REVIEW ARTICLE

PLATELET RICH FIBRIN AND IMPLANTS - A REVIEW

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ABSTRACT

Platelet rich fibrin (PRF) is a fibrin matrix in which platelet cytokines, growth factors and cells are trapped and may be released after a certain time and that can serve as a resorbable membrane. Choukroun and his associates were amongst the pioneers for using PRF protocol to improve bone healing in implant dentistry. Autologous PRF is considered to be a healing biomaterial, and presently, studies have shown its application in various disciplines of dentistry.

Keywords: Platelet rich fibrin, implant, fibrin, growth factors.

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INTRODUCTION

In order to restore a dental implant optimally, it must be placed in an ideal anatomic position. However, this is not always possible, since physiological wound healing following tooth extraction, trauma, or pathology, often results in a deficiency of both hard and soft tissue.1Unless augmentation procedures are carried out, placing an implant in these tissue-deficient sites would ultimately compromise the functional and aesthetic results.

Although several different augmentation procedures have been developed, many of them are associated with a number of disadvantages such as increased overall cost, the requirement for a second surgical site and the use of animal derived products. With the aim of minimizing the need for tissue augmentation, several alveolar ridge preservation (ARP) techniques or socket preservation have been developed most of which include the use of foreign graft materials and therefore increase the risk of disease transmission.

Among the great challenges facing clinical research is the development of bioactive surgical additives regulating inflammation and increasing healing. The healing of hard and soft tissue is mediated by a wide range of intra and extracellular events that are regulated by signaling proteins. Understanding the entire process is still incomplete. However, it is known that platelets play a crucial role not only in hemostasis, but also in the wound healing process.[2]

PLATELET CONCENTRATE EVOLUTION

Platelets are anucleate cytoplasmic fragments derived from bone marrow megakaryocytes and measure 2-3 µm in diameter. They contain many granules, few mitochondria and two prominent membrane structures, the surface connected canalicular system and the dense tubular system.

In 1974, platelets regenerative potentiality was introduced, and Ross et al.,were first to describe a growth factor from platelets.[3] Platelet growth factors are a well-known source of healing cytokines, usable for clinical applications. Numerous techniques of autologous platelet concentrates have been developed and applied in implant dentistry. These techniques finally lead to a fibrin and platelet concentrate for topical application.[2]

Although the use of fibrin adhesives is well documented from the past 30 years[4] their use is still controversial due to the complexity in preparation and risk of cross-infection.

After that concentrated platelet-rich plasma (cPRP) was developed with a less complex production protocol. It is prepared from the patient's own blood and is activated by the addition of thrombin and calcium. The structure consists of a three dimensional biocompatible fibrin scaffold with a limited volume of plasma enriched in platelets. When PRP is activated the growth factors and proteins are released to the local environment accelerating postoperative wound healing and tissue repair. The disadvantage of using PRP is that its properties can vary depending on the concentration of platelets, amount of leukocytes, the type of activator used and time of placement of fibrin scaffold after clotting. The presence of bovine thrombin in PRP can result in the development of antibodies to the clotting factors V, XI and thrombin which can adversely affect the coagulation process. All these have led to the generation of a new family of platelet concentrate called platelet-rich fibrin which overcomes many of the limitations of PRP. PRF is a potent autologous regenerative material with many clinical applications in the field of implant dentistry as it accelerates both soft tissue and hard tissue healing[5].

PLATELET-RICH FIBRIN- A NATURAL FIBRIN MATRIX

PRF was first developed in France by Choukrounet al in 2001 to improve bone healing in implant dentistry. PRF represents a new revolutionary step in the platelet gel therapeutic concept.[6]

Leukocyte and platelet-rich fibrin (L-PRF) is a newly developed platelet concentrate that is prepared from the patient's own blood. This

second generation platelet concentrate eliminates the risk associated with the use of bovine thrombin.[7] Production protocol of PRF attempts to accumulate platelets and released cytokines in a fibrin clot. It is nothing more than centrifuged blood without any addition, which makes it possible to avoid all the restrictions of the French law related to blood-derived product reimplantation. This technology requires a PC-02 table centrifuge and a collection kit from Process (Nice, France).

Platelet rich fibrin (PRF) is a fibrin matrix in which platelet cytokines, growth factors and cells are trapped and released after a certain time and that can serve as a resorbable membrane.[3] Autologous PRF or Choukron's Platelet-rich fibrin (PRF) has been recently proposed as an aid for promoting hard and soft tissue regeneration[1]. Fibrin membranes are prepared from the patient's own blood free of any anticoagulant or other artificial biochemical modifications.[1]

PRF is a consistent fibrin biomaterial that releases high amounts of growth factors such as [8] - Transforming growth factor B1 (TGF B-1), Platelet-derived growth factor AB (PDGF-AB), Vascular endothelial growth factor (VEGF), Fibroblast growth factor (FGF), Epidermal growth factor (EGF), Hepatocyte growth factor (HGF), Insulin-like growth factor (IGF), Matrix glycoprotein such as thrombospondin-1.

All of these play a role in replacing lost tissue, resurfacing of the wound and restoring vascular integrity. [8] Compared to other platelet concentrates, L-PRF releases these factors at a sustained rate over a longer period, thereby optimizing wound healing & hemostasis.[8] L-PRF promotes bone growth and maturation, graft stabilization and improves the handling properties of graft materials.[3] The PRF clot forms a strong natural fibrin matrix, which concentrates almost all the platelets and growth factors of the blood harvest and shows a complex architecture as a healing matrix with unique mechanical properties which makes it distinct from other platelet concentrates.[3]

PRF is superior to other platelet concentrates like PRP due to its ease and inexpensive method of preparation and also it does not need any addition of exogenous compounds like bovine thrombin and calcium chloride. It is advantageous than autogenous graft also because an autograft requires a second surgical site and procedure. [8]

Literature quotes several ways in which PRF can be used in implant dentistry:

Hafez et al (2015) used PRF membrane in successfully maintaining particulate autogenous bone graft and achieving primary coverage over immediately placed implants.[8]

Mazor et al (2009) successfully used L-PRF as the only grafting material in a series of sinus augmentation procedures. With this technique, Mazor et al were able to demonstrate that L-PRF could stimulate new bone formation in areas that were previously deficient of the amount of bone required for implant placement[9].

Peck et al (2011) used L-PRF in an ARP procedure to limit ridge resorption after tooth extraction and to maximize the tissue available for ideal implant placement[10].

In a similar 6-year follow-up study, Simonpeiri (2012) et al were able to demonstrate that using L-PRF as a sole grafting agent was a viable long-term option in sinus augmentation procedures.[11]

Del Corso et al (2012) reports the successful use of leukocyte-PRF during immediate post extraction implantation and loading for esthetic replacement of a fractured maxillary central incisor with promising results.[13]

Vijayalakshmi et al (2012) describes application of PRF along with bone graft and guided tissue regeneration (GTR) membrane in the treatment of fenestration defect around an implant.[3]

An In vivo study by Tatullo et al. in 2012 showed the use of PRF and piezo surgery reduced the healing time, favoring optimal bone regeneration. It was possible to achieve good primary stability of endosseous implants, though lacking of functional loading.[13]

Hafez et al (2015) used PRF membrane in successfully maintaining particulate autogenous bone graft and achieving primary coverage over immediately placed implants.8

In vitro studies show expression of osteopontin and osteocalcin and late osteogenic markers and confirmed PRF is useful in stimulating tissue healing and bone regeneration.[14]

PREPARATION OF PRF

The classical technique for PRF preparation was invented by Dr. Choukroun in 2001. It is the current PRF technique authorized by the French Health Ministry in which PRF is prepared without using an anticoagulant during blood harvesting or bovine thrombin during gelling.[6]

The first step is collection of whole venous blood (5ml) in two sterile vacutainer tubes (6ml) without anticoagulant. Vacutainer tubes are placed in a centrifugal machine. This is then centrifuged at 3000rpm for 10minutes after which it settles into three layers: Upper straw-coloredacellular plasma, red-colored lower fraction containing red blood cells and the middle fraction containing the fibrin clot. Upper straw-colored layer is then removed and middle fraction is collected.[6]

ADVANTAGES OF PRF

The clinical benefit of PRF depends on time interval between speed of handling between blood collection and centrifugation as PRF is prepared without any additional anticoagulants. This provides good soft tissue coverage over the immediate implants and it enhanced bone stability and provides complete coverage of the implants and blending to surrounding tissues.[3] PRF technique was easy to perform and released growth factors for at least 7 days. Moreover being an autogenous graft, no adverse immune response was expected.[1]

This technique requires no biochemical handling of blood and shows favorable healing due to slow polymerization.[3]

DRAWBACKS OF PRF

PRF membranes should be used immediately after preparation as it will shrink resulting in dehydration altering the structural integrity of PRF. Dehydration also results in the decreased growth factor content in PRF and leukocyte viability will be adversely affected altering its biologic properties.

PRF when stored in refrigerator can result in risk of bacterial contamination of the membranes. These limitations with the use of PRF can be circumvented by sticking onto a standard protocol for preparation and preservation.

CONCLUSION

PRF as a biomaterial acts by releasing high-concentration growth factors to the wound site, thereby stimulating healing and new bone formation.

Unlike other ARP procedures, the use of L-PRF is a simple method that requires minimal cost and reduces the need for specialized grafting material. Because it is a completely autologous product, the risk of disease transmission and graft rejection does not arise.

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