Role of plasma-rich fibrin in oral surgery

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ABSTRACT
Platelet-rich fibrin (PRF) is a fibrin meshwork, in which platelet cytokines, growth factors, and cells are entrapped and discharged after a period and can serve as a resorbable film. PRF is the next generation of platelet concentrates equipped to improve arrangement without biochemical blood handling; PRF is an evolution of the fibrin adhesive, which is widely used in the oral surgery. The guidelines of this innovation depend on concentrating platelets and growth factors in a plasma medium, and initiating them in a fibrin gel, keeping in mind the end goal to enhance the healing of wounds. Maxillary bone loss requires numerous regenerative techniques: as a supplement to the procedures of tissue regeneration, a platelet concentrate called PRF was tested for the 1st time in France by Dr. Choukroun. This article enriches the benefits and role of plasma-rich fibrin in oral surgery. Platelet-concentrate fibrin is an evolution of the fibrin glue, which is widely used in the oral surgery.

KEY WORDS: Piezo surgery, platelet-rich fibrin, platelets, sinus lift
Biology

In the past decade, PRP has emerged as a nonoperative procedure for cartilage injuries. The rationale for its use is mostly based on its functional components. Platelets are produced by megakaryocytes as anucleated cells. A variety of growth factors, coagulation factors, chemokines, cytokines, integrins, and adhesion molecules are present in platelets. After activation, the platelets in PRP can release a variety of growth factors at a significantly higher concentration than the baseline levels in blood. Platelets in PRP are also a source of mediators and modulators in inflammation. After incubation with polycrylamide, platelets release anti-inflammatory cytokines, including interleukin (IL)-1 receptor. PRP contains numerous plasma proteins, which are the critical components in the healing process of connective tissue stroma. Plasma contains fibrinogen and other clotting factors that could be activated, thereby forming a fibrin scaffold for the cells to adhere, migrate, and to proliferate. The clinical benefits of the PRP fibrin matrix are well known in oral surgery as well as wound repair. There are no blood vessels in articular cartilage, hence they are unable to initiate the healing process like other tissues with a good regenerative potential. The PRP membrane may mimic the primary stage of wound healing and tissue repair. To provide an accurate overview, the classification system advocated by Dohan Ehrenfest et al. is adopted here to categorize generic PRP into pure PRP, leukocyte-PRP, pure platelet-rich, and leukocyte-PRF (L-PRF).

Effect of Platelet-rich Plasma on Cells

In almost all published studies, PRP has shown to have a strong positive effect on chondrocyte proliferation in vitro. Differentiation is, however, less in concordance with the effect of PRP on chondrocyte differentiation. Akeda et al. reported that 10% PRP treatment significantly increased proteoglycan and Col II synthesis in comparison to treatment with 10% platelet poor plasma or 10% fetal bovine serum (FBS), with the major profiles of proteoglycan and collagen resemble to those seen in cells cultured with FBS, indicating maintenance of a stable chondrocyte phenotype with PRP exposure. However, the most common pro-inflammatory cytokine, IL-1 β, was only proved to be elevated after the activation of platelets, while the anti-inflammatory molecules, such as IL-4 and IL-10, were elevated more than 5 times. Mesenchymal stem cells (MSCs) have a lot of advantages over chondrocytes by their abundant availability, robust chondrogenic activity accompanied by cartilage matrix production, and multi-lineage differentiation ability to repair osteochondral defects. Many researchers have found that PRP exhibits a mitogenic effect on MSCs and could also enhance the proliferation and chondrogenic differentiation of bone marrow-derived MSCs (BMSCs). In this study, however, BMSCs were cultured for only 7 days, and the long-term effects of PRP on MSCs, thus, remained unclear.

Preparation of Platelet-rich Fibrin

PRF is also called Choukroun’s PRF apart from other similar concentrates such as Vivostat PRF and fibrin PRF. Venous blood of patient is taken before surgery and centrifuged at 3000 rpm for 10 min without anticoagulant in a 10 ml vacutainer. After centrifugation, it settles in three layers, the upper straw-colored acellular plasma, middle portion containing the fibrin clot, and red-colored lower portion containing red blood cells. The upper straw-colored layer is removed and middle portion is collected, 2 mm below to the lower dividing line, which is the PRF. The mechanism involved here is the fibrinogen concentrated in the upper part of the tube combines with the circulating thrombin when centrifuged to form fibrin. After that, a fibrin clot is formed in the middle between acellular plasma and the red corpuscles. The middle part is platelets are entrapped massively in fibrin meshes. The success of this technique depends entirely on time gap from the blood collection to its transfer for centrifuging, and it should be done in less time.

Role in Maxillofacial Surgery

The attention of maxillofacial surgery community was enhanced by a chain of scientific papers during the 1990s, which claimed that PRF could be valid for both hemostasis and bone grafting. Bone regenerative techniques include sinus lift for implant placement, which is considered to be one of the most common procedures for augmenting the maxilla. They are presently used to assess the importance of sinus lift and implantation with L-PRF (Choukroun’s technique) as a sole sub-sinus filling material. PRF-based membranes are used for masking the alveolar ridge augmentation side in several in vivo studies. L-PRF is a new platelet concentrate used with a great success in a number of surgical procedures to optimize the wound healing. Numerous studies showed that LPRF has the property of the new bone formation. The use of PRF has reduced healing time by promoting optimum bone regeneration. At 106 days, we observed a good primary stability of endosseous implants. Platelets have a role in homeostasis, but in recent years, it has been studied that they improve wound healing in multiple extractions to preserve the alveolar ridge height. PRF could be useful for small otologic surgery. Sports-related soft tissue injuries cause athletes to lose a significant amount of time from their sports and represent a significant burden to society in terms of health-care resources, personal disability, and activity restriction. By using PRF and piezo surgery, the healing time is reduced, compared to 150 days described in literature, favoring optimal bone regeneration. Jang et al. determined the capability of fibrin powder as a biochemical material for the restoration of perimplant defects.

Advantages of platelet-rich fibrin

- Single step and simplified process
- Autologous blood sample with minimum blood manipulation
- Natural polarization with minimal immunological reaction
- Can be used with bone grafts

Disadvantages of platelet-rich fibrin

- The success of the PRF protocol depends directly on the handling, mainly, at the time of blood collection and its transference for the centrifuge
• Need for glass-coated tube to achieve clot polymerization
• Possible refusal of treatment by the puncture required for blood collection (Borie 2015).

Conclusion

PRF utilizes the patient’s own blood, thereby decreasing or eliminating the transmission of diseases. Choukroun’s technique is simple and inexpensive for successful regeneration of periodontal tissues. PRF membrane protects the surgical site and promotes soft tissue healing. It acts as a biological connector between different graft elements and as a matrix that supports neoangiogenesis, capturing stem cells, and migration of osteoprogenitor cells to the center of the graft. Currently, PRF seems to be an accepted minimally invasive technique with minimal risks and good clinical results.

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Conflicts of interest

There are no conflicts of interest.

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