



Platelet Concentrates In Periodontics

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Abstract

The significance of platelets in blood clotting and wound healing is one of their critical elements. They are presently becoming much more well-known in dentistry for periodontal regeneration. Before the introduction of platelet-rich plasma (PRP), fibrin glue was utilized as a sealant. The first generations of platelet concentrates were employed in variety of medical sectors, such as the treatment of chronic wounds, trichology, and aesthetics. Platelet Rich Fibrin, the second generation of platelet concentrates (PRF), first was introduced in France during the year 2000 by Choukroun et al. Relatively speaking, PRF does have a number of advantages to traditionally generated PRP. In this review, we will highlight the significance of platelet concentrates in regeneration, repair and healing in the field of periodontics.

Keywords: Platelet Concentrates, PRP, PRF, Regeneration and Wound Healing

Introduction

Periodontal regeneration is the re-forming of the lost periodontium as a result of destruction to restore the original architecture and function of the periodontium.

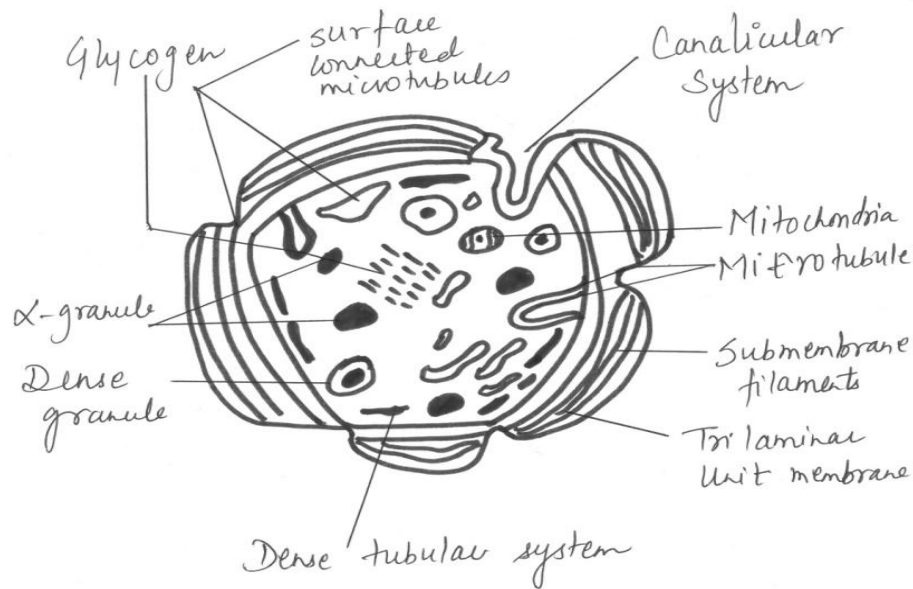
The main outcome of periodontal therapy is to attain sufficient periodontal attachment and bone level of periodontally compromised teeth. According to the world workshop in Periodontics of AAP (1996), periodontal treatment is considered as regenerative when it fulfils the following conditions as human histological proofs that show the genesis of new

cementum, periodontal ligament, and alveolar bone & controlled human clinical trials signifying superior clinical attachment level gain and bone level gain.

Platelets are enucleated with 2-3 um in diameter, colourless, moderately refractive bodies with cell organelles like mitochondria and various granules. Concentrates are made by reducing the diluting agent such as growth factors.

Growth factors are prompt proteins that revive cell growth, differentiation, survival, inflammation & tissue repair.

Structure Of Platelet



Platelet concentrates are haematological components derived from blood and marrow precursor cells.

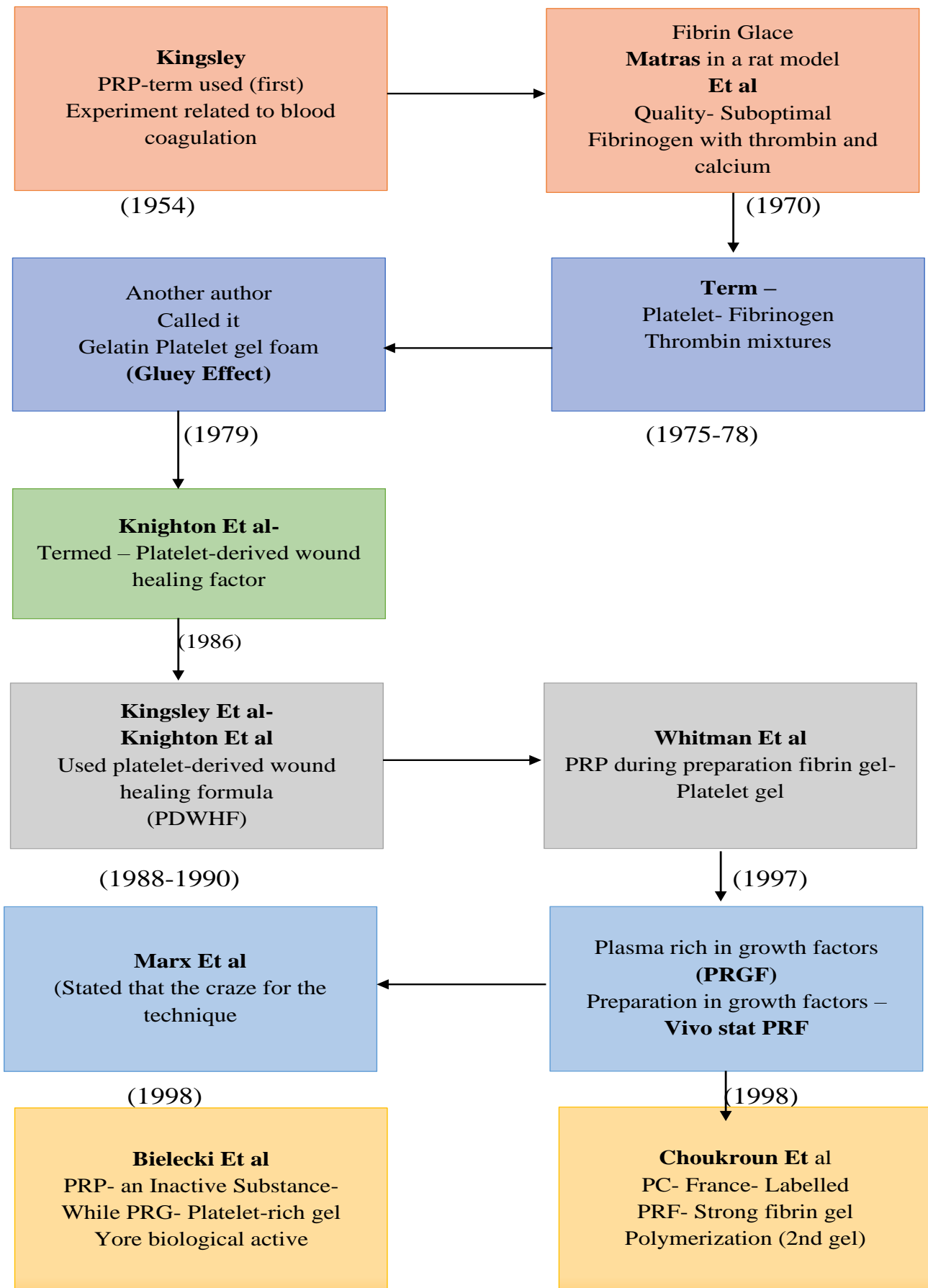
Platelet concentrates contains various autologous growth factors for instance Platelet-derived growth factor (PDGF), Vaso Endothelial growth factor (VEGF), Fibroblast growth factor (FGF), Insulin-like growth factor (ILGF), transforming growth factor (TGF), and epidermal growth factor (EGF), and concentrates are formed that are made by reducing the diluting agent, that function as powerful biological accelerators that stimulate various cellular events during wound healing such as cell proliferation, differentiation, matrix synthesis, that initiates natural healing process in a wound which starts from blood coagulation leading to fibrin clot and matrix formation that are useful for periodontal regeneration.

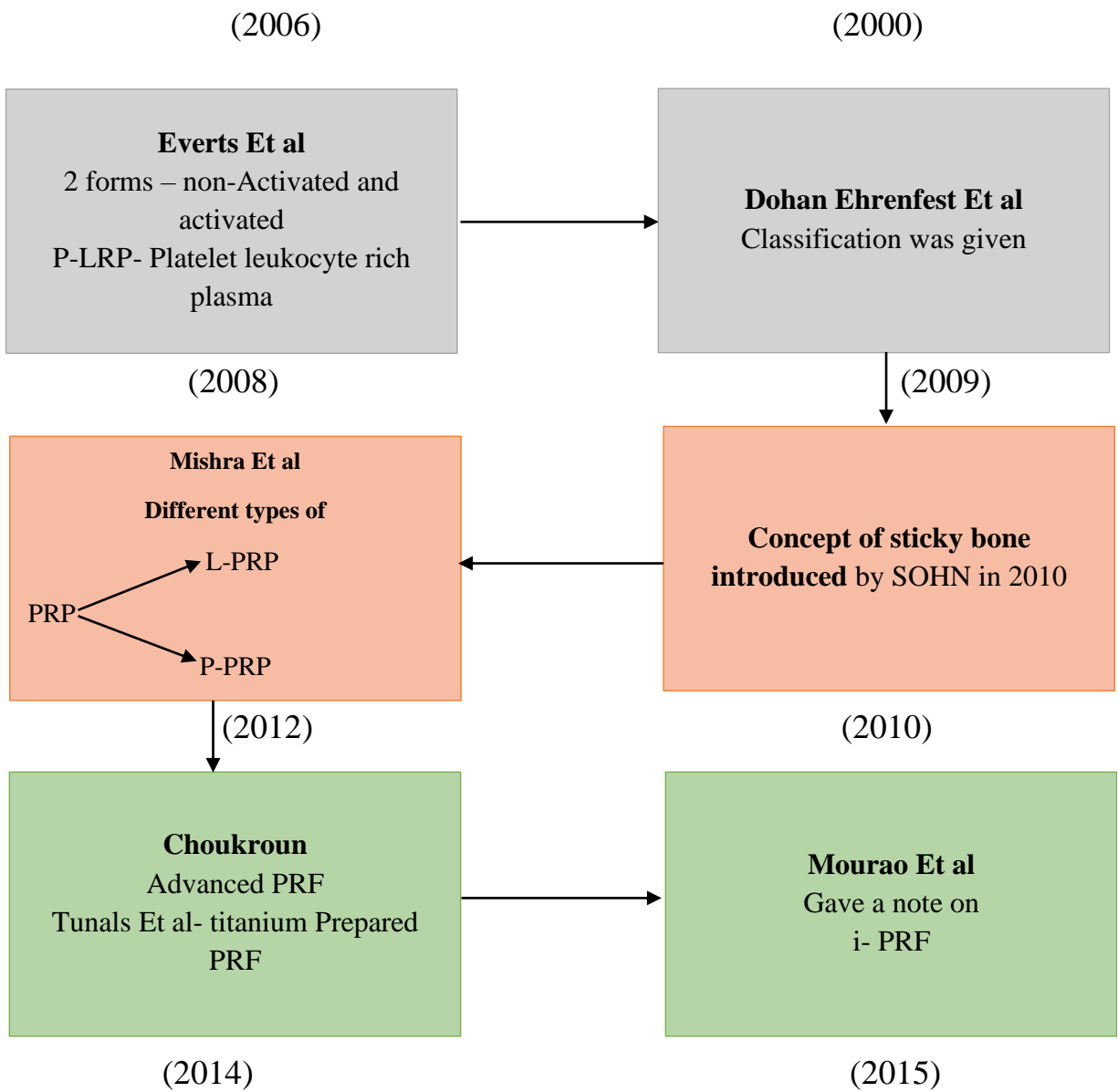
Evolution Of Platelet Concentrates

The most common platelet concentrates are Platelet-rich plasma (PRP) & platelet-rich fibrin. (PRF). PRP is first-generation platelet concentrates with increase amount of platelet but less proportion of natural fibrinogen whereas PRF is second-generation platelet concentrates & consists of autologous fibrin matrix that has more amount of platelets & leukocytes

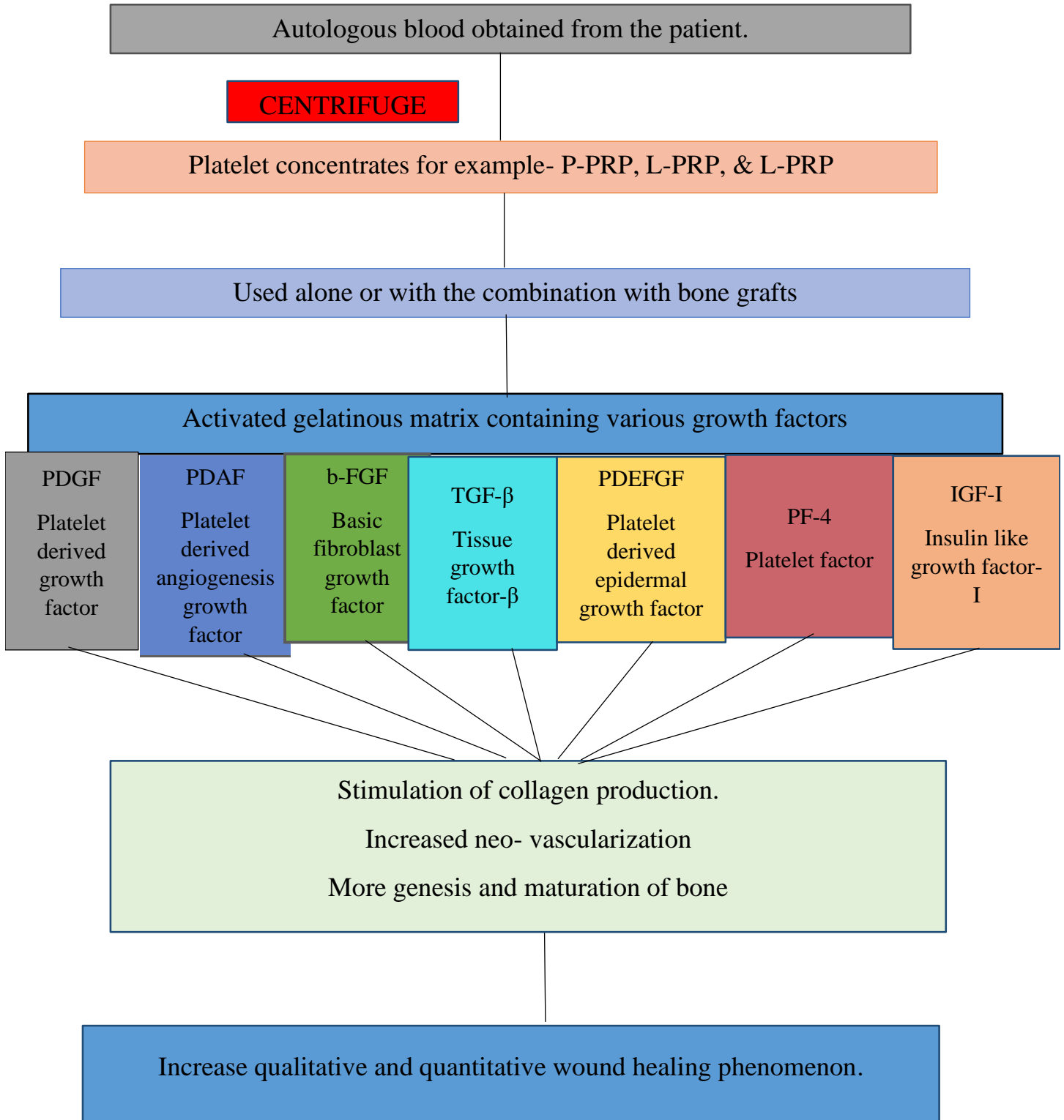
Now the question arises □ why platelet concentrates has been chosen for regenerative purposes in periodontics?

Objective- Platelet concentrate technology is to extract all the elements from a blood sample that could be used to improve healing and promote tissue regeneration.





Rationale For Using Platelet Concentrates In Periodontics



Mechanism Of Action Using Platelet Concentrates

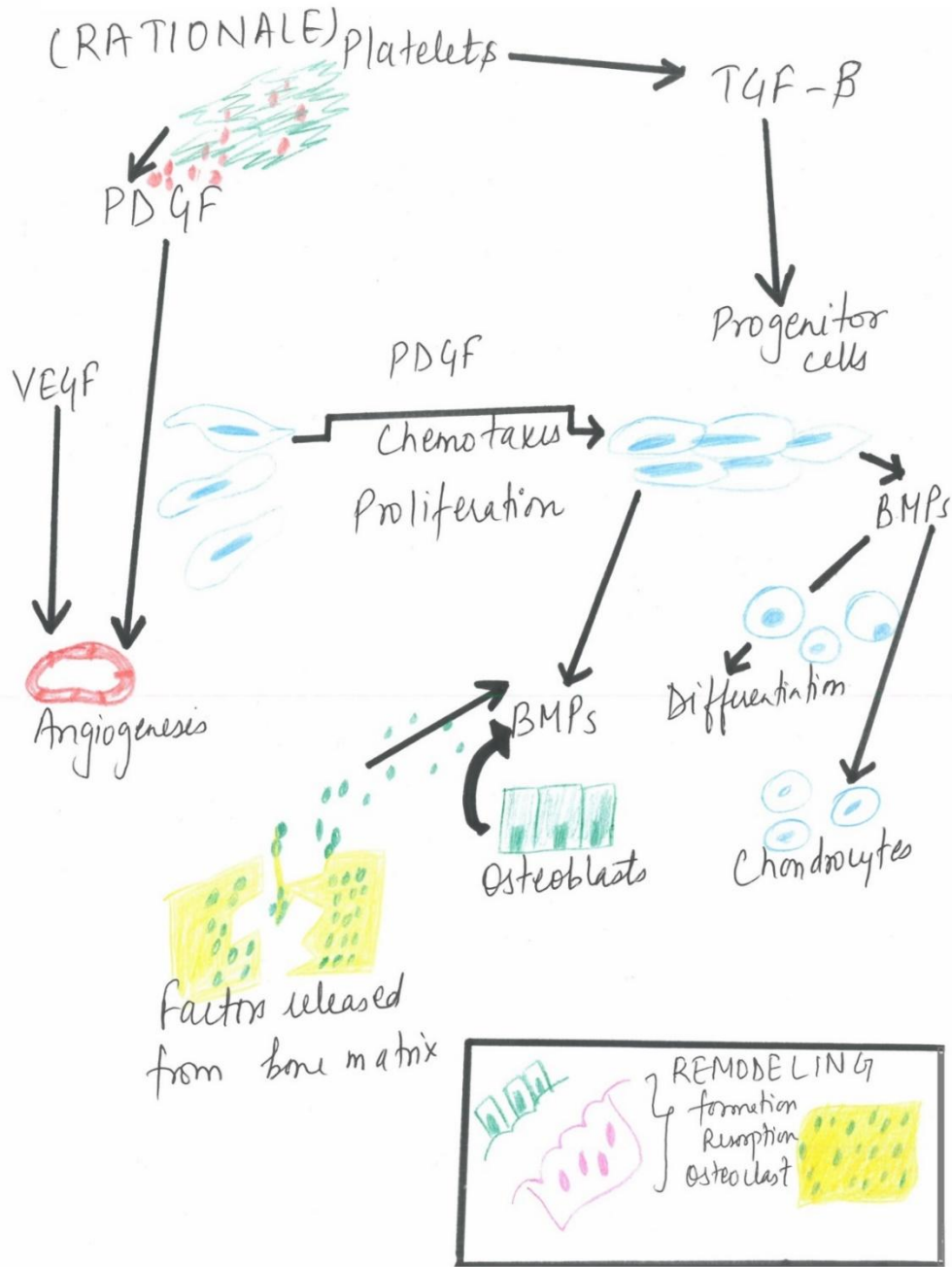
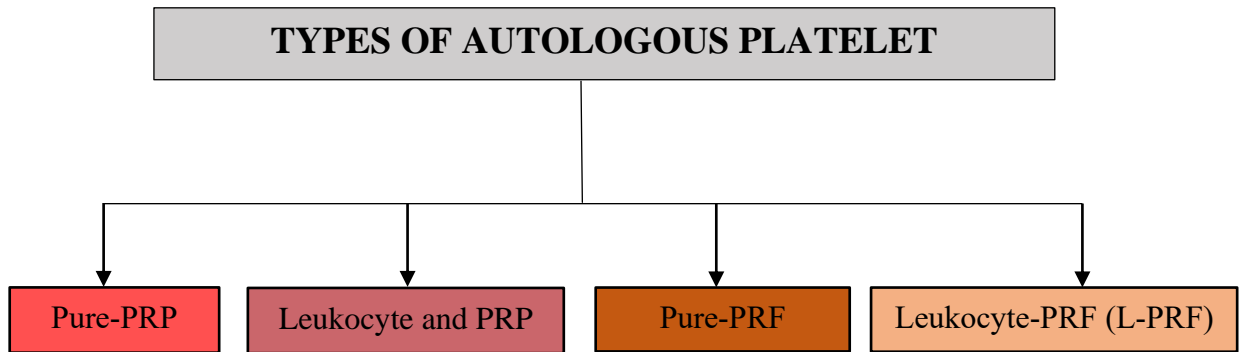
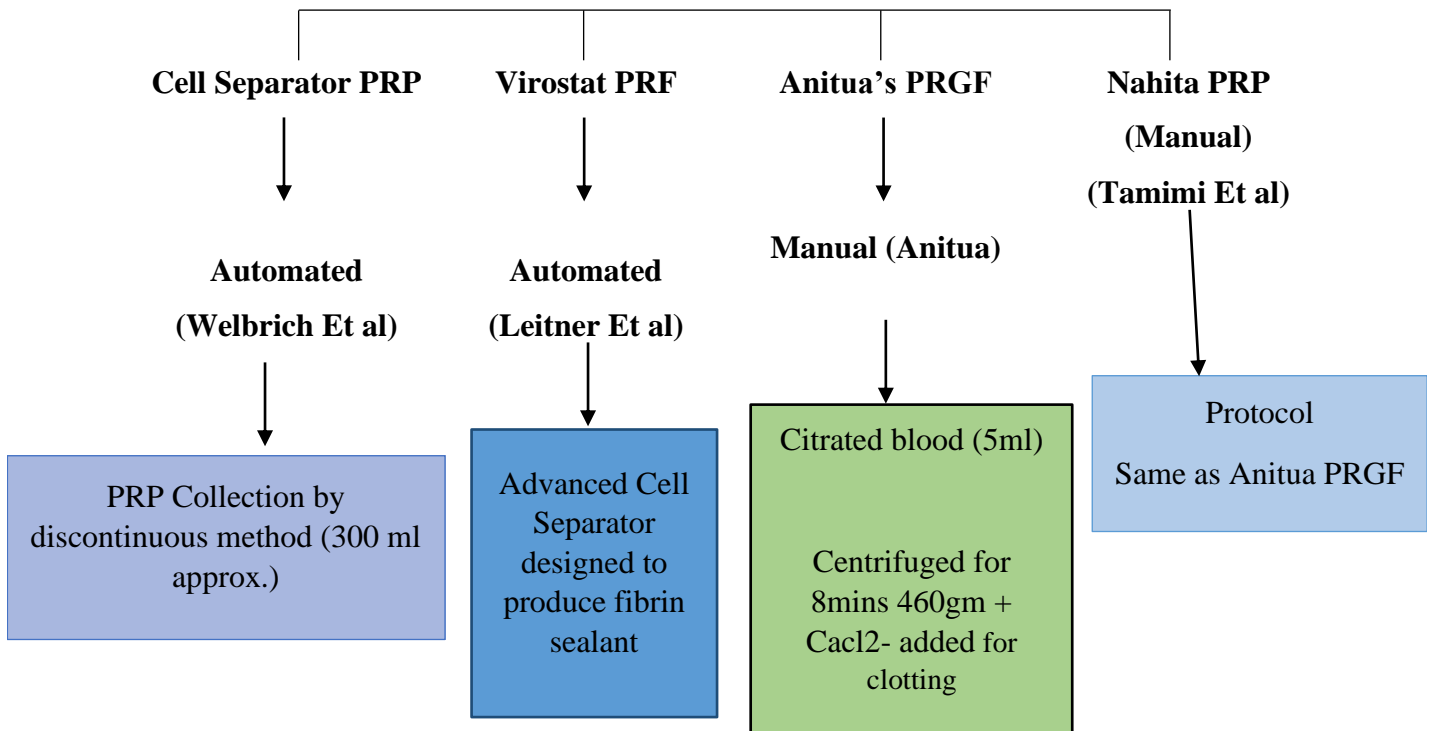


DIAGRAM OF MOA- AT TISSUE LEVEL & HEALING PROCESS

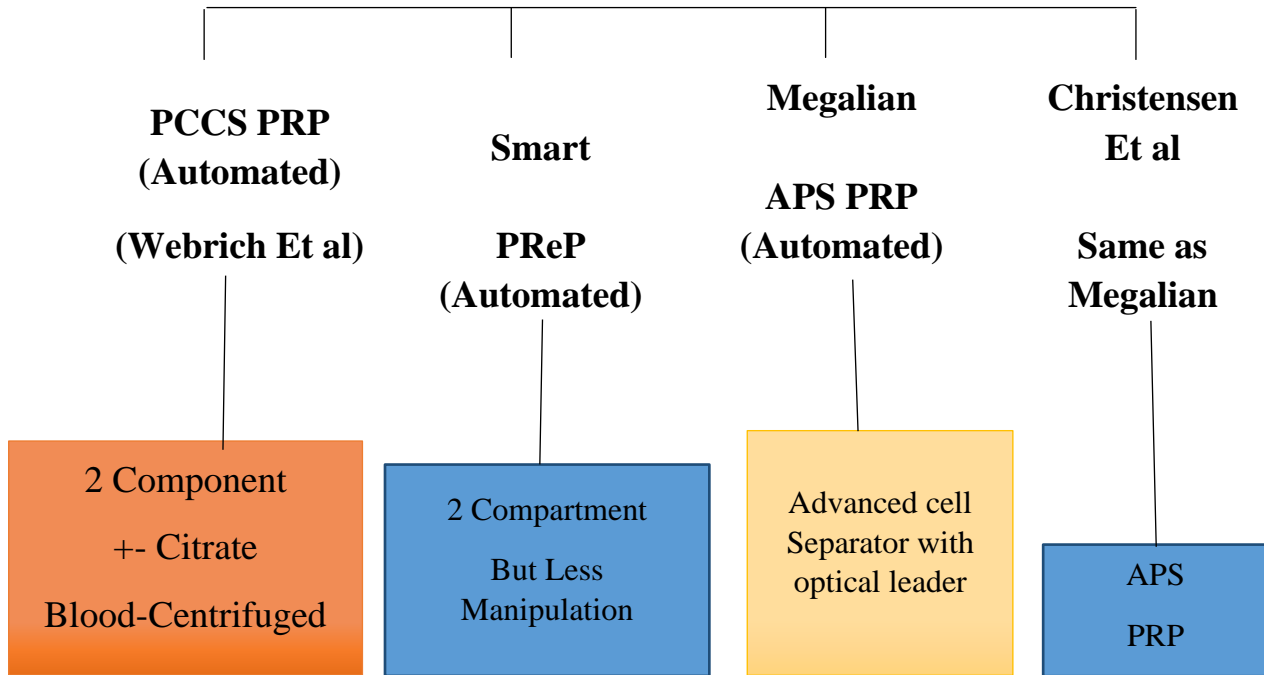
CLASSIFICATION OF PLATELET CONCENTRATES (DOHAN EHRENFEST ET AL (2009))



(METHODS OF COLLECTION) – PRP/PRF



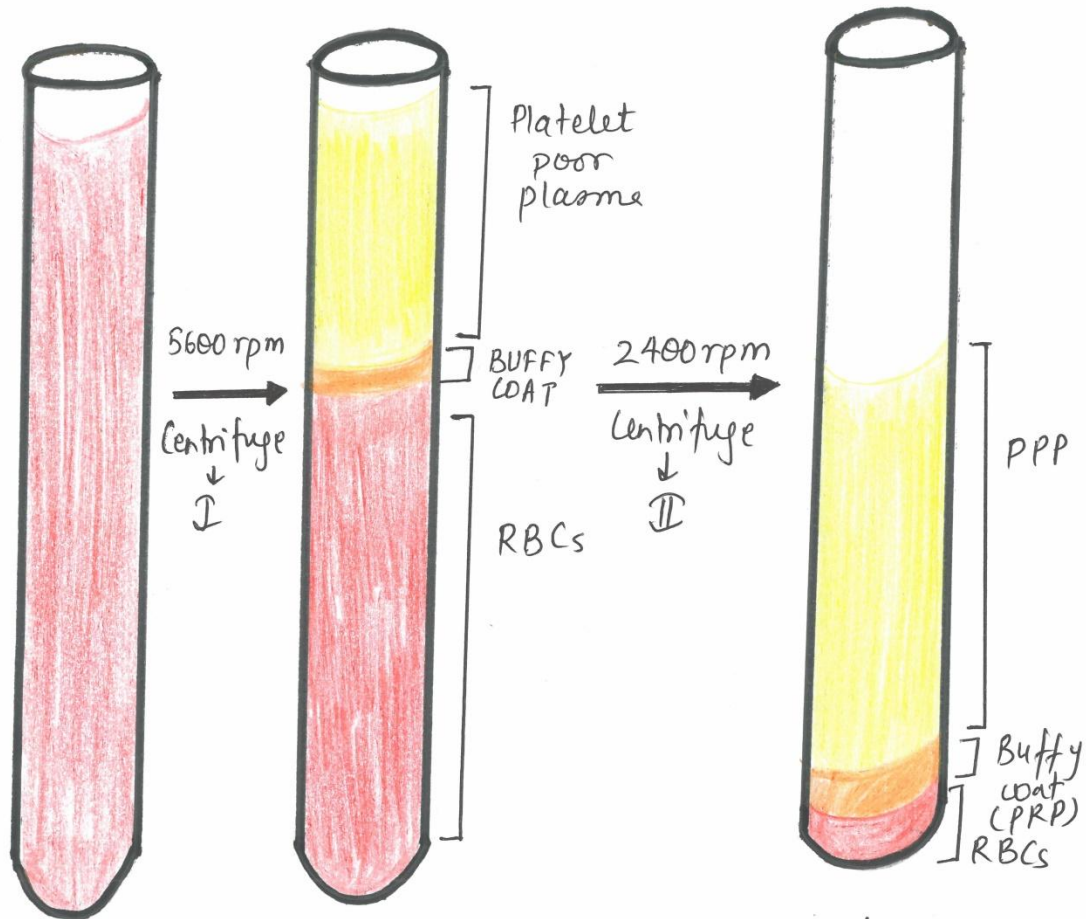
(METHOD OF COLLECTION) L-PRP



Procurement Method For Platelet-Rich Plasma – A Two-Step Centrifuge Procedure

PRP procurement

- Withdraw blood - step-1
- Followed by 2 centrifugation - step-2



Autologous
Blood

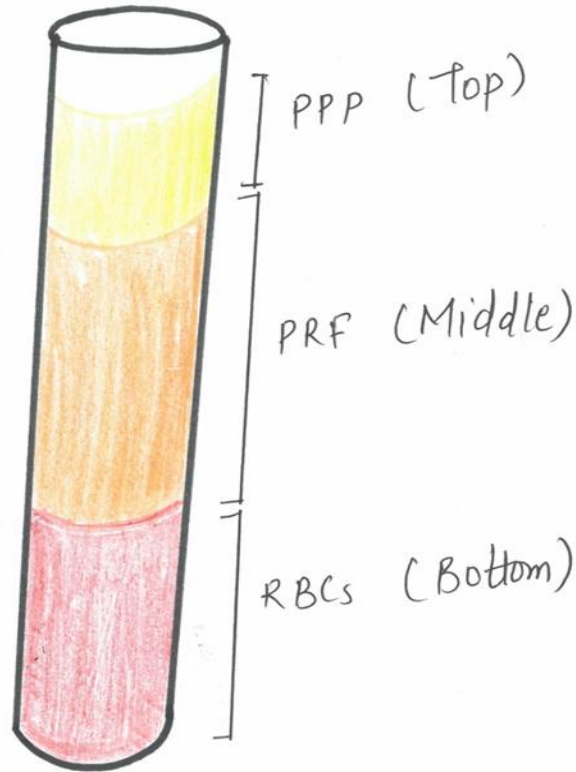
7 mL of PRP & 2 mL air
in 10 mL syringe \bar{c} a 14 gauge
catheter.

+ 1 mL mixture of thrombin + CaCl₂
↓
aspirated into syringe

Procurement Method For Platelet-Rich Fibrin – A One-Step Centrifuge Procedure

PRF procurement

- Step - 1 - Withdraw Blood
- Step - 2 - Centrifuge (3000rpm)
↓
10 min



Different Techniques And Their Drawbacks

1. Platelet concentrates and fibrin glue in the 1970s

Technique- concentrated fibrinogen factor XIII and Fibrin tin from donor plasma led to polymerization of fibrinogen

Drawbacks- the risk of disease transmission to community available

2. Autologous fibrin adhesive- 1994 (Taya Pongsak)

Techniques- Blood is collected one to three weeks before procedure followed by separating of one limit of while blood into RBC component and plasma 25hrs before being ready to use.

Drawback- A long and complex procedure
-Amount of content required less

- Less weak and low resistance than commercial sealants.

3. Platelet-rich plasma by Whitman (1997)

Technique- Double centrifugation of autologous blood is done with

Soft spin (1300-RPM-10Mins) & Hard spin (200RPM-10Min)

After that PRP collected from the bottom part of the tube

Drawback- Bovine thrombin- shows life-endangering coagulopathies in rare cases.

Higher concentration – Impede- cell migration during bone healing

Release of growth factors-PRP over a brief period

4. Plasma rich Growth factors (PRGF)- 1999 (Anitua and Co-workers)

Technique- Venous blood collected centrifuged (460 RPM for 8min)

Collection of plasma with rich growth factor (PRGF)

Present at bottom of tube + CaCl₂

(0.05 ml of PRGF-10min.)

Drawback

Incomplete activation of Platelet

Low level of growth factors released

5. Platelet rich fibrin (PRF)- Choukroun et al (2001)

Technique – 10ml of a blood sample without anticoagulant is centrifuged (400g- approx.)

(300 RPM- 10 min.)

Drawback- Limited amount PRF- because received from an autologous blood sample.

Systemic utilization of PRF for general surgery is limited

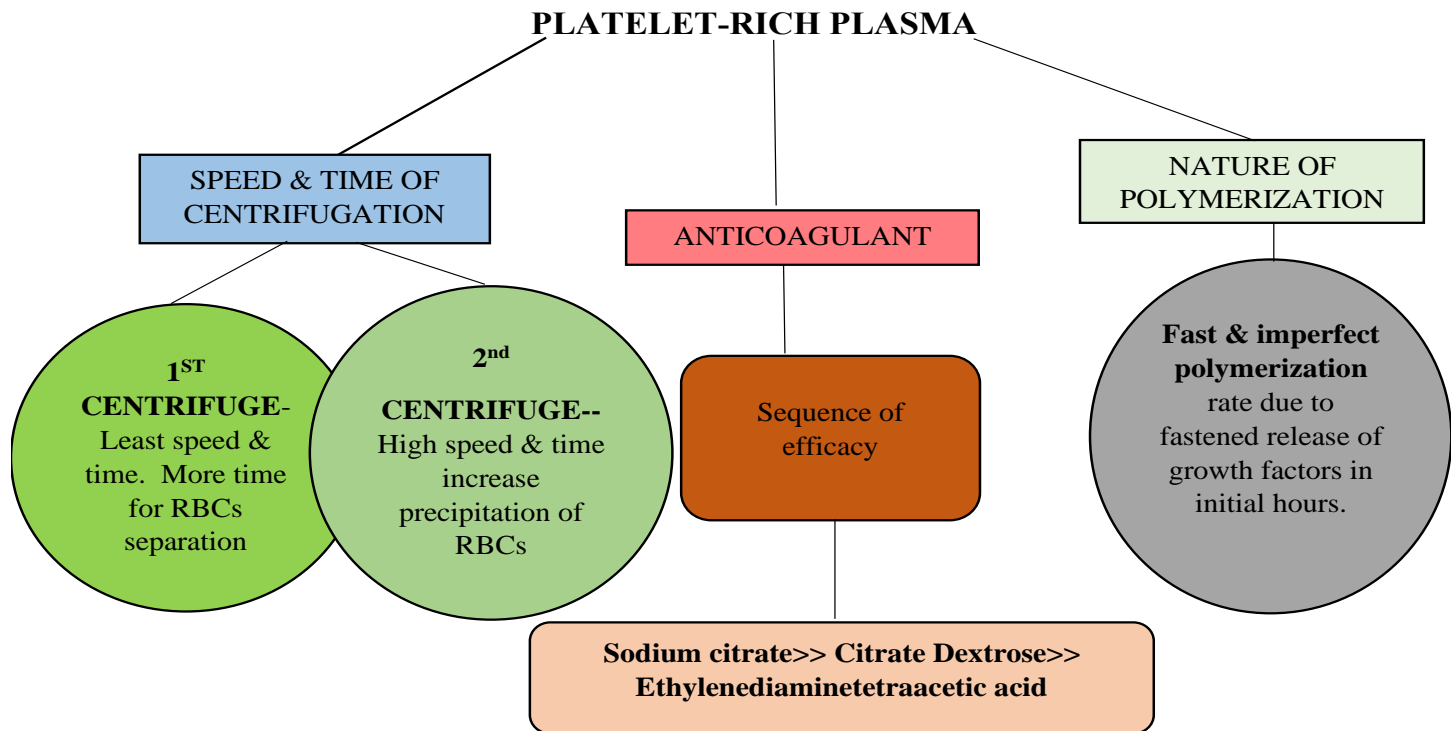


Biological Properties For Use Of Platelet-Rich Plasma-Periodontal Regeneration

PRP has various growth factors, such as PDGF and TGF- strongly modulate the regeneration phenomenon. In vitro study shows expansion, distinction of periodontal ligament and osteoblast cells whereas the proliferation and differentiation of epithelial cells are inhibited.

PRP can enhance collagen synthesis in the extracellular matrix and act as a scaffold for cellular migration and adhesion. PRP reduces the healing period by fastening wound healing.

FACTORS AFFECTING BIOLOGICAL PROPERTIES OF



Clinical Studies - Periodontal Regeneration With Platelet-Rich Plasma

1. **Gentile et al (2010)**- Case series of 15 patients with reconstructive surgery and oral implantology revealed the efficacy of PRP in terms of post-operative patient satisfaction and low morbidity.
2. **Fernandes Et al (2016)**- 2-5% of PRP is ideal for osteogenic differentiation of mesenchymal stem cells in-vitro.
3. **Del Fabbro et al (2011)**- Positive effect when used in combination with graft materials for treatment of Intradbody defects and No significant for the treatment of gingival recession.
4. **Daif et al (2012)**- Application of PRP along fracture lines may enhance bone regeneration.

PLATELET-RICH FIBRIN



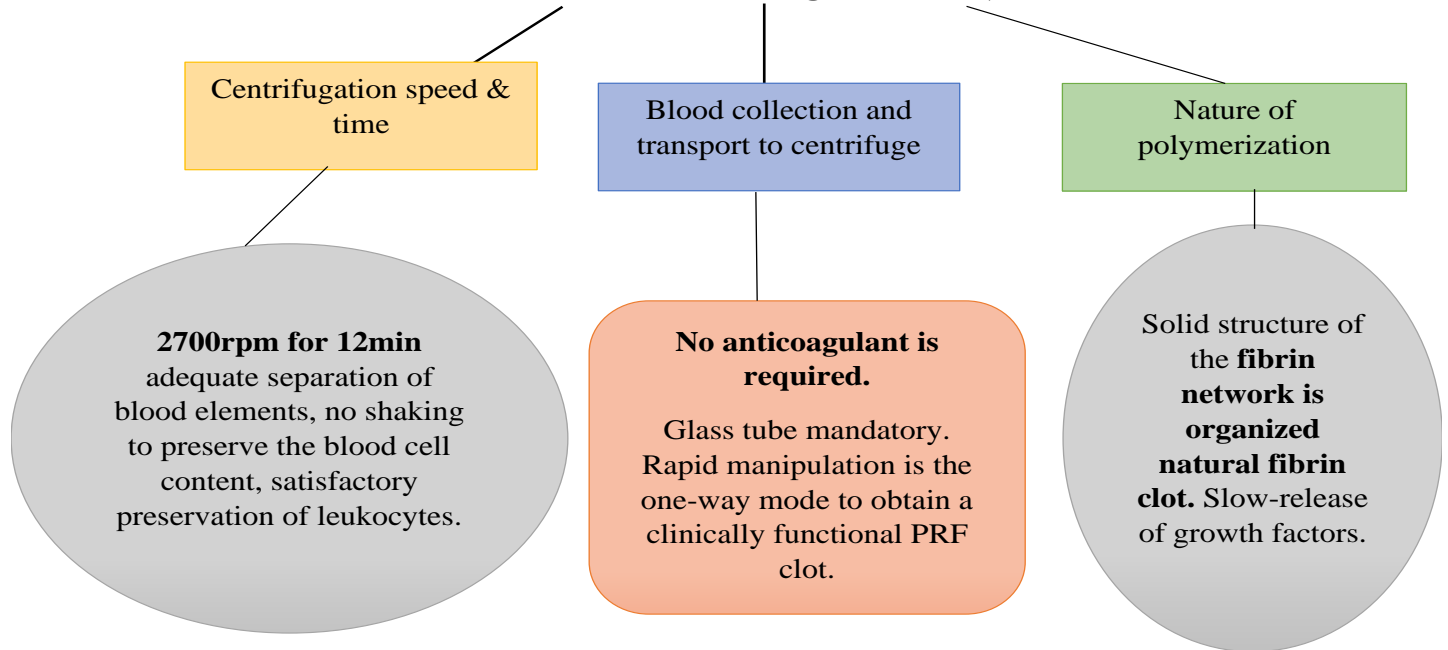
➤ It has a solid, organized structured and has increased mechanical properties in comparison to other platelet concentrates.

Biological Properties For Use Of Platelet-Rich Fibrin- Periodontal Regeneration

PRF can differentiate and proliferate undifferentiated and stem cells that are responsible for periodontal regeneration, such as cementoblast, periodontal ligament, and osteoblast rejuvenating effect on the lost tissue.

A dense fibrin matrix triggers the expression of integrin $\alpha\beta_3$, which adheres to cells to bind to fibrin, fibronectin, and vitronectin. That initiates the process of angiogenesis and thus leading to tissue wound healing.

FACTORS AFFECTING BIOLOGICAL PROPERTIES OF PLATELET-RICH FIBRIN



Clinical Studies On Periodontal Regeneration With Platelet-Rich Fibrin

1. **Vahabi et al (2015)**- 85.6% showed the effect on soft tissue cell behavior invitro and induced fibroblast proliferation at 24 hours.
2. **Jankovic et al (2012)**- RCT of 15 patients and Root coverage was achieved in 75.85% of cases.
3. **(2014)**- PRF increases type 1 collagen formation in the full and split-thickness flap in porcine animals.
4. **Castro et al 2016 Meta-analysis** of IBD showed a significant difference in support of L-PRF Meta-analysis of furcation defect showed significant difference gain in support of L-PRF. Meta-analysis of root coverage, does not show advantageous effects of L-PRF.
5. **Sezgin et al (2017)**- Positive effects with an organic bovine bone material through RCT included 15 cases of Intrabony defects.
6. **Najeeb et al., 2017** Systematic review PRF & open flap debridement together gives better outcomes compared to the open flap debridement alone.

Evidence of efficacy of PRF in periodontal regenerative therapy has been assessed in the systematic review and meta-analysis, it reports PRF add up clinical and radiographic outcomes in periodontal regenerative therapy.

PRF multiplies the regenerative potential of a bone substitute. It also increases wound healing.

Advances In Traditional Leukocyte-Platelet-Rich Fibrin

1. **CONCENTRATED GROWTH FACTORS**- bigger, heavier, and more in growth factor fibrin matrix.
2. **STICKY BONE**- Increases tissue healing and reduces bone loss during the healing period.
3. **ADVANCED-PLATELET RICH FIBRIN**- releases growth factors TGF- β , PDGF, VEGF, and chemotactic molecules CCL-5 (Chemokine ligand 5) and eotaxin.
4. **TITANIUM PREPARED-PLATELET RICH FIBRIN**- more efficacious platelet activator than silica, for preparing L-PRF.

Efficacy And Effectiveness - Platelet-Rich Fibrin

5. **INJECTABLES-PLATELET RICH FIBRIN-** increase efficacy incorporation with particulate bone allograft or autograft materials.

it enhances cell biocompatibility, migratory properties, expansion assay and expression of TGF-β1 and collagen 1 production.

Newer Concepts Of Prf

II. **BIO-PRF (Horizontal Centrifugation Protocol)- Miron et al (2019)** found that horizontal centrifugation concept. Horizontal action created a big increase in each the quantity and quality of platelets and leukocytes.

I. **Albumin Gel-platelet-rich Fibrin Mixture (Alb-PRF)-** releases seven key growth factors found in blood up to a 10-day period, comprising PDGF-AA, PDGF-AB, PDGF-BB, TGF-β1, VEGF, epidermal growth factor (EGF) and insulin growth factor 1 (IGF-1). So

PRP vs PRF

<u>USES</u>	PRP	PRF
	Beneficial Effect on gingival/periodontal fibroblast regeneration	Root coverage with single and multiple recession
	Benefit surgical sites and wound healing S aureus, E- Coli and Klebsiella Pneumonia active against oral microorganism – S orals, S-agalactiae E- Faecalis	Treatment of 3 walled defects
	Bone regeneration and soft tissue healing	Combined periodontic endodontic lesions
	Resorbable barrier membrane	Palatal wound healing after force gingival grafts
	Chitosan + PRP	In tissue engineering
	M Collagen Synthesis	As a scaffold in the bone region
	Healing	
<u>ADVANTAGES</u>	PRP	PRF
	Rapid regeneration	Simple and efficient techniques
	Convenient for patient	Simple step centrifugation
	Blood is collected in the immediate pre-operative period	Autologous blood sample So, allergies
		No external thrombin as polymer
		Combination or with bone grafts
		Healing rate of grafted bone
		Can be used as a membrane
		Economical and quick

DISADVANTAGES	PRP	PRF
	The adverse reaction may depend on the quantity of thrombin	The final amount is low due to the autologous blood nature
	Used in a patient with thrombin coagulation disorders	The success rate depends upon handling test
	More laboratory requirement	Glass coated tube required
	Lack of uniformity	
	High storage time	

Recent Advances – Brand Names-Prp

LOWER PRP	HIGHER PRP
(2.5-3 times baseline concentration system)	(5-9 times baseline concentration system)
Arthrex ACP (2-3X)	Biomet GPS II and III (Platelet count 3-8x)
Cascade PRP therapy (1-1.5x)	Harvest smart P
PRGF by the biotech institute, Victoria	Rep 2 APC + (4-6x)
Spain (2-3x)	Arterio Cyte- Medtronic Magellan (3-7x)
Regen PRP (Regen Laboratory, Mollens Switzerland)	

Recent Advances -Prf

A-PRF Advanced PRP	A-PRF+ Advanced PRP+	i-PRF Injectable PRF	T-PRF Titanium-prepared-PRF
1500 upon for 14 mins	1300 RPM for 8mins. In sterile glass based vacuum tubes	700 RPM for 3 mins. In plastic tubes	2800 RPM for 12mins in medical-grade
Sterile plain glass based vacuum tube			Titanium tubes

Advantages Of Platelet Concentrates In Implantology

1. **With Fibrin Clot-** wherein PRF membrane maintains and protects the bone grafts and its fragments can be used as a biological

connector between the different elements of grafts, new angiogenesis capture of stem cells.

2. **Increase Thickening Of Keratinized Gingival Tissue-** eventually enhanced

esthetic integration and final result of prosthesis

3. **Platelet Cytokines** (PDGF, TGF- β , IGF-I) increased.

Leukocytes And Cytokines in the fibrin network play a significant role in the self-regulation of inflammation and infectious phenomenon within grafted material.

Limitation Of Platelet Concentrates

Role and efficacy of the effectiveness of platelet concentrates **are variables depending on its technique sensitivity.**

One question arises- whether it is only, the **platelet in PC's that play the lead role or the non-platelet component equally** important when considering a clinical application.

Conclusion

Platelet concentrates has been used in numerous applications of dentistry since many years. Technological advancement in this field shows favorable results in the use of platelet-rich fibrin (PRF) in Periodontal regeneration. Various studies have been conducted to determine the use of PRF in various methods that's periodontology and implant dentistry and encouraging results obtained in both soft and hard tissue regeneration.

Various factors like speed, duration of centrifuge, temperature, blood hematocrit affect the quality of the fibrin scaffold. Being a completely natural, physiologic, and economical source of autologous products, it possesses beneficial effects of eliminating concerns about immunologic reaction and disease transmission.

However, since knowledge on this topic is still in its primary stage the efficacy of these platelet concentrates in periodontal regenerative therapy should be evaluated in studies in compassing of larger samples and their clinical applications in RCTs to be encouraged.

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