ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 07, Issue, 07, pp.14056-14059, July, 2017

ORIGINAL RESEARCH ARTICLE   Open Access

PLATELET-RICH FIBRIN IN MAXILLOFACIAL SURGERY- REVIEW OF LITERATURE

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ARTICLE INFO

Article History:
Received 27th April, 2017
Received in revised form
09th May, 2017
Accepted 16th June, 2017
Published online 31st July, 2017

Key Words:
Platelet Rich Fibrin,
Growth Factors,
Platelet Rich Plasma

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ABSTRACT

PRF technique was developed by Choukroun *et al* in 2001. Platelet Rich Fibrin (PRF) is autologous biomaterial which is the second-generation platelet concentrate. PRF has a favourable biological property that accelerate healing of soft tissue, and bone, giving a wide range of applications found in oral and maxillofacial surgery and other surgical fields. It is used to accelerate the healing of soft and hard tissue. In contrast to the PRP, the PRF is composed of autologous fibrin matrix in which a large amount of platelets and their growth factors are embedded. PRF-graft is used in augmentative techniques residual bone defects, alone or in combination with biomaterials. PRF accelerates the healing of soft tissue and reduces the possibility of dehiscence and exposure of the membrane.

Citation: Dr. Sujeesh Koshy, Dr. Eapen Thomas, Dr. Ravi Rajan Areekkal and Dr. Akhilesh Prathap, 2017. "Platelet-rich fibrin in maxillofacial surgery- review of literature", *International Journal of Development Research*, 7, (07), 14056-14059.

INTRODUCTION

Platelet-rich fibrin (PRF) is an autologous biomaterial which presents the second generation of thrombocyte concentrates. It possesses favourable biological characteristics which accelerate both soft tissue and bone healing, due to which fact it is extensively used in oral and maxillofacial surgery, as well as other surgical specialties (Choukroun *et al*., 2006; Choukroun *et al*., 2006). The greatest benefits of working with PRF are simple preparation, availability for every patient and minimal trauma. Several works related to the issue of the use of PRP and PRF in periodontal, oral, maxillofacial and plastic surgery as well as in otorhinolaryngology have been published (Dohan *et al*., 2011)**.** Platelet Rich Plasma or PRP and Platelet Rich Fibrin or PRF are autologous preparations which are produced after the patient's blood sample is placed in a centrifuge and they consist of thrombocytes and plasma.

A human blood clot consists of approximately 95% of erythrocytes, 5% of thrombocytes and less than 1% of leukocytes. Contrary to that, PRP/PRF clot consists of 4% of erythrocytes, 95% of thrombocytes and 1% of leukocytes (Nenad Tanasković, 2016). A recent classification of the different platelet concentrates divided them into four different categories depending on the leukocytes and fibrin content: pure platelet-rich plasma (P-PRP), such as cell separator PRP, Vivostat PRF or Anitua's PRGF; leucocyte- and platelet-rich plasma (L-PRP), such as Curasan, Regen, Plateltex, SmartPReP, PCCS, Magellan or GPS PRP; pure plaletetrich fibrin (P-PRF), such as Fibrinet and leucocyte- and platelet-rich fibrin (L-PRF), such as Choukroun's PRF. This classification allows us to analyse the successes and failures that have occurred so far in oral surgery, and direct research towards further applications of these technologies (Bielecki *et al*., 2012 ; Bielecki *et al*., 2012 ; Cieslik-Bielecka *et al*., 2012).

What is Fibrin?

Fibrin is the activated form of a plasmatic molecule called fibrinogen (Mosesson, 2001). This soluble fibrillary molecule is massively present both in plasma and in the platelet a-granules and plays a determining role in platelet aggregation during hemostasis. It is transformed into a kind of biologic glue capable of consolidating the initial platelet cluster, thus constituting a protective wall along vascular breaches during coagulation. In fact, fibrinogen is the final substrate of all coagulation reactions. Being a soluble protein, fibrinogen is transformed into an insoluble fibrin by thrombin while the polymerized fibrin gel constitutes the first cicatricial matrix of the injured site (Clark, 2001; Collen *et al*., 1998; van Hinsbergh *et al*., 2001). PRF technique was developed in 2001 by Choukroun *et al*., and it presents the second generation of autologous thrombocyte concentrate used for accelerating the soft and hard tissue healing. Contrary to PRP, PRF consists of the autologous fibrin matrix, into which a large amount of thrombocytes and their growth factors were built in. During the period of 7-11 days after the application, the fibrin net is degraded, while the growth factors are progressively released. With PRP there is no fibrin net and that is why the growth factors are released only once and in an uncontrolled manner during the PRP preparation and application period. Due to that, releasing the growth factor only once directly influences only the initial stadium of the wound healing process, lacking the extended effect which is important for the soft tissue and bone regeneration. Because of that extended effect, fibrin net plays an important role in the regenerative characteristics of PRF.

PRF preparation

PRF is the material produced through the centrifugation process of the patient's blood, without using any extra additives. Due to that fact, no anticoagulants or bovine thrombin are necessary for its preparation. PRF protocol is simple: after veinpuncture, 20–60 ml of blood are taken and put in several 9 ml test tubes without anticoagulants, and it immediately goes through the centrifugation process at 3000 per minute, for fourteen minutes (Image1 and 2). Due to the absence of anticoagulants, the coagulation cascade is initiated; fibrinogen changes into fibrin which is multiply cross-linked, creating a dense fibrin net. In that way fibrin clot containing a half of leucocytes and almost all active thrombocytes present in the collected blood sample is created. For the PRF preparation it is important how quickly the blood is collected and how soon the centrifugation process begins.

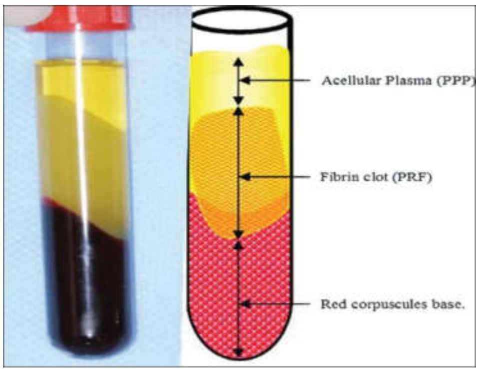

Image 1

Image 2

PRF application

PRF and oral surgery: The regenerative medicine techniques are applied in dentistry to restore the bone loss: the PRF was tested for the first time in France by Dr. Choukroun. Bone regenerative techniques include sinus lift for implant placement, which is considered one of the most predictable procedures for augmenting bone maxilla. Several approaches have been developed and are currently used to assess the relevance of simultaneous sinus lift and implantation with L-PRF (Choukroun's technique) as sole subsinus filling material. The use of L-PRF as sole filling material during simultaneous sinus lift and implantation seems to be a reliable surgical option promoting natural bone regeneration (Simonpieri *et al*., 2011; Del Corso *et al*., 2012; Simonpieri *et al*., 2009; Del Corso *et al*., 2012; Mazor *et al*., 2009). PRF-based membranes have been used for covering the alveolar ridge augmentation side in several in vivo studies. A study has compared the use of PRF with the commonly used collagen membrane Bio-Gide as scaffolds for periosteal tissue engineering. PRF appears to be superior to collagen (Bio-Gide) as a scaffold for human periosteal cell proliferation. PRF membranes are also demonstrated to be suitable for in vitro cultivation of periosteal cells for bone tissue engineering (Gassling *et al*., 2017).

Advantages of PRF alone include less surgical time, elimination of techniques and potential healing difficulties associated with membranes, and less resorption during healing, as compared to guided bone regeneration procedures (Simon *et al*., 2011; Bambal *et al*., 2012). PRF membrane acts as a mechanical and biological protection of the Schneiderian membrane, protecting it from perforations which can occur while pushing in the graft granules into the sinus cavity. PRF membrane can be used for repairing the existing perforations, while growth factors can accelerate its healing. Besides that, the bone graft around the top of the implant can be stabilized.
PRF membrane can be applied instead of the resorbable collagen membrane through the lateral window in order to prevent the invagination of the mucogingival tissue. It is beneficial because of being economically acceptable as an autologous biomaterial and because of being biologically active since it releases growth factors which accelerate soft tissue and bone healing. Another study analysed from a clinical and histological point of view, the potential use of PRF with the piezosurgery associated with deprotenised bovine bone (Bio-oss) as graft material in the augmentation of the maxillary sinus in case of severe bone atrophy comparing with a control group in which only Bio-oss was used. The use of PRF reduced healing times by promoting optimum bone regeneration. At 106 days was observed a good primary stability of endoosseus implants (Tatullo *et al*., 2012). PRF clot can be chopped up into smaller pieces by using scissors and added to the graft which will better interconnect the graft

into a whole, stimulate the neoangiogenesis, proliferation and chemotaxis of the osteoprogenitor cells. Contrary to commercial resorptive or nonresorptive membranes, PRF membrane is economically more acceptable, reducing the patient's expenses. PRF can be used on its own in alveolar preservation techniques in order to preserve the dimensions and accelerate bone and soft tissue healing. After the four-month healing period, post-extraction alveoli are filled with a mature bone, without any soft tissue invagination. The dimensions of the alveolar ridges are almost preserved, with the minimal ridge width loss of 7.38% and height loss of 7.13%. In the studies in which resorbable membranes and bone grafts were used, resorption values of 17.79% of height and 11.59% of width were identified, in some studies even higher.

PRF for facial plastic surgery: It's known that platelets play a role in homeostasis, but in recent years has been studied as they improve wound healing. It was demonstrated that platelet concentrates accelerate wound healing. The use of a new preparation, platelet- rich fibrin matrix (PRFM) for plastic surgery of the face, such as volume augmentation, fat transfer supplementation, represent a new technique in aesthetic surgery[31]. In fact injection of PRFM into the deep dermis and subdermis of the skin stimulates a number of cellular changes that can be harnessed for use (Sclafani *et al*., 2012). The PRF produces an autologous and natural platelet concentrate that releases growth factors and stimulates the regeneration of the surrounding tissues for cosmetic applications (Sclafani *et al*., 2009). Fat grafts have always been induced neoangiogenesis. A study was designed to compare the efficacy of first- and second-generation PRPs combined with a fat graft during facial lipostructure surgery. The first comparative study highlights the efficacy of the platelets concentrates for adipocyte grafts. The results suggest that the combination of fat grafts and PRF is more effective than the combination of fat and PRP for facial lipostructure surgery (Keyhan *et al*., 2013).

Conclusion

The use of PRF allowed the reconstruction of the alveolar ridges at the gingival and bone levels. Due to its favourable biological characteristics which accelerate both soft tissue and bone healing it is used in oral and maxillofacial surgery, as well as other surgical specialties. PRF graft is used in augmentative techniques of bone defects, on its own or in combination with biomaterial. The greatest benefit of working with PRF is the simplicity of the preparation development, availability for every patient and minimal trauma. PRF can be divided into two categories, depending on the leukocyte content: L-PRF and P-PRF. As a general conclusion it can be said that we live in a period of transition in the use of PRP and PRF in oral and maxillofacial surgery.

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