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Platelet Rich Fibrin and Its Role in Regenerative Dentistry: A Mini Review

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Abstract

Platelets play a prime role in the field of regenerative dentistry. Platelet rich fibrin (PRF) comprises of a fibrin matrix consisting of platelet cytokines and an inventory of growth factors. These growth factors consist of proteins which are known to be involved with the cells during the process of tissue regeneration and growth. PRF application has surpassed other platelet concentrates like PRP due to its effortlessness and economical method of preparation, and also its prevention from the need of supplemental exogenous compounds like bovine thrombin and calcium chloride. This review attempts to contour the relevant composition regarding the technique of using platelet rich fibrin (PRF), various types of stem cell sources that have been identified, focusing on its preparation, advantages, and disadvantages of using it in dentistry.

Keywords: Platelet rich plasma; Fibrin; Regeneration; Dentistry

Introduction

Wound healing is a process which includes a multi-staged approach and interaction of a complex cascade of cells and molecules in the host's defense mechanism [1]. As your body engrosses in wound healing, a captivating process occurs throughout each of the systems that constitute the body [2-4]. The conception of healing process is still partial and is a keen subject for research, but it is well known that platelets play a significant role in both hemostasis and wound healing activity [5-8]. There is corroboration on the fact that platelets play a crucial role in tissue healing and inflammation [9,10]. The presence of growth factors and cytokines are important guidelines to regenerate the wound area [11-13]. Upon the activation of platelets there is proof of release of not only cytokines, enzymes, proteins but also fibrinolytic and anti-fibrinolytic proteins, which act as a matrix during the pathway of tissue repair [12]. This has led to the notion in the use of platelets as a remedial tool to improve tissue healing.

The world of dentistry was first familiarized with the regenerative capacity of platelets in the 70s. As per its first definition in 2007, it is a preparation of platelets present in a small volume of plasma containing a large amount of growth factors (GFs), which is essential for bone growth and regeneration [14]. Platelet-rich fibrin (PRF) is frequently named as Choukroun's PRF after its inventor, and was described as a second-generation platelet concentrate which contains platelets and growth factors in the form of fibrin membranes prepared from the patient's own blood free of any anticoagulant or other artificial biochemical modifications [15].

Activation of PRP can lead to an immediate burst of more than 15 growth factors present in the PRP, with the primary ones being insulin-like growth factor (IGF), transforming growth factor β (TGF-β), vascular endothelial growth factor (VEGF) and platelet-derived growth factor (PDGF), along with their isoforms [12,13]. These growth factors consist of proteins which are known to be involved with the cells during tissue regeneration and growth [12,13].

One of the modern innovations in regenerative dentistry is the use of platelet concentrates for *in vivo* tissue engineering applications, which include platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) [16,17]. PRP has reported great advantages because of its osteogenic potential. However, there is also a risk in its application, as PRP requires the addition of exogenous compounds like bovine thrombin, which may generate antibodies to certain blood clotting factors that could cause coagulopathies and harm the host [16,17]. PRF application has surpassed other platelet concentrates like PRP due to its effortlessness and economical method of preparation, and also its prevention from the need of supplemental exogenous compounds like bovine thrombin and calcium chloride [18-20]. The benefits of using PRP include its convenient use, ease of availability and isolation, good handling and storage properties. Being autologous, its use abolishes the risk of immune rejection and transmission of pathogens. The PRF clot forms an authentic fibrin matrix, high in strength and a compound architecture as a healing framework with distinctive mechanical properties which makes it discrete from other platelet concentrates [21,22].

The following review attempts to contour the relevant composition regarding the technique of using platelet rich fibrin (PRF), various types of stem cell sources that have been identified, focusing on its preparation, advantages, and disadvantages of using it in dentistry.

Platelet rich fibrin (PRF)

PRF demonstrates a novel shift in the therapeutic development of platelets. PRF is routinely called Choukroun's PRF, after its inventor, as there are varied platelet concentrates with corresponding names [23-25]. Choukroun's platelet-rich fibrin (PRF) is a leukocyte and platelet rich fibrin biomaterial with a distinct arrangement and three-dimensional framework [15,24,26]. PRF is distinguished as a second generation framework as it is primed as an elemental condensed form minus the accretion of any anticoagulants. PRF is also observed to have a packed fibrin complex, containing leukocytes, cytokines and glycoproteins such as thrombospondin [22]. Leukocytes that are condensed in PRF scaffold hold a necessary position in growth factor release along with immune administration. Furthermore, it

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also constitutes growth factors, such as transforming growth factor b, platelet derived growth factors, vascular endothelial growth factor, etc. These factors hold a critical role in the functioning of PRF in regeneration and wound healing [2].

Preparation of PRF

PRF was conditioned and formed by Choukroun et al. in 2007 [24-28]. The procedure for PRF formation is smooth. PRF is prepared without using an anticoagulant during blood harvesting. Ross et al. were amongst the first to establish a growth factor from platelets [29].

The procedure involves removing blood that is contained into test tubes minus an anticoagulant and needs to be centrifuged immediately, i.e. at two minutes at 2700 rpm. The concomitant product consists of three layers:

1. Acellular platelet poor plasma (PPP)
2. PRF Clot at the mid-level
3. Red fraction of the RBC at the lowest level.

PRF by Choukroun's technique is prepared innately without addition of thrombin, and it is investigated that PRF has a genuine fibrin framework and can secure growth factors from proteolysis. PRF can be reasoned as an innate fibrin-based biologic substance promising to the formation of a microvascularization and able to create and signal cell migration into the wound location.

Advantages of using PRF

Studies have prompted safe and promising results, indicating its use in medicine and the dental field [30-35]. PRF can be used autonomously, or in amalgamation with bone grafts, depending on the requirement. The key benefits of using PRF are faster wound healing and bone regeneration, along with its definitive resorption post-surgically. This avoids the need for a second surgery, which is especially beneficial in elderly patients. Being a minimally invasive procedure, its lower risks assist in satisfactory clinical results.

Another major advantage of using PRF is its assistance in hemostasis, favoring healing and having an enhanced effect on the immune system [27]. Its preparation is a fluent and effectual technique that is easily accessible. It has a native fibrin meshwork with the addition of growth factors. This undoubtedly keeps their activity for an acceptably longer duration. It is certainly a cost-effective and receptive option when compared to growth factors when used along with bone grafts. PRF can be used as a compatible scaffold for regenerative therapy, as it complies with the standard of selectively merging and sustaining tissue differentiation.

Clinical applications

PRF quenches many standards of a perfect physical scaffold. Studies have disclosed numerous feasible usage of PRF. It is applied in handling autologous PRF in oral and Maxillofacial Surgery for upgraded bone healing when practiced in Implant surgery. Gassling et al. [36,37] perceived in a study conducted that PRF membranes are ideal for accomplishment of periosteal cells for bone tissue engineering. Its application also lies in root coverage methods for alleviating gingival recession using flap procedures and a PRF matrix [30,38-40]. PRF is considered to be a suitable biomaterial for pulp-dentin matrix regrowth. Homogeneously, Rudagi et al. [41] also described a research validating the thriving healing and apexification with combined use of MTA (mineral trioxide aggregate) as a root-end barrier, and analogous PRF membrane as an internal complex.

PRF and bone graft are amalgamated for collaborative periodontic-endodontic furcation anomalies. Sculean et al. [42-44], in their research observed that the fusion of barrier membrane and grafting materials validates in the histological indication of periodontal regeneration and produces significant bone repair. PRF membranes are utilized for relieving residual extraction sockets. Choukroun's PRF could aid in bone reconstruction procedures. It is used as a prime scaffold in pulp revascularization methods. Being affluent with growth factors, it appears to increase cellular growth, forming a matrix for tissue formation and promoting the inflammatory counter reaction. Also used for the reconstruction of bigger bony defects following cancer resection. PRF clots are often straightaway utilized in plastic surgery. PRF has a key role in wound healing, hence aiding in accelerated periodontal treatment. Sato et al., reviewed this drug mixture and reported it to be suitable in the sterilization of carious lesions in the tooth, necrotic pulps, infected root dentin and periapical lesions [45]. PRF contains biologically active proteins, stimulating and promoting repair. Hence, it can be used in clinical position demanding speedy healing. Lastly, they assist in the healing of soft and hard tissues as tissue engineering scaffolds.

Drawbacks of PRF

The main drawback governing the use of PRF is its making and storage. Correspondingly, PRF membranes should be utilized incontinently after formation, as deposition is arduous as it will compress changing the physical integrity of the PRF, abating its growth factor percentage. PRF when preserved in the refrigerator can conclude in the threat of its bacterial contamination. Nevertheless, these shortcomings can be bypassed by clinging onto a genuine protocol for formation and maintenance. Further drawbacks of PRF reside in its handling and manipulation in order to place it into the root canal. Clinical experiments are pivotal to associate the outcome of PRF in the revitalization of the tooth.

Conclusion

Currently, PRF has been investigated to show favorable clinical results, being a minimally invasive technique with reduced risks. Being a cost effective technique that is straightforward and acceptable, it is definitely a subject to be highlighted in terms of research. In the coming time more clinical investigations and *in-vivo* and *in-vitro* studies need to be undertaken to throw light on its advantages and reach its clinical applications to its maximum potential.

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