

Platelet rich plasma: An Iterative process towards healing

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Abstract

The influence of platelet rich plasma in the field of medical science and dentistry been one of the prominent and undoubtedly a magnificent discovery in terms of research and clinical application. The unflinching determination of few authors and researches has given a good amount of outcome in clinical trials, so it has helped us in evaluating and analysing the platelet rich plasma in a much layered way. This article will highlight the PRP in endodontics. Clinical evaluation, drawing of blood, its mechanism of action and pros and cons of of this therapy, with an overall view and an unbiased information.

Keywords: Platelet derived growth factors, Platelet rich fibrin, Buffy coat.

Introduction

Platelet rich plasma has been a phenomenal significant development in the field of endodontics. It has paved its way through healing, regeneration, healthy growth of the tissue and bone with a revascularization/ revitalization procedure using different types of cements in the process of healing. Platelet rich plasma is used in overall general health modalities including lumbar disc pain, shoulder pain and instability, hip strains, knee sprains, ankle and other joint osteoarthritis. Platelet rich plasma is potentially more useful with stem cells.

What is Platelet Rich Plasma?

Platelets are the clotting cells of our blood, and they directly enhance in the healing process. Studies have suggested that growth factors released by platelets: Recruit reparative cells. May augment tissue repair, and accelerate soft tissue healing.

Platelets are best known for their function of blood clotting to stop bleeding and also a critical component in injury healing.

Platelet initiate repair and attract stem cells to the injury. Platelet-rich plasma is just that; it is a volume of autologous plasma that has a platelet concentration above baseline¹

How is Platelet rich Plasma Created?

The entire process of drawing blood to solution preparation takes place approximately 20-30 minutes. A small amount of blood is taken from the patient, just like a routine blood test. Once the blood is drawn, it is later placed into the centrifuge. The centrifuge machine spins the blood at a high speed in order to separate the blood into red blood cells and high concentration of platelet rich plasma. The buffy coat that is left behind is also called as leukocyte band (leukocytes and platelets)

Preparation of PRP

PRP is obtained from a sample of patients' blood drawn at the time of treatment. A 30 cc venous blood draw will yield 3-5 cc of PRP depending on the baseline platelet count of an individual, the device used, and the technique employed.

The blood draw occurs with the addition of an anticoagulant, such as citrate dextrose A to prevent platelet activation prior to its use. Preparation-related costs are significantly lower than with commercial kits²

Types of Preparation:²

There are two types of preparation that is generally used the PRP method or the Buffy coat method.

Procedure

PRP Methods

1. Obtain WB by venipuncture in acid citrate dextrose (ACD) tubes.
2. Do not chill the blood at any time before or during platelet separation.
3. Centrifuge the blood using a 'soft' spin.
4. Transfer the supernatant plasma containing platelets into another sterile tube (without anticoagulant)
5. Centrifuge tube at a higher speed (a hard spin) to obtain a platelet concentrate.
6. The lower 1/3rd is PRP and upper 2/3rd is platelet poor plasma (PPP). At the bottom of the tube, platelet pellets are formed.
7. Remove PPP and suspend the platelet pellets in a minimum quantity of plasma (2-4ml) by gently shaking the tube.

Buffy Coat Method

1. WB should be stored at 20°C to 24°C before centrifugation.
2. Centrifuge WB at a high speed speed.
3. Three layers are formed because of its density: the bottom layer consisting of RBCs, layer consisting of platelets and WBCs and the top PPP layer.
4. Remove supernatant plasma from the top of the container.
5. Transfer the buffy coat layer to another sterile tube.
6. Centrifuge at low speed to separate WBCs or use leucocyte filtration filter.

What is the Difference Between Platelet Rich Plasma and Platelet Rich Fibrin?

In order for activation thrombin or calcium chloride or anticoagulants are added in platelet rich plasma whereas in platelet rich fibrin activation is not required. The major difference between these two products is their polymerization that leads to their different biologic characteristics. Polymerization of PRP is included by addition of anticoagulants but PRF polymerization is a natural and slow process. Hence, PRF has more suitable fibrin network for storage of cytokines and growth factors and also cell migration.³

What does PRP Contains?

Platelets, an important reservoir of growth factors in the body, play an important role in many processes such as coagulation, immune response, angiogenesis and the healing of damaged tissues. Numerous proteins are contained in the alpha-granules of platelets: platelet-derived growth factor (PDGF), transforming growth factor (TGF), platelet factor interleukin (IL), platelet-derived angiogenesis factor (PDAF), vascular endothelial growth factor (VEGF), epidermal growth factor (EGF), insulin-like growth factor IGF and fibronectin⁴

It contains growth factors and bioactive molecules like transforming growth factors beta, bone morphogenic proteins, insulin like growth factors, angiogenetic growth factors which stimulate growth factors, which stimulate collagen production, angiogenesis and cell differentiation.

What is PRP in Relation to Recombinant growth Factors?¹

PRP is the combination of seven native growth factors within a normal clot as the carrier. The clot is composed of fibrin, fibronectin, and vitronectin, which are cell adhesion molecules required for cell migration such as is seen in osteoconduction, wound epithelialization, and osseointegration. PRP, however, contains only the same concentrations of these cell adhesion molecules as does a normal blood clot. Therefore, PRP is not a fibrin glue. PRP acts on healing capable cells to increase their numbers (mitogenesis) and stimulate vascular ingrowth (angiogenesis). Therefore, it is unlikely to significantly promote bone substitutes and other non-cellular graft materials. However, because it has been shown to stimulate autogenous marrow grafts, it is likely to enhance the bone formation when applied to combinations of cellular autogenous bone and non-cellular bone substitutes.¹

Clinical Applications in Endodontics

1. Periapical tissue repair with increase in root length.
2. Thickening of the root walls
3. Apical closure.
4. Treatment of periapical lesions
5. Necrotic pulp and open apex

Side effects or Adverse Reaction

Its a safe treatment option with no allergic reaction as it is drawn from an own individual blood.

Platelet Rich Plasma: Growth Factors and Pro and anti Inflammatory Properties

PRP is a rich source of growth factors and promoted significant changes in monocyte-mediated proinflammatory cytokine/ chemokine release. LXA4 was increased in PRP, suggesting that PRP may suppress cytokine release, limit inflammation, and thereby, promote tissue regeneration⁵

Which one to prefer PRF (platelet rich plasma) or PRP (platelet rich fibrin) ?

Studies have shown that platelet rich plasma is better than Platelet rich fibrin and induced bleeding technique with respect to periapical wound healing when used in the regenerative endodontic procedures⁶

Regenerative Endodontics

It focuses on replacing traumatized and diseased pulp tissue in the teeth and deals with the healing of the impaired dental tissues, including dentin, pulp, cementum and periodontal tissues.

Regenerative endodontic procedures (REPs) are designed to replace damaged structures including dentin and root structures as well as cells of the pulp-dentin complex. The ultimate goal of REPs is the regeneration of tooth pulp based on 3 pillars: the source of stem cells (genesis), the supply of growth factors (induction), and the presence of a scaffold (conduction)⁷

Clinical significance/ Achievement

Healing Process

Most of the growth factors are stored in the alpha granules of the platelets and are released after activation. Platelet-derived growth factor, transforming growth factor beta, epidermal growth factor, and vascular endothelial growth factor are some of the many growth factors and proteins available in PRGF-Endoret. Other growth factors come from the blood plasma such as insulin like growth factor I and hepato-cyte growth factor. All these biologically active proteins are able to influence recruitment, growth, and morphogenesis of cells in order to promote the healing process⁷.

Increase in the Dentinal wall Thickness

Histologic results from animal and human species have described the formation of cementoid/osteoid tissue deposited on the canal walls, which increases their thickness. Moreover, bridge formation by cementum- and/or bone like tissue has been also described.⁷

Root lengthening in an Open Apex Case⁸

Management of permanent teeth with a necrotic pulp, periapical pathology, and arrested root development poses a great challenge for dentists. The results of halted root development include weak root dentin, open apices, and

stunted root growth; hence such teeth are prone to root fracture. Moreover, such abnormalities make them unsuitable for debridement and filling with traditional techniques and obturation materials.

MTA, Calcium hydroxide is used for the treatment of such cases., but the disadvantage common to both is that they do not allow for continued root development, resulting in thin dentin walls and a feeble root structure. Recent advances in tissue engineering have focused upon three factors for tissue regeneration.

1. Adult stem cells
2. Signalling molecules and 3D physical scaffold that can sustain cell growth and differentiation.

Stem cells from Apical Papilla of Immature Teeth

Accountable for continued apex formation in a sterile environment.

Regeneration

Allows for rapid continuation of root development, increased wall thickness, and natural healing of periapical tissues

Platelet Rich Plasma

Source of growth factors and ability to maintain the vitality of pulp tissues by promoting cell growth and transport of growth factors.

In REPS a matrix is necessary to provide physiochemical and biological microenvironment that supports the growth, migration and differentiation of dental stem cells. PRP is versatile, easy to prepare, and can be used as a matrix for REPS.

Firstly

It provides the conduction; the fibrinogen present in plasma is cleave to form fibrin. then thr fibrin is cross linked with the factor 8A creating a three dimensional fibrin scaffold that part in part of release protein content and serves as a matrix for endogenous cells.

Secondly

It provides induction, supplying the growth factors and bioactive molecules like (*Transforming growth factor, beta, bone morphogenic proteins, insuling growth factor and angiogenetic growth factors needed for the repair or the regeneration of dentin pulp system*)⁸

FDA Approval with a Green Flag

A PRP device is used for in for increasing the concentration of platelets in the blood plasma. Using the device, PRP method is prepared by two methods PRP method and buffy coat method. Both methods methods take the patients whole blood anti- coagulated with citrate dextrose followed by centrifugation. The U.S. Food and Drug Administration (FDA) approved these methods of PRP preparation in 2009.

Advantages

1. It is safe as it is by-product of the patients blood; therefore, disease transmission not an issue³.
2. It is cost effective as expenses of the harvesting procedure are greatly reduced⁹
3. Promotes faster healing, growth factors produce increase of tissue synthesis and thus faster tissue regeneration⁹

Disadvantages

1. It cannot be used in patients with bleeding disorders⁹
2. It cannot be used in patients on NSAIDS or anti-platelet drugs or in chronic liver cases⁹

In Treatment of Re- current Periapical Cyst (the Grey Area)

Treatment outcomes, both clinical and radiographic, were highly satisfactory with complete resolution of all clinical signs and symptoms. Healing seemed to be quite rapid, possibly explained by the combined use of PRP and Biodentine. A significant resolution of radiolucency was observed as early as 3 months in non cystic large periapical lesions. However, long term randomized controlled clinical studies are required to validate these findings. Also, a long term recall at 1 to 3 years is suggested to check for any reversal of symptoms.⁸

Conclusions

Platelet rich plasma holds a promising breakthrough in the field of dentistry. It has been observed that it serves as a successful scaffold in regenerative, apical wound healing, increase in dentinal wall thickness, closure of apex without use of surgical procedure with a good success rate. The growth factors present helped in collagen synthesis, proliferation of osteoblastic cells.¹⁰ So hence it is definitely a path breaker in the present scenario.

Conflict of Interest: None.

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