Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2020, 9(8): 20-24

Platelet Rich Fibrin and its Relevance in Oral and Maxillofacial Surgery

Padmaraj Hegde, Vikram Shetty, Ashish Rai and Saiswarup Badrinath*

Nitte (Deemed to be University), AB Shetty Memorial Institute of Dental Sciences (ABSMIDS), Department of Oral and Maxillofacial Surgery, Mangalore, India

**Corresponding e-mail: drsaiswarupb@gmail.com*

ABSTRACT

Platelets have a major role to play in cessation of bleeding and hemostasis and the studies in the recent past have led to a better understanding in identifying their functions in regulation of immune response, wound healing, osteogenesis, and angiogenesis and is a subject of great interest. It has been proved that plalelets play a crucial role in the formation of blood clot and release growth factors, thereby promoting and maintaining the process of wound healing. Platelet rich fibrin (PRF) is product derived of platelets from one's blood and when used either in its gel or liquid form, it enhances tissue repair. In the recent past, the PRF has been used extensively in various oral and maxillofacial surgical procedures successfully. We conducted a narrative review over the literature using electronic databases as; PUBMED, SCOPUS, Google Scholar studies involving data on platelet rich fibrin and its application in Oral and Maxillofacial Surgery. We reviewed the reference lists of included studies to find more relevant articles for additional evidence. It has been observed that PRF enhances the recovery and contributes to the post-operative healing and general well-being.

Keywords: Platelets, Hemostasis, Platelet rich fibrin, Blood

INTRODUCTION

Platelets have a major role to play in cessation of bleeding and in hemostasis, but the studies in the past decade have led to a better understanding in identifying their functions in regulation of immune response, wound healing, osteogenesis, and angiogenesis and has become a subject of interest [1-3]. The functional components are the reason which has enabled its enhanced properties. Megakaryocytes produce platelets as anucleated cells [4]. Plalelets play a crucial role in the formation of blood clot and release growth factors, thereby promoting and maintaining the process of wound healing [5]. On activation, a variety of growth factors are released which have an antagonistic effect on tissue repair. Platelet-rich plasma (PRP) are concentrates of platelets obtained in small volumes of plasma and platelets are derived from blood. Used either in its gel or liquid form, PRP enhances tissue repair. PRP and Platelet-rich fibrin (PRF) are autologous platelet concentrates which is extracted from an individual's blood. PRF is a second generation natural fibrin-based biomaterial derived out of anticoagulant-free blood harvest without use of any additive artificial biochemical product which helps in attaining fibrin that is enriched by platelets and growth factors.

We conducted a narrative review over the literature using electronic databases as; PUBMED, SCOPUS, Google Scholar studies involving data on platelet rich fibrin and its application in Oral and Maxillofacial Surgery. We reviewed the reference lists of included studies to find more relevant articles for additional evidence.

Biologic Mechanisms of PRF

Platelets are discoidal and anuclear structures formed from megakaryocytes in bone marrow. Their cytoplasm has innumerable granules which are secreted during activation. Platelets have a lifespan of 8 to 10 days. These granules contain a variety of proteins-platelet specific proteins like β-thromboglobulin or non-platelet specific like fibronectin, thrombospondin, fibrinogen and many other factors of fibrinolysis inhibitors, fibronectin, growth promoters, other factors of coagulation among others. The platelet membrane is composed of a phospholipid double layer where receptors are inserted like collagen, thrombin among others. Activation is the essential in initiation and supporting hemostasis since aggregation occurs on injured site and leads to interaction of coagulation mechanisms. However,

degranulation launches the initial stages of healing with the release of cytokines and its ability to stimulate proliferation and cell migration [6].

Platelet Cytokines

PDGFs (Stimulant of mesenchymatous lineages): PDGFs (Platelet-derived growth factors) are important regulators for proliferation, survival of mesenchymatous cell lineages migration, and proliferation. They possess the unique ability of inducing stimulation easily by inhibiting the development of these cells with their wide distribution of specific receptors.

For all tissue remodelling mechanisms and the embryonic development, the position of regulation node plays a crucial role. PDGFs, therefore, play an important role in mechanisms related to the physiological cicatrisation, the etiopathogenesis of atherosclerosis and many other fibroproliferative disease such as neoplasia and pulmonary and renal fibrosis [7-10].

TGFβ-1 (Fibrosis agent): Transforming growth factor β (TGF-β) is a vast family involving more than 30 entities. The prototype molecule that is often referred to as ''the'' TGFβ is TGFβ-1 in truest sense. It is the most extensively secreted isoform, not only in the platelet α-granules, but also in general during intercellular dialog [11].

The IGF axis (Cell-protective agent): Insulin-like growth factors (IGFs) I and II are positive regulators of proliferation and differentiation for most cell types, which inadvertently include tumor cells, which utilise the IGF system to enhance their survival rate [12]. Though these cytokines are cell multiplication mediators, they mainly contribute to apoptosis regulation, by initiating survival signals protecting cells from various matricial apoptotic stimuli [13]. Interestingly, IGFs are massively present in circulation of blood, even though they are released during platelet degranulation.

Preparation of PRF

Credit of discovery of PRF goes to Choukroun, et al. [14] who used it initially for specific use in oral and maxillofacial. The described technique required no anticoagulant. PRF is centrifuged blood without any additions, which makes its use ethically feasible. The PRF extraction process required table centrifuge and an arterial blood collection kit. The protocol is simple: blood sample is taken without addition of any anticoagulant in 10 mL tubes and is immediately centrifuged at 3000 rpm for minutes (approximately 400 g) [15,16].

Uses of PRF in Oral and Maxillofacial Surgery

Sinus lift: A sinus floor elevation is a technique aimed at increasing the residual bone height of the posterior edentulous maxilla. Boyne and James [17] in the 1980s performed sinus augmentation with autogenous bone grafts by the lateral window technique which was later developed by Tatum, et al. [18]. PRF has been effectively used in sinus lift procedures in two ways, either as fragments mixed with different bone substitutes such as autogenous bone, graft, xenogeneic, allogeneic, and some artificial materials or as a sole filling material [19].

Improvement of nasolabial folds: Dermal augmentation in the facial region remains as one of the most commonly performed aesthetic facial procedure and research in pursuit of better aesthetic results continues to grow. Many exogenous filler materials depend on an autologous fibrotic response for volume augmentation. Scalfani, et al. [20] performed a series of cases where the efficacy of a single injection of autologous Platelet-rich fibrin matrix (PRFM) for the correction of deep nasolabial folds in 15 subjects was evaluated and he concluded that PRFM can provide significant long-term diminution of deep NLFs without the use of foreign materials. He opined that PRFM holds significant potential for stimulated dermal augmentation.

Regeneration of peri-implant bone defects: Platelet concentrates is considered of not much relevance to improve osseo-integration in normal conditions, but they are effective for the regeneration of peri-implant bone defects [21]. Three specific situations can be encountered:

1) Bone defects around the implant, the peri-implantitis-also called deosseo-integration

2) Bone defects caused during implant placement, where the initial bone volume for implantation is not large enough for implant support [21]

3) Bone defects seen in an immediate post-avulsion or post-extraction implantation procedure [22]

In literature, a few reports have been found about a graft using PRF alone for peri-implant bone defects [22]. Lee et al. demonstrated, in animal model, that peri-implant defect sized 3.0 × 5.0 mm (width × length) was successfully repaired by the application of PRF alone in the bony defect [23]. However, only limited in vitro studies have been carried out on the effects of PRF on regeneration of peri-implant bone defects.

Aesthetic surgeries: To evaluate the clinical safety and efficacy of the use of autologous Platelet-rich fibrin matrix (PRFM) in facial plastic surgery, Sclafani, et al. [24] performed a series of aesthetic enhancing surgeries. The author followed up the medical charts of 50 patients with at least 3 months of follow up who were treated with PRFM for aesthetic purposes and these patients were reviewed for patient satisfaction, objective clinical results, and adverse events. Most patients were treated for deep nasolabial folds, while the volume-depleted midface region, superficial rhytids, and acne scars were other commonly treated areas. The patients underwent an average of 1.6 treatments (range: 1-5 treatments) and the authors found no patients with any swelling lasting longer than 5 days, and most noted only minimal bruising lasting for 1 to 3 days. Most patients were satisfied with the results of the treatment [24]. The author concluded that "autologous PRFM treatment is a well-tolerated, excellent choice for use in the face."

In pursuit to evaluate the use of PRF, Sclafani, et al. [25] subsequently tried to evaluate the histological changes induced in human skin by injection of autologous Platelet rich fibrin matrix (PRFM). Four healthy adult volunteered to be included in the study. PRFM was prepared from 9 mL of arterial blood and injected into the deep dermis and immediate subdermis of the upper arms of subjects. Full thickness skin biopsy specimens were taken from these areas over a 10-week period, and the specimens were histologically evaluated. The author opined that injection of PRFM into the deep dermis and subdermis of the skin stimulates a number of cellular changes that can be harnessed for use. Coupled with prior in vitro and in vivo studies, the author concluded that these results provided a much clearer picture of the cellular effects of PRFM and its potential uses in facial plastic surgery.

Nerve regeneration: Neurosensory disturbance (NSD) is a frequently concomitant following Bilateral sagittal split osteotomy (BSSO) surgery. Tabrizi, et al. [26] studied the effect of Platelet-rich fibrin (PRF) on nerve recovery following BSSO. PRFM was applied to one side after the osteotomy and before fixation in the twenty-one patients included in the study. The contralateral side served as the control group. Post-operative assessment was done at 6 and 12 months using two-point discrimination test and a brush directional stroke test and self-reported paresthesia was assessed using a 10-point Visual analogue scale (VAS). The author concluded that PRF has potentially enhanced the recovery of paresthesia post BSSO.

Surgical therapy of medication-related osteonecrosis of the jaw: Szofia Szentpeteri, et al. [27] examined the effect of the membranous form of plate PRF on patients with medication-related osteonecrosis of the jaw. The author studies 101 patients who underwent an operation because of second or third-stage osteonecrosis of the jaw induced by anti-resorptive therapy. The author opined that PRF membrane supports healing and reduced relapse rates. PRFM prevents the occurrence of wound healing complications. PRF membrane can be recommended as a supplement to surgical therapy of the disease.

CONCLUSION

Use of PRFM is an autologous treatment which has the potential to stimulate natural biologic processes to achieve better aesthetic and functional results in oral and maxillofacial surgery. This process essentially replicates the wound-healing process, but lack of erythrocytes may contribute in bypassing the inflammatory stage. This is hypothesized to lead to an earlier initiation of the proliferative phase, which explains the relatively early improvements. Since formation of PRF utilizes the one's own blood, it eliminates risk of transmission of diseases or allergies. Choukroun's protocol is simple and inexpensive technique for successful formation of PRF membrane. PRFM protects the surgical site and enhances soft tissue healing. It acts as a biological connector between different graft elements and as a matrix that supports neo-angiogenesis, capturing stem cells and migration of osteo-progenitor cells to the center of the graft. Currently, PRF seems to be an accepted minimally invasive technique with minimal risks, good clinical results and provides surgeons with untapped opportunities to get better post-operative results.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

[1] Weyrich, A. S., S. Lindemann, and G. A. Zimmerman. "The evolving role of platelets in inflammation." *Journal of Thrombosis and Haemostasis,* Vol. 1, No. 9, 2003, pp. 1897-905.

[2] Nurden, Alan T., et al. "Platelets and wound healing." *Frontiers in Bioscience: A Journal and Virtual Library,* Vol. 13, 2008, pp. 3532-48.

[3] Nurden, Alan T. "Platelets, inflammation and tissue regeneration." *Thrombosis and Haemostasis,* Vol. 105, No. 6, 2011, pp. S13-33.

[4] Italiano Jr, J. E., and R. A. Shivdasani. "Megakaryocytes and beyond: The birth of platelets." *Journal of Thrombosis and Haemostasis,* Vol. 1, No. 6, 2003, pp. 1174-82.

[5] Lucarelli, E., et al. "A recently developed bifacial platelet-rich fibrin matrix." *European Cells and Materials,* Vol. 20, No. 1, 2010, pp. 13-23.

[6] Lauritano, D., et al. "Is platelet-rich fibrin really useful in oral and maxillofacial surgery? Lights and shadows of this new technique." *Annals of Oral and Maxillofacial Surgery,* Vol. 1, No. 3, 2013, p. 25.

[7] Rosenkranz, Stephan, and Andrius Kazlauskas. "Evidence for distinct signaling properties and biological responses induced by the PDGF receptor α and β subtypes." *Growth Factors,* Vol. 16, No. 3, 1999, pp. 201-16.

[8] Lucarelli, Enrico, et al. "Platelet-derived growth factors enhance proliferation of human stromal stem cells." *Biomaterials,* Vol. 24, No. 18, 2003, pp. 3095-100.

[9] Heldin, Carl-Henrik. "Simultaneous induction of stimulatory and inhibitory signals by PDGF." *FEBS Letters,* Vol. 410, No. 1, 1997, pp. 17-21.

[10] Yu, Jiu-Hong, Carolyn Ustach, and Hyeong-Reh ChoiKim. "Platelet-derived growth factor signaling and human cancer." *BMB Reports,* Vol. 36, No. 1, 2003, pp. 49-59.

[11] Schliephake, H. "Bone growth factors in maxillofacial skeletal reconstruction." *International Journal of Oral and Maxillofacial Surgery,* Vol. 31, No. 5, 2002, pp. 469-84.

[12] Winkler, R., et al. "The IGF system: Summary and recent data." *Revue Medicale de Liege,* Vol. 55, No. 7, 2000, pp. 725-39.

[13] Butt, Alison J., Sue M. Firth, and Robert C. Baxter. "The IGF axis and programmed cell death." *Immunology and Cell Biology,* Vol. 77, No. 3, 1999, pp. 256-62.

[14] Choukroun, J., et al. "Uneopportunite´ enparo-implantologie: Le PRF." *Implantodontie,* Vol. 42, 2000, pp. 55-62.

[15] Dohan, David M., et al. "Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part I: technological concepts and evolution." *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology,* Vol. 101, No. 3, 2006, pp. e37-44.

[16] Dohan, David M., et al. "Platelet-rich fibrin (PRF): A second-generation platelet concentrate. Part II: Platelet-related biologic features." *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology,* Vol. 101, No. 3, 2006, pp. e45-50.

[17] Boyne, Philip J. "Grafting of the maxillary sinus floor with autogenous marrow and bone." *Oral Surgery,* Vol. 38, 1980, pp. 613-6.

[18] Tatum Jr, O. H., et al. "Sinus augmentation. Rationale, development, long-term results." *The New York State Dental Journal,* Vol. 59, No. 5, 1993, pp. 43-8.

[19] Hamdoun, R., O. K. Ennibi, and Z. Ismaili. "PRF in oral surgery: A literature review." *Journal of Medical Implants and Surgery,* Vol. 1, No. 2, 2016, p. 100.

[20] Sclafani, Anthony P. "Platelet-rich fibrin matrix for improvement of deep nasolabial folds." *Journal of Cosmetic Dermatology,* Vol. 9, No. 1, 2010, pp. 66-71.

[21] Mouhyi, Jaafar, David M. Dohan Ehrenfest, and Tomas Albrektsson. "The peri-implantitis: Implant surfaces, microstructure, and physicochemical aspects." *Clinical Implant Dentistry and Related Research,* Vol. 14, No. 2, 2012, pp. 170-83.

[22] Jang, Eun-Sik, et al. "Restoration of peri-implant defects in immediate implant installations by Choukroun platelet-rich fibrin and silk fibroin powder combination graft." *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology,* Vol. 109, No. 6, 2010, pp. 831-6.

[23] Lee, Jong-Won, et al. "Restoration of a peri-implant defect by platelet-rich fibrin." *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology,* Vol. 113, No. 4, 2012, pp. 459-63.

[24] Sclafani, Anthony P. "Safety, efficacy, and utility of platelet-rich fibrin matrix in facial plastic surgery." *Archives of Facial Plastic Surgery,* Vol. 13, No. 4, 2011, pp. 247-51.

[25] Sclafani, Anthony P., and Steven A. McCormick. "Induction of dermal collagenesis, angiogenesis, and adipogenesis in human skin by injection of platelet-rich fibrin matrix." *Archives of Facial Plastic Surgery,* Vol. 14, No. 2, 2012, pp. 132-6.

[26] Tabrizi, R., et al. "Can platelet-rich fibrin accelerate neurosensory recovery following sagittal split osteotomy? A double-blind, split-mouth, randomized clinical trial." *International Journal of Oral and Maxillofacial Surgery,* Vol. 47, No. 8, 2018, pp. 1011-4.

[27] Szentpeteri, Szofia, et al. "The effect of platelet-rich fibrin membrane in surgical therapy of medication-related osteonecrosis of the jaw." *Journal of Oral and Maxillofacial Surgery,* Vol. 78, No. 5, 2020, pp. 738-48.