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Platelet Rich Plasma and Its Application in Dentistry

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Abstract: In many dental and oral surgery procedures, particularly those involving aged patients, platelet-rich plasma (PRP) is emerging as a beneficial adjunct to aid healing. PRP is a novel method to tissue regeneration. PRP is created by centrifuging the patient's own blood, and it contains growth factors that have an impact on tissue repair through influencing wound healing. Present review aims to discuss method of preparation of PRP and its application in dentistry.

Keywords: Dentistry, Platelet-Rich Plasma, PRP

Introduction

Platelet-rich plasma applications used in new autologous cellular therapies have the potential to supplement a range of regenerative therapy regimens. The treatment of musculoskeletal (MSK) and spinal problems, osteoarthritis (OA), and patients with persistent complex and recalcitrant wounds all have unmet needs for tissue healing techniques.[1,2] Platelet-rich plasma has become a great approach in tissue regeneration procedures and is becoming an important addition in measures where efficient healing of dental tissues is required.[3,4]

A blood product with a high concentration of platelets is called platelet-rich plasma. It is a contemporary method of tissue regeneration that is evolving into a useful tool to speed up healing following various oral surgical procedures. This substance can be produced by centrifuging the patient's own blood, and various preparation methods have been proposed for the finished

product.[5] Typically, soft spinning was used to first separate the leukocyte fraction from the plasma fraction in anticoagulated blood. In order to separate the platelets from the platelet-poor plasma, the plasma fraction was subsequently subjected to a second strong spin. Leukocytes are suspended in a smaller volume of PPP and are activated by thrombin and calcium in the platelet pellet. Platelets are 2–5 times more numerous after these two centrifugation processes than in regular blood.[6]

PRP functions as a direct surgical hemostatic agent that is compatible, safe, and effective as well as fibrin tissue glue with tissue sealing property. Additionally, it enhances the hemostatic response to damage, triggers angiogenesis, speeds up endothelial and epithelial turnover, facilitates the recovery of soft tissues, and reverses the inhibition of wound healing caused by exogenous hormones.[7] Present review aims to discuss method of preparation of PRP and its application in dentistry.

Method of PRP Preparation

PRP is made using a sample of the patient's blood taken at the time of the procedure. Depending on the person's baseline platelet count, the tool used, and the technique used, a 30 cc venous blood draw will produce 3-5 cc of PRP. To prevent platelet activation before to usage, an anticoagulant, such as citrate dextrose A, is added to the blood drawn during the blood draw. A specialized "table top cold centrifuge" is used by the writers. Costs associated with preparation are far lower than with commercial kits.[8]

There are numerous methods of PRP preparation. However, all of them primarily involve differential centrifugation. There are two primary methods of PRP preparation:[8,9]

1. **Open technique**

This method involves the open preparation of PRP. The blood encounters the environment in the working area. Pipettes and tubes are sterilized separately and used in the process of preparation of PRP.

2. **Closed technique**

This method involves the use of commercial devices or kits. Here the blood or the PRP is not exposed to the environment during the process of preparation of PRP.

PRP Method[10,11]

1. Obtain Whole blood 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 (2-4 mL) by gently shaking the tube.

Platelet Rich Plasma

The blood clot is the center of focus of initiating all soft tissue healing and bone regeneration. In all natural wounds a blood clot forms and starts the healing process. A natural blood clot contains:[1]

- 94% Red blood cells
- 6% Platelets
- <1% White blood cells along with numerous fibrin strands.

A PRP clot instead contains

- 5% Red blood cells
- 94% Platelets
- 1% White blood cells

Components of Platelet Rich Plasma are:

- Growth Factors
- WBC & phagocytic cells
- Native fibrogen concentration
- Vasoactive and chemotactic agents
- High concentration of platelets

The final stage of the coagulation cascade, which is the creation of a fibrin clot, is mimicked by platelet rich plasma. PRP's positive effects are caused by the release of certain growth factors through granules. Collagen synthesis and angiogenesis are encouraged by platelet rich plasma, which increases the strength of early wounds. These peptides function in a self-regulatory feedback mechanism both locally and systemically. It has been demonstrated that PRP "jump starts" the healing process after damage, resulting in high-quality tissue repair and patient care. High leukocyte concentration is thought to be the cause of the antibacterial action. These components become less concentrated after seven days. The initial platelet count in the clot within the graft or wound is increased by PRP, and the pace of healing is proportional to that initial platelet count.

Table 1: Growth factors related to Platelet Rich Plasma

Platelet derived growth factor	PDGF	Mitogenesis increase in the number of healing cells. Angiogenesis-generating new capillaries
Transforming growth factor ß	TGF-ß	Enhances synthesis of type I collagen, promotes angiogenesis, stimulates chemotaxis of immune cells, inhibits osteoclast formation and bone resorption
Epithelial growth factor	EGF	Released during platelet aggregation and induces replication and migration of cells. Stimulate reepithelization, angiogenesis and¬ collagenases activity
Vascular endothelial growth factor	VEGF	Stimulates angiogenesis, migration and mitosis of endothelial cells, increases permeability of the vessels, stimulates chemotaxis of macrophages and neutrophils
Insulin-like growth factor	IGF	Secreted by osteoblasts during bone formation to increase numbers of osteoblasts and thereby accelerate bone deposition
Fibroblast growth factor	FGF	Stimulates the proliferation of endothelial cells, fibroblasts, vascular smooth muscle cells, skeletal muscle myoblasts and some forms of epithelial cells.

Clinical Application of PRP in Dentistry

Application of Periodontics: PRP is a first-generation platelet concentrate containing high concentration of platelet but minimal amount of natural fibrinogen. The architecture of PRP consists of cellular movement, thickened fibrin polymers that produce a stiff network that is hostile to cytokine enmeshment, and bilateral junctions (condensed tetra molecular) made up of strong thrombin concentrations. Treatment of periodontal defects, root covering techniques, ridge augmentation grafting, guided bone regeneration, sinus lift grafting, and implant surgery are all periodontal applications of PRP. The therapeutic use of PRP also encompasses orthopaedic surgery, blepharoplasty, cutaneous fat grafts, and mandibular and maxillary repair (tumor and trauma-related abnormalities).[12,13]

Application in Pediatric Dentistry

Regenerative medicine appears to be the most effective and appropriate method for therapeutic pulp therapy since its core idea is to mimic natural processes of growth and development.[14] PRP, a revolutionary method to tissue regeneration that is obtained by sequestering and concentrating the platelets, is now the alluring agent in regenerative medicine. Additionally, autologous preparation is inexpensive, reduces the concerns of disease transmission and immunogenic reactions, and is easily accomplished using readily accessible commercial equipment that can be prepared and used in a dental operating room. All of these benefits support the clinical and radiographic evaluation of PRP as a pulpotomy medication in primary molars in this investigation.[15,16] Beltagy TM et al. (2018) found 100 % [clinical] success rate of pulpotomized teeth at the end of 12 month recall time with PRP. They found that efficacy of PRP as a potent therapeutic medicament in pulpotomy of primary teeth. Also, the findings in their study suggest that PRP had a promising effect, and it could be an alternative to the currently used pulpotomy medicament.[17]

Application in Endodontics

Dentists face a significant problem when it comes to managing permanent teeth with necrotic pulp, periapical disease, and stopped root growth. Strong root dentin, open apices, and stunted root growth are the outcomes of stalled root development; hence, such teeth are vulnerable to root fracture.[18] Dentists face a significant problem when it comes to managing permanent teeth with necrotic pulp, periapical disease, and stopped root growth. Strong root dentin, open apices, and stunted root growth are all effects of stopped root development, making such teeth more vulnerable to root fracture. Three essential elements for tissue regeneration have been the focus of recent advancements in tissue engineering: adult stem cells, signaling molecules, and a three-dimensional physical scaffold that can support cell proliferation and differentiation. Due to its capacity to maintain the vitality of pulp tissues by encouraging cell growth and the transport of growth factors in a clean environment, platelet-rich plasma has recently been described as a source of growth factors and a potentially ideal scaffold for regenerative endodontic treatment regimens.[19,20,21] To handle non-vital immature teeth with periapical disease, treatment procedures that make use of this natural mechanism of enhanced healing and tissue regeneration in conjunction with thorough cleaning of the root canal system are helpful. PRP regeneration methods have been the subject of numerous case series and in-vivo research that have been published.[21]

Application in Cosmetics

Since the clarification of its mechanism and reports of its clinical efficacy, platelet-rich plasma (PRP) has drawn a

lot of interest in the field of dermatology. PRP has shown promise for treating several aesthetic issues and skin conditions, either on its own or in combination with other treatments. Wrinkles, coarseness, pigmentation, and loose skin are all signs of ageing skin. PRP can cause the extracellular matrix to restructure (ECM). This boosts the expression of matrix metalloproteinases to eliminate photodamaged ECM components and promotes dermal fibroblast proliferation and collagen creation.[22]

Application in Oral Surgery

A common dental procedure involving severely decaying, periodontally compromised, irreparable, or impacted teeth is tooth extraction. Significant postoperative pain can result from these surgeries, especially when third impacted molars are extracted. Furthermore, patients, particularly those using anticoagulant treatment, may experience prolonged bleeding.[23] Numerous techniques have been used to speed up the healing process, such as the use of fibrin sponges and bio stimulation with lasers, to alleviate post-operative discomfort and improve tissue repair mechanisms. PRP has recently been suggested as a method of acquiring high concentrations of growth factors essential for tissue healing and regeneration. This method's therapeutic goal is to speed up the healing process and improve healing quality by encouraging tissue restoration.[24\\]

Table 2: Advantage and Disadvantage of Platelet Rich Plasma

Advantage	Disadvantage
• Not harmful to tissues • Simple and easily accessible • Accelerates the regeneration of endothelial, epithelial, and epidermal tissue • Encourages angiogenesis and increases collagen production • Enhances the healing of soft and hard tissue wounds • There is no danger of infectious illness transmission.	• Lack of uniformity in PRP preparation protocol as different platelet concentrations have different storage time.

Conclusion

PRP, an autologous platelet concentration in concentrated plasma, is frequently utilized to encourage the repair of both soft and hard tissues. The importance of its application is related to the large number of growth factors included in a well-made PRP concentrate. By employing various processes, these growth factors improve the effectiveness and speed of wound healing. PRP works as a fibrin tissue glue with tissue sealing properties and as a direct surgical hemostatic agent that is compatible, safe, and efficacious. Additionally, it promotes angiogenesis, accelerates endothelial and epithelial turnover, aids the recovery of soft tissues, and undoes the effects of exogenous hormones that hinder wound healing. Further studies should be conducted to support the usage of PRP in dental and oral surgical procedures.

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