, Dental Implants, Growth Factors.

## INTRODUCTION

The growing multidisciplinary field of tissue engineering aims at predictably repairing, regenerating or restoring damaged and supporting tissues. This includes cell, tissue and organs, due to an assortment of biological conditions, involving congenital abnormalities, injury, disease and aging.

Autologous blood derivatives such as PRF and PRP, have been used for regenerative procedures in various fields of medicine and dentistry, including plastic surgery, reconstructive surgery, and dermatology, to deliver greater concentrations of

autologous growth factors directly to host tissues. These growth factors have been shown to be chemotactic for various cell types, including monocytes, fibroblasts, endothelial cells and stem cells. Thus creating tissue micro-environments and directly influencing the proliferation and differentiation of progenitor cells. [1]

## DISCUSSION:

### Evolution of Blood Derivatives

The development of platelet concentrates finds its origin in the concept of fibrin adhesives

***Table 1 - Evolution of platelet concentrates.***

| Name | Proposed by | Technique | Drawbacks |
|---|---|---|---|
| Platelet concentrates | 1970's | Donor plasma which was then mixed with thrombin and calcium which led to polymerization of fibrinogen | Poor stability or risk of disease transmission in case of commercially available products |
| Autologous fibrin glue | Tayapongsak 1994 | Pre-operative (one to three week before procedure) collection of blood followed by around 30 minutes (ammonium sulphate precipitation technique) to 48 hours (cryopecipitate technique) of handling. | Technique was long and complex. The amount of concentrate obtained was quite less as compared to the amount of blood collected (2ml from 75ml blood in ammonium sulfate concentrate technique and 10-15ml concentrate from 250ml of blood). |
| Platelet rich plasma | Whitman 1997 | Double centrifugation of autologous blood with anticoagulant. It consisted of a soft spin followed by which the blood would separate into red corpuscular base, buffy coat and the platelet poor plasma. The last two components were aspirated and re centrifuged at a hard spin after which PRP was collected. | In few cases Bovine thrombin could give rise to life threatening coagulopathies. |
| Plasma rich in growth factors | Anitua & co-workers 1999 | Autologous blood with anticoagulant was centrifuged at 460G for 8 minutes and this resulted in collection of plasma rich in growth factors (PRGF) at the bottom of the tube. This PRGF was then taken from the bottom of the tube and cacl2 was added (0.05ml/ml of PRGF). This led to coagulation in around 10 minutes and a gelatinous PRGF was obtained. | Led to incomplete activation of platelets and low levels of growth factors release. |

### Different types of autologous blood derivatives

The different platelet concentrates can be classified into four categories, depending on their leucocyte and fibrin content:

- Pure platelet-rich plasma (P-PRP)

Example: cell separator PRP, Vivostat, Anitua's PRGF.

- Leucocyte- and platelet-rich plasma (L-PRP)

Example: Curasan, Regen, Plateltex,

SmartPReP, PCCS, Magellan or GPS PRP.

- Pure platelet-rich fibrin (P-PRF)

Example: Fibrinet.

- Leucocyte and platelet-rich fibrin (L-PRF)

Example: Choukroun's PRF.

This classification will help determine different reasons for success and failure of technique, along with providing a new approach for development of newer techniques.

*Table 2. PRF preparation protocols*

| Type of PRF | Proposed by | RPM | Time (Minutes) | Tube |
|---|---|---|---|---|
| Leukocyte & Platelet rich Fibrin (L-PRF) | Choukroun (2004) | 2700 | 12 | Glass coated tube |
| Advanced platelet rich fibrin (A-PRF) | Ghanaati (2014) | 1300 | 14 | Patented |
| Injectable platelet rich fibrin (I-PRF) | Mourao (2015) | 700 | 3 | Non coated |
| Advanced plateletrich fibrin Plus (A-PRF+) | Fujioka-Kobayashi, Miron (2016) | 1300 | 8 | Same as A-PRF |

**Protocol for different PRF preparations**

The classic PRF protocol was suggested by *Choukroun & coworkers* (Table 2). The basic protocol of producing PRF includes centrifugation of freshly drawn blood without any anticoagulant in glass based collection tubes which results in formation of three layers i.e. red blood corpuscles at the bottom, platelet poor plasma at the top and PRF in between. The same protocol has been modified to obtain A-PRF and i-PRF by modifying the centrifugation speed, time and the tube in terms of its design and material which the PRF is produced. [2]

**Recent Advances in PRF**

PRF as a biologic surgical additive has been successfully used for varied applications in dentistry. Since inception there has been evolution of various techniques, in-depth research regarding its biological actions, clinical applications. Several modifications have been advocated in the conventional protocol like the advanced PRF, injectable PRF, PRF lysate and Titanium-prepared PRF.

**1. Advanced PRF**

Leukocyte and PRF (L-PRF) is produced at a speed of 2700 rpm for 12 minutes in sterile glass based plastic tubes. [3] For formation of A-PRF, slower speed (1500 rpm) and more time (14 minutes) is used in sterile plain glass-based vacuum tubes (A-PRF10 tubes).

The authors propose that such a protocol leads to enhanced B & T-lymphocyte entrapment, more even distribution of platelets, neutrophils. Also, the number of viable cells including platelets is much higher in A-PRF. There is better deployment of resident monocyte, macrophages and lymphocytes.[4] Clinically, this would be beneficial as it would translate into increased amount of growth factor and cytokine release. However, some studies have provided contradictory results.

**2. Advanced PRF +**

*Fujioka-Kobayashi (2016) suggested* another modification of A-PRF, by reducing centrifugation time (1300 rpm) to 8 minutes called as A-PRF+. [5]

The authors argue that less time would result in a decrease in the amount of forces that the cells of the blood would be exposed to & hence, would increase the cells content of the PRF matrix. When they assessed the PRF produced by this protocol to L-PRF and A-PRF in terms of growth factor release, biocompatibility & cellular activity, they observed that A-PRF+ demonstrated highest release of PDGF, TGF- β1, EGF and IGF.

**3. Injectable PRF**

One of the latest developments in the PRF technology is the production of injectable PRF (i-PRF). As compared to PRP, one drawback that limits the applications of PRF is that PRF is obtained as a gel form which is not conducive to be injected.

For preparation of i-PRF, blood is collected in plastic tubes without any anticoagulants and centrifuged for 3 minutes at 700rpm. [6]

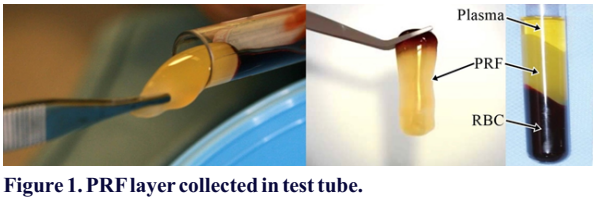


**Figure 1. PRF layer collected in test tube.**

Another set of authors have proposed a similar protocol where they centrifuge plain blood in non-coated test tubes at 2400-2700 rpm for around 2 minutes. The supernatant is collected and they have named it concentrated growth factors (CGF). [7]

Mixing the bone graft with i-PRF (Sticky Bone) also gives the benefit of growth factor release at the recipient site which would otherwise be missing in a normal bone graft. This has the potential to convert any osteoconductive graft to osteopromotive (due to the presence of platelets & growth factors) which would translate into faster and better efficiency of bone formation.

**4. PRF Lysate**

A newer application of PRF based products is the PRF Lysate. In this, after PRF preparation, it is incubated at 37°C in a humidified atmosphere of 5% CO2/95% air and the exudate thus collected has been referred to as PRF lysate. It is said to be a good source of several growth factors including PDGF, TGF, VEGF & EGF. [8]

It has also been used to reverse the damage caused by chronic UV radiation exposure to human dermal fibroblasts by significantly increasing the proliferation rates, migration rates and collagen deposition equal to those of normal fibroblasts. [8,9] This is a relatively new application and further studies on its application is essential.

**5. Titanium-PRF**

Another avenue which has been investigated is the usage of different materials for blood processing during PRF preparation.

Recently, *Tunali & co-workers* used medical grade titanium tubes to produce PRF and called it T-PRF. On examination it was observed that T-PRF samples seemed to have a highly organized network

with continuous integrity compared to the L-PRF samples. Also, the fibrin network of T-PRF covered a larger area than that of L-PRF and was thicker in size. [10]

TPRF was obtained from centrifugation of 20 ml blood at 2800 rpm for 12 minutes in medical grade titanium tubes. When the same was applied for palatal mucosal wound healing, it was found that T-PRF membranes exhibited positive effects on palatal mucosal wound healing. [11]

However, further research is required to find the best bio-material for PRF processing which would enhance the biologic properties of PRF.

**Future Scope:**

The literature on platelet concentrates for topical use in dental surgery is nowadays prolific and particularly developed in periodontology and implant dentistry.

Injectable PRPs will probably develop more and more in many other fields of surgery over time, particularly aesthetic dentistry and sports medicine.

However, if the craze for growth factors was very strong in oral surgery and implantology, the disillusion was also very quick, many clinicians considering that the PRP techniques are too expensive and time-consuming for no or minimal clinical improvements.

In coming future, inexpensive, simple and efficient techniques such as L-PRF will find extensive use in implant dentistry.

PRP gels and PRF are innovative tools with many potential applications in periodontal and dentoalveolar surgery.

**REFERENCES:**

1. Sclafani, A.P., et al. Modulation of wound response and soft tissue ingrowth in synthetic and allogeneic implants with platelet concentrate. Arch Facial Plast Surg 7, 163, 2005.
2. Friedlaender GE, Perry CR, Cole JD, Cook SD, Cierny G, Muschler GF, et al. Osteogenic protein-1 (bone morphogenetic protein-7) in the treatment of tibial nonunions. J Bone Joint Surg. 2001;83-A Suppl 1(Pt 2):S151–8.
3. Toffler M, Toscano N, Holtzclaw D. Osteotome-mediated sinus floor elevation using only platelet-rich fibrin: an early report on 110 patients. Implant Dent.2010 Oct;19(5):447-56.
4. Martin, P. Wound healing-aiming for perfect skin regeneration. Science 276: 75, 1997.
5. Fujioka-Kobayashi M, Miron RJ, Hernandez M, Kandalam U, Zhang Y, Choukroun J. Optimized platelet-rich fibrin with the low-speed concept: growth factor release, biocompatibility, and cellular response. J Periodontol 2017 Jan;88(1):112-121.
6. Miron RJ, Fujioka-Kobayashi M, Hernandez M, Kandalam U, Zhang Y, Ghanaati S, Choukroun J. Injectable platelet rich fibrin (i-PRF): opportunities in regenerative dentistry? Clin Oral Investig. 2017 Feb 2. doi:10.1007/s00784-017-2063-9. [Epub

ahead of print]
7. Sohn DS, Huang B, Kim J, Park WE, Park CC. Utilization of autologous concentrated growth factors (CGF) enriched bone graft matrix (sticky bone) and CGF-enriched fibrin membrane in implant dentistry. J Implant Advanced Clin Dent 2015;7:11-8.
8. He L, Lin Y, Hu X, Zhang Y, Wu H. A comparative study of platelet-rich fibrin (PRF) and platelet-rich plasma (PRP) on the effect of proliferation and differentiation of rat osteoblasts in vitro. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;108:707–713.
9. Wirohadidjojo YW, Budiyanto A, Soebono H. Platelet-Rich Fibrin Lysate Can Ameliorate Dysfunction of Chronically UVA-Irradiated Human Dermal Fibroblasts. Yonsei Med J 2016;57:1282-5.
10. Tunalı M, Özdemir H, Küçükodacı Z, Akman S, Yaprak E, Toker H et al. A novel platelet concentrate: titanium-prepared platelet-rich fibrin. Biomed Res Int 2014;209548
11. Ustaoğlu G, Ercan E, Tunali M. The role of titanium-prepared plateletrich fibrin in palatal mucosal wound healing and histoconduction. Acta Odontol Scand. 2016;74:558-64