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Platelet-rich fibrin: A "Splendid material" in oral and maxillofacial surgery

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Abstract

An autologous biomaterial called PRF offers the second generation of thrombocyte concentrates. PRF first described by choukroun et al. is a new second generation of platelet concentrate It is widely utilized in oral and maxillofacial surgery as well as other surgical disciplines because it has advantageous biological properties that accelerates both soft tissue and bone healing. The ease of preparation, availability for every patient, and minimal trauma are the main advantages of working with PRF.

Keyword: Platelet Rich Fibrin, Platelet Rich Plasma, Wound Healing, Haemostasis.

Introduction

The use of platelet concentrates for the enhancement of repair and regeneration of the soft and hard tissues following various surgical operations is one of the most recent developments in dentistry. Blood clots post-surgery start the healing and regeneration of both hard and soft tissues. The body's natural wound healing processes can be accelerated and improved by using platelet concentrates.

Plasma Rich Fibrin is defined as an autologous healing biomaterial, incorporated in a matrix of autologous fibrin most leukocytes, platelets and growth factors harvested from a simple blood sample.

PRF first described by choukrounet al.,is a new second generation of platelet concentrate[3]Platelet-rich fibrin (PRF), has been developed with simplified processing and no biochemical blood handling. It is preferable than PRP because of the streamlined processing method and simple handling. It is possible to use PRF to encourage bone regeneration, graft stabilization, wound healing, and hemostasis. The fibrin matrix's improved organization allows it to more effectively control stem cell movement and the healing process. The clinical applicability of PRF was enhanced by the release of growth factors from PRF through in vitro research and positive outcomes from in vivo studies. It has been demonstrated that PRF produces superior effects to PRP. This review article's main objective is to outline the potential roles that PRF could offer in oral and maxillofacial surgery.

History

The development of these preparations began in 1970 with research by Matras on "Fibrin glues" that accelerated the healing of skin wounds in rats[1]. The utilisation of blood extracts was later upgraded to "Platelet fibrinogen-thrombin mixtures or platelets gels" between the years of 1975 and 1979 . Up to the article by Marx et al., which started off the insane for such techniques, the development of these techniques continued relatively slowly [2].

Due to the prolonged fibrin gel polymerization of the preparation, Choukroun J et al. produced a self-clogging platelet concentrate in France in 2006 and named it "Platelet-Rich Fibrin (PRF)" (Second Generation)[3]. Later, the "Leukocyte Platelet-Rich Fibrin (L-PRF)" was frequently regarded as an and permitted the definition of novel treatment principles: NTR (Natural Tissue Regeneration).

Advanced and Injectable PRF ,Titanium-prepared platelet-rich fibrin (T-PRF) and "Advanced Fibrin Glue (AFG)," as well as autologous albumin gel and liquid platelet-rich fibrin (Alb-PRF), are additional modified forms of PRF made using different centrifugation techniques or collection tubes. The second most significant change in terminology didn't occur until recent years, when several authors, especially the teams of Dohan Ehrenfest, Everts and Bielecki, noted that these platelet concentrates were also connected to different types of circulating cells, particularly leukocytes.

Classification

Dohan Ehrenfest et al(2009).classification distinguished the products based on the presence of cells (mainly leucocytes) and the architecture of the fibrin.[4]

1. **P-PRP (pure platelet-rich plasma):** The prepared exhibits a low-density fibrin network following activation and is absence of leucocytes**.**
2. **L-PRP (leucocyte- and platelet-rich plasma):** After being activated, the preparations exhibit a low-density fibrin network and include leucocytes**.**

3. **P-PRF (pure platelet-rich fibrin) or P-PRF matrix**: The preparations contain a high-density fibrin network and are absence of leucocytes.
4. **L-PRF (leucocyte- and platelet-rich fibrin):** The prepared exhibits a high-density fibrin network following activation and is presence of leucocytes**.**

Biological Aspect

The PRF production process was created in France by Choukroun et al. It seeks to collect platelets and released cytokines in a fibrin clot. The many proteins found in platelet granules include platelet-specific (such as beta-thromboglobulins) and non-platelet-specific (such as fibronectin, thrombospondin, fibrinogen, and other coagulation, growth promoters, fibrinolysis inhibitors, immunoglobulins, etc.), as well as calcium, serotonin, and other substances. The first stage of healing is stimulated by cell migration and proliferation within the fibrin matrix, which is stimulated by activation and degranulation. These processes help to initiate and support aggregation at the healing site and the release of cytokines (IL-1 beta, IL-6, TNF-alpha)14 and growth factors (TGF beta 1, PDGF, VEGF, and EGF).[5]

Dohan et al. proposed that PRF addition may correct some destructive and noxious excesses during the healing process of wound tissues, thereby decreasing many adverse effects at the inflammatory site naturally caused by surgical act. This could be an immune regulation node with inflammation retro-control abilities and explained the decrease in postoperative infections.[6]

According to Dohan et al., PRF has better healing qualities than PRP and releases growth factors more gradually. The ability of cells to migrate from fibrin scaffold has been observed and demonstrated; some authors have also shown that the PRF acts as a supportive matrix for bone morphogenetic protein reactions. Thrombin converts this protein into an insoluble fibrin, and the polymerized fibrin gel acts as the first cicatricial matrix at the injured site. The slow, natural polymerization that occurs during centrifugation in combination with the physiological thrombin action on the collected autologous fibrinogen are essential for determining the three-dimensional structure of the fibrin network, which will result in a very strong and elastic PRF membrane.[6]

The plasmatic molecule fibrinogen is massively prevalent in both plasma and the platelet alpha granules, and the soluble fibrillary molecule fibrin is an active form of this molecule. It may play a role in platelet aggregation during homeostasis. Since fibrinogen is the end substrate of all coagulation, adding bovine thrombin to enhance the conversion of fibrinogen to fibrin, which is required in PRF. The immune system is supported by PRF, which also aids in hemostasis.[7]

Method for Obtaining Platelet Rich Fibrin (PRF)

Choukouran's PRF, in contrast to Platelet rich fibrin matrix (PRFM) used by Simon et al. which uses additives such as buffered tri-sodium citrate and calcium chloride together with double centrifugation, can be prepared by using a very simple technique which is nothing more than centrifuged blood without any additives, which makes it possible to avoid all blood-derived product reimplantation related restrictions of French law and requires neither anticoagulants nor bovine thrombin.

Anil kumar et al. and Sunitha and Munirathnam [8] reportedly used REMI Laboratories (India) table top for centrifugation (Fig 1,2). A blood sample is taken without anticoagulant in 10 ml tubes and immediately centrifuged at 2700-3000 rpm for 10-12 minutes. The resultant product consists of following three layers: (a) RBC at the bottom, (b) PRF clot in middle and (c) upper

most layer consisting of platelet poor plasma (PPP) (Fig 3,4). The outcome of this technique entirely depends upon the speed of blood collection and transfer to the centrifuge. As the blood sample starts to coagulate almost immediately upon contact with the tube-glass and it takes a minimum of few minutes of centrifugation to concentrate fibrinogen in middle and upper part of the tube, rapid handling is the only way to obtain a clinical usable PRF clot and any delay to collect blood and starts centrifugation may be the cause of failure resulting in polymerisation of fibrin in a diffuse way in the tube with small blood clot without consistency. Driving out the fluids trapped in the fibrin matrix by squeezing the PRF clot between the sterile dry gauze, practitioners will obtain a highly resistant autologous PRF membrane (a highly promising biomaterial) for multiple clinical usage.

Fig.1 Centrifugation Machine Remi Industries

Fig.2 Centrifugation Chamber with test tube

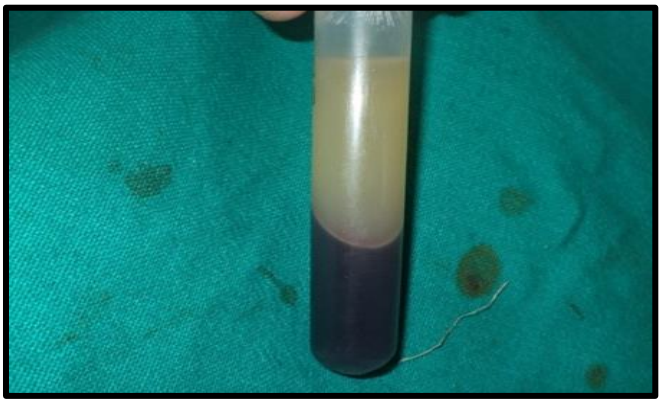

Fig 3: Showing PRF in upper layer and remaining blood in lower layer

Fig 4: PRF For placement

Advantages of PRF

- When compared to PRP, PRF preparation is quicker and less expensive.

- It is also sturdy, flexible, and durable, making it simple to work with. It may be tailored to fit any size and is supple enough to conform to a variety of anatomical locations.
- PRF avoids the procedure of introducing bovine thrombin.
- The fibrin matrix exhibits biological actions like fibrin glues as well as mechanical adhesive properties: It ensures maximum root covering by keeping the flap elevated and stable, promoting neo angiogenesis, minimising necrosis, and preventing shrinkage of the flap.
- The favourable healing is caused by the delayed polymerization. In vivo in humans, the PRF resorption phase lasts 7–11 days. Slow polymerization during PRF processing results in the intrinsic incorporation of platelet cytokines and organic chains in the fibrin meshes and their release during the remodelling of the fibrin matrix. Increase its benefit in soft tissue repair and reduce postoperative complications.[9]

Disadvantages of PRF

- Due to the usage of autologous blood, the quantity is limited. After collection, fast handling is necessary.
- The quickness of blood collection and transmission to the centrifuge is essential to the effectiveness of this approach. In fact, without an anticoagulant, the blood sample coagulates nearly right away when it comes into touch with the glass of the tube. A therapeutically useful PRF clot can only be obtained with swift handling.
- Use of a glass-coated tube is necessary for clot polymerization.
- Clinical expertise is needed to manipulate PRF.
- After preparation, it becomes very difficult to preserve PRF since it shrinks.
- Dehydration causes PRF to shrink and impair its structural integrity, requiring its usage right away.

Use of PRF in Oral and Maxillofacial Surgery

We may anticipate that PRF will have a role in all areas that needs healing and regeneration when we take into account its functions in relation to tissue regeneration.

Extraction socket preservation: According to Choukroun et al., the application of a PRF membrane stimulates the growth of new blood vessels and epithelialization. As a result, this promotes faster wound healing. According to Simon et al study new bone was created under 3 weeks with morphometric tissue, where they planned a socket preservation procedure employing PRF [3].

However, when socket preservation surgery is performed using PRF, the danger of exposure or complications decrease because a blocking membrane is not used, and there is decreased chance for a foreign body reaction and the associated de-crease in bone substance.

Guided bone regeneration with and without implant: According to research by He et al the growth factors of PRF can constantly drive the growth and differentiation of osteoblasts, using mice osteoblasts. PRF are typically employed as a type of membrane when placed on bone grafts. According to Toffler et al., the use of PRF as a membrane accelerates the regeneration of the gingiva and prevents the leakage of bone graft material. [10]

For sustaining pain and edema: PRF is essential for tissue healing. Studies conducted in vitro and in vivo have demonstrated that the application of PRF dramatically improves cell migration. The majority of clinical investigations discovered that the usage of PRF improved wound healing. Clinical studies' findings indicate that using PRF speeds up the recovery of soft tissues, reduces edema and trismus, and improves patient comfort. However, there is little indication that pain

continues, and it typically manifests during the early stages of soft tissue recovery. [11-13]

For Sinus Lift: PRF can be applied as a solitary filler material or as fragments combined with various bone replacements. In the investigations by Mazor and Simonpieri, one or two PRF membranes were employed as the only filler and no grafting material was used to fill the osteotomy window or sinus membrane [14]. Tajima also placed PRF clots as a sole filling material, no membranes. The results of these study showed that all studies were case series without a control group to demonstrate the advantages of using PRF to fill sinus cavities as opposed to a natural blood clot. To verify these therapeutic strategies, more research is required.

Regeneration of Peri-Implant Bone Defects: In normal circumstances, platelet concentrates might not be useful for enhancing Osseointegration, but they might be helpful for regenerating peri-implant bone deficiencies. There aren't many reports on grafts for peri-implant bone abnormalities utilising PRF alone. By applying PRF alone to the bone defect, Lee et al. showed in an animal model that a peri implant defect measuring 3.0 -5.0 mm could be successfully healed. The effects of PRF on regeneration of peri implant bone deficiencies have only been the subject of a few small in vitro research.[15]

PRF in Reconstructive Surgery: PRF used in reconstructive surgery because this accelerate the physiological wound healing; besides, in association with bone grafts, it seems to accelerate new bone formation. Maxillary bone loss frequently requires additional regenerative procedures as a supplement to the tissue regeneration procedures. Dr. Choukroun tested PRF (Platelet Rich Fibrin), a platelet concentrate, for the first time in France. Maxillary atrophy is a clinical disorder that is becoming more prevalent, and its treatment requires patient-specific techniques that allow for minimal intraoperative time and maximal postoperative compliance.[1]

PRF in periodontal Surgery: PRF can be utilised in regenerative periodontal therapy eg.to accelerate the healing of both hard and soft tissue wounds and to encourage periodontal tissue regeneration. The ability of PRF to induce differentiation and proliferation is thought to be the reason for this effect. Additionally, PRF's graft stabilisation, wound sealing, and haemostatic properties are only a few of the many advantages of using it for periodontal therapy.

Dressing agent: These platelet derivatives became even more significant as it was discovered that PRF had a synergistic effect on healing the overlying oral mucosa. VEGF and other growth factors, including cytokines, chemokines, and antimicrobial compounds, are essential for supporting both hard and soft tissue during the PRF process and promoting healing. According to a Toffler study, the study group reported at least four times less dry socket than the control group, when PRP was utilised in their sockets.[16]

PRF in miscellaneous cases: In rare clinical situations like the management of cysts, the repair of sinus membrane perforations, the closure of oroantral fistulae, and osteonecrosis, PRF may also be helpful in conjunction with growth factors. There are numerous ways to sustain OAF. One of them that has just been introduced is PRF. The results of the studies on PRF in OAF closure show that the thickness of soft tissue increased during healing and that wounds heal more quickly. Because it just contains natural substances, less donor site morbidity happens because additional materials are not required. In osteoradionecrosis PRF utilization alone or with other treatment modalities take place in recent years. The theory behind PRF treatment

in cysts is the same as that for improving both soft and hard tissue repair.

Conclusion

An autologous biomaterial called PRF offers the second generation of thrombocyte concentrates. It is widely utilized in oral and maxillofacial surgery as well as other surgical disciplines because it has advantageous biological properties that accelerates both soft tissue and bone healing. The ease of preparation, availability for every patient, and minimal trauma are the main advantages of working with PRF.

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