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Platelet rich fibrin: A general review

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Abstract

To evaluate the literature regarding the effectiveness of autologous platelet rich fibrin (PRF) in periodontal hard tissue regeneration. The use of PRF in periodontal applications for its inexpensive and autologous material are promising. Each of these studies assessed indicated improved periodontal outcomes with the adjunctive use of PRF in Open flap debridement. All studies presented shows statistically significant differences for Intra bony defects, as measured on standardized radiographs read by computer aided software. After assessing the strength and validity of the available studies, the results presented were only in a moderately conclusive manner. Larger, longer termed longitudinal, multicentred randomized controlled clinical trials are required, which employ strong sampling techniques are needed to determine the effects of PRF on the regeneration on periodontal hard tissue.

Once more of these studies are available, a systematic review should be conducted. Ongoing research together with review type publications will help clinicians form an evidenced based decision on the potential of PRF in regeneration of periodontal hard tissue.

Keywords: Platelet rich fibrin, Platelet concentrates, Regeneration, Tissue engineering, Growth factors

Introduction

Regeneration is the reconstitution or reproduction of a lost or injured part of the body in such a way that the architecture and function of the injured tissues are completely restored. To restore the structure and function of the periodontium is the main goal of regenerative periodontal therapy. Periodontal regeneration requires an orchestrated sequence of biologic events such as cell migration, adherence, growth and differentiation to have the potential to increase the success and predictability of periodontal regenerative procedures. Numerous growth factors, alone or in combination, have been tested for periodontal regeneration in animal experiments. Among these are insulin-like growth factors, fibroblast growth factors, epidermal growth factor, platelet-derived growth factors (PDGF), vascular Rich Fibrin and endothelial growth factor, parathyroid hormone, transforming growth factor-b and bone morphogenetic proteins [1].

Platelets derived from the megakaryocytes of the bone marrow form an intracellular storage pool of proteins like insulin-like growth factor, platelet-derived growth factor and transforming growth factor that are vital to wound healing [2].

Platelet concentrates obtained from plasma solutions can be used for local healing during surgeries [3, 4]. To obtain highly concentrated PDGF, preparation of PRP by sequestrating and concentrating platelets in plasma is needed. Various studies have reported on the use of PRP in treatment of periodontal intra bony defects either alone or in combination with grafts or in treatment of furcation defects [1].

Platelet-rich plasma (PRP) is a fraction of plasma that provides a rich source of growth factors and may enhance the initial stabilization and revascularization of the flap and grafts [5]. Since PRP is a liquid nature, difficult in handling and the clinical potential for bone regeneration with PRP is having a very short release of growth factor profile. These led to the emergence of a second-generation platelet concentrate termed PRF which is fabricated from 100% autologous sources [6, 7].

PRF has multiple applications in implant and dent alveolar surgery. PRF may be used alone or combined with bone grafts as a

socket preservation material and for treatment of periodontal bony defects [8, 9]. It is used to enhance tissue healing and to minimize postoperative inflammatory complications after mandibular third molar extractions [10, 11, 12].

Very little or no data was available directly investigating the effects of PRF on soft tissue healing, new bone formation in GBR, horizontal/vertical bone augmentation procedures, treatment of peri-implantitis, and sinus lifting procedures [13]. This review specifically focuses on effectiveness of PRF on regeneration in periodontics.

What is PRF?

Choukroun, in the year 2000, defined Platelet-rich fibrin (PRF), a second generation platelet concentrate, consists of a group of glycanic chains, cytokines and glycoproteins within a polymerized fibrin network [14].

Classification

By Dohan Ehrenfest *et al*. classified platelet concentrates as follows, depending on their leucocyte and fibrin content:

1. Pure platelet-rich plasma (P-PRP),
2. Leucocyte- and platelet-rich plasma (L-PRP),
3. Pure plaletet- rich fibrin (P-PRF) and
4. Leucocyte and platelet-rich fibrin (L-PRF), such as Choukroun's PRF [15].

Structure

PRF has a three-dimensional network structure which is both flexible and durable. It is rich in fibrin, platelets, white blood cells, growth factors, cytokines, and other components conducive to tissue repair.[16] These cytokines include interleukin-1, -4 and -6, interleukin (IL)-1β, and other growth factors like platelet-derived growth factor, (TGF-β1), vascular endothelial growth factor and epithelial growth factor.[17] These components can be effective in regulating the proliferation, differentiation and apoptosis of repair-related cells, and subsequently regulating and promoting tissue repair.[18]

Preparation of PRF

Based on the protocol developed by Choukroun *et al*, the PRF is prepared as follows. Just prior to surgery, intravenous blood is collected in three 10-ml sterile tubes without anticoagulant and immediately centrifuged in centrifugation machine at 3,000 revolutions (Approximately 400 g) per minute for 10 minutes. The centrifugation of blood immediately post collection allows a fibrin clot in the middle, between the RBC at the bottom and cellular plasma which is a platelet poor plasma at the top. PRF can be easily separated from red corpuscles base using a sterile tweezers and scissors just after removal of PPP and then transferred onto a sterile compress. On squeezing the serum from the PRF clot, a stable fibrin membrane is obtained. Fig 1 shows the layers of PRF [19].

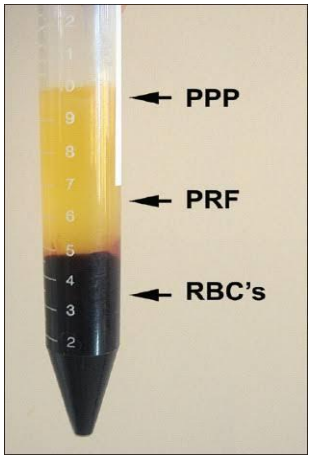

Fig 1: Layers of PRF

PRP Preparation

Based on Lekovic *et al*'s protocol PRP is prepared as follows. 20ml blood is drawn from the antecubital vein on the day of surgery. Blood collection is done in sterile plastic test tubes that contained Citrate Phosphate Dextrose- Adenine¶ as an anticoagulant in the ratio of 2.8 ml to 20 ml of blood. The blood containing test tubes were shaken gently to enhance complete mixing of the blood with the anticoagulant. Then it was kept at room temperature for a minimum of 45 min. to minimize the complement activity. Later, blood-containing test tubes were centrifuged using a refrigerated centrifugal machine at 3000 rpm for 10 min., which resulted in separation of the top layer of Platelet-poor plasma (PPP), the bottom red blood cells (RBC) and middle PRP because of differential densities. Two to three millilitres of the top layer corresponding to the PPP was aspirated with a pipette and collected in a separate sterile plastic tube. The same aspirated PPP was used to obtain the autologous thrombin at the time of application. The PRP was collected in conjunction with the top 1–2mm of the RBC fraction because the latter is also rich in newly synthesized platelets [20].

Table 1: Advantages of PRF over PRP [21]

	PRF	PRP
1.	Simplified and cost effective process and use of bovine thrombin and anticoagulants not required	Concern over the use of bovine thrombin, the fact that bovine thrombin has been associated with development of antibodies to clotting factors V,XI and thrombin, which had occasionally lead to life threatening coagulopathies.
2.	No biochemical handling of blood	Requires the need of anti-coagulants
3.	Favorable healing due to slow polymerization	Slower healing compared to PRF
4.	More efficient cell migration and proliferation	Lack of uniformity in PRP preparation protocol as different platelet concentration has different storage time.
5.	It has supportive effect on immune system	Addition of thrombin for conversion of fibrinogen to fibrin in PRP leads to drastic activation and rapid polymerization leading to dense network of monofibers poor in cytokine concentration
6.	Maximum concentration of the cytokines	Lesser cytokine than PRF

Biologic aspects of PRF

PRF consists of platelets, leukocytes, cytokines, and stem cells within a fibrin matrix. The leukocytes appear to strongly influence the release of growth factors, immune regulation,

anti-infectious activities, and matrix remodelling during healing. It has been shown that PRF slowly releases growth factors-such as platelet derived growth factor-AB, transforming growth factor-1b, and glycoproteins, particularly fibronectin and vitronectin, along with vascular endothelial growth factor for more than seven days. These growth factors are thought to stimulate bone regeneration through osteoblastic proliferation and differentiation [22].

PRF, a second generation platelet concentrate holds several advantages over first generation platelet concentrate materials. It is inexpensive and relatively simple to produce chair side. Moreover, it is completely autologous. Unlike the first generation platelet concentrates, it requires no exogenous additives such as bovine thrombin or calcium chloride. It also has the advantage of being able to be compressed, and formed into a membrane and it has been shown to release growth factors over a period of at least seven days [23, 24].

Clinical Implications

The use of PRF in clinical practice is quite practical because the fabrication of PRF is a simple, fast, and cost effective technique and it is also less expensive to the patient than other methods such as other platelet concentrates or bone grafting. Although the method for preparing PRF is relatively simple, expert training is required. PRF is a complex living biomaterial, and care must be taken in the preparation and conservation of the material. The success of this technique is dependent on the speed of collection of the venous blood specimen and on the transfer for centrifugation. Coagulation will begin to occur almost immediately because the sample is kept completely autologous. The success of PRF as a treatment modality in patients with systemic diseases such as insufficient platelet count, thrombocytopenia, afibrinogenemia, leukocyte adhesion syndromes, immune suppression, diabetes, and autoimmune disorders [25].

The filling of Intra Bony Defects with Platelet Rich Plasma appears to lead to very favourable results when at least three of the bony walls are intact. Different types of defect for example, one walled or two walled have different potentials for regeneration. The number of remaining bony walls present has been found to be correlated to potential osseous regeneration [26].

Clinical applications of PRF in periodontics

The current uses of PRF in periodontics include the treatment of gingival recession and, more recently, of osseous regeneration in periodontal IBD. The technique suggested for the clinical application of PRF in periodontal defects is that one PRF clot be placed in the IBD, and then be covered by two PRF membranes. It has been claimed that the membranes will act as a barrier a GTR membrane to prevent the down growth of the junction epithelium along the root surface. Another suggested technique is to mince a PRF membrane, place in the IBD, and cover with another PRF membrane. Another method being explored is to mince a PRF clot and mix with a synthetic material, such as hydroxyapatite, before covering the graft with a PRF membrane [27].

Angiogenesis

Uchida *et al* stated that angiogenesis "the formation of new blood vessels inside the wound" is crucial in the delivery of oxygen, nutrients, and crucial cells from nearby tissues in the hypoxic microenvironment of healing wounds, they also stated that vascular endothelial growth factors (VEGF) were found responsible for regulating angiogenesis in the healing of surgically induced holes in the bone of rats. This was in accordance with similar results obtained by Stein brech *et al* as they also observed the crucial role of VEGF in angiogenesis during the healing of long bones [28].

Implications in wound healing

Although leukocyte and platelet cytokines play an important role in the PRF healing capacity, it has often been suggested that it is the fibrin matrix supporting these elements which is actually responsible for its therapeutic potential. The keys to tissue regeneration lie in their angiogenic potential, their immune system control, their potential to recruit circulating stem cells, and their ability to ensure undisturbed wound closure/healing by epithelial tissues. The angiogenic properties of PRF may therefore be explained by the three dimensional structure of the fibrin matrix which holds a number of growth factors and cytokines simultaneously embedded in the matrix including PDGF, TGF-β1, IGF, and VEGF. The regenerative potential of these cytokines has been abundantly studied in tissue wound healing and regeneration. Further the fibrin matrix stimulates the expression of integrin avb3 which allows cells to bind to fibrin, fibronectin, and vitronectin. These events are of utmost importance to initiate the process of angiogenesis and thus tissue wound healing [29].

As far as Periodontics is concerned PRF is used in the treatment of periapical lesions, gingival recession and intra bony defects and endoperio lesions either alone or in combination with GTR or hydroxyl apatite graft.

Anil Kumar *et al* has reported the use of PRF as a novel approach for the treatment of gingival recessions along with laterally positioned flap in the mandibular anteriors.

Chang *et al* suggested that PRF stimulated Osteoprotegerin (OPG) production and promotes phosphorylated extracellular signal regulated protein kinase (p-ERK) production which inturn proliferates osteoblasts. Huang *et al* also suggested that, in the human pulp cells, stimulation of osteogenic differentiation is done by PRF which also releases growth factors, thus helping in periodontal regeneration [30, 31].

Applications in various fields of dentistry

PRF when used in extraction socket, it helps in tissue regeneration by stabilizing the clot. This helps in wound healing and acts as an adjuvant therapy in patients under anticoagulant.

Corso *et al* showed that the use of PRF, either solely or in combination with bone grafts during various sinus lift procedures and also in combination with Tricalcium phosphate (beta TCP) without bone grafts has been extensively in use [32].

PRF in combination with graft materials improves the integrity of the graft materials and acts as a blood clot, hence has also been found to produce favourable results in avulsion sockets. In wide extraction sockets where wound closure has been difficult, PRF acts as a protective membrane and its elasticity helps in epithelisation and proper wound closure and stabilization of graft

In various studies, PRF has been proved to act as a scaffolding material that helps in tooth revitalization and regeneration of pulp, and it is also proved that PRF along with MTA acts as an root end barrier and induces faster periapical healing**.** The role of PRF in pulpotomy procedures has also been found along with MTA. It has also been used in the

treatment of bony defects post periapical surgeries [33].

Huang *et al*, PRF helps increases protein expression of Dental pulpal cells and proliferation of the cells. OPG and ALP expressions are the markers of odontoblastic differentiation [34].

In tissue engineering

Gassling *et al* stated that PRF can be used in the *in vitro* cultivation of periosteal cell for the purpose of bone tissue engineering, because PRF is more superior when compared to collagen. Hence PRF acts as a potential tool in tissue engineering. Apart from this the role of PRF in the clinical aspect of tissue engineering are to be investigated [35].

PRF in intrabony defects

This review discusses the effects and application of PRF on periodontal regeneration. In a study by A.R Pradeep *et al* compared the treatment effectiveness of 90 intrabony defects using PRP or PRF along with OFD or OFD alone. Only 3-wall IBD were included in the present study since there was a positive correlation between the number of wall present and the potential of regeneration of the grafting material and concluded that significant reduction in PD and CAL gain were found in all three groups when compared at baseline and also at 9 months. More reduction of Pocket depth was found with PRF treated subjects than the subjects treated with conventional periodontal flap surgery alone. The percentage of IBD fill in the PRF group is higher than the conventionally treated subjects, because of various growth factors present in PRF that helps in faster healing of tissue. PRF can be squeezed to form a membrane and can be used as fibrin bandage serving as a matrix to accelerate the healing of wound edges. One of the limitations of the PRF technique, as compared to other methods for obtaining platelet concentrates, is that PRF must be used within a short time after blood drawing and centrifugation while the others can be activated on demand a few minutes before use [36].

The effectiveness of treatment of IBD with PRF was assessed from five *in vivo* human peer reviewed trials addressing the effectiveness of PRF in periodontal IBD were included. Results showed that: 1) all five studies in clinical and radiographic periodontal parameters with the use of PRF in open flap debridement (OFD) as compared to OFD alone; 2) three of the studies in probing depth (PD), and 3) four out of the five studies in clinical attachment loss (CAL). Two of the five studies suffered a relatively significant loss to follow up. All studies presented statistically significant differences for IBD fill for PRF group, as measured on standardized radiographs read by computer aided software and concluded that Further long term, larger, multicentered randomized controlled clinical trials are required to determine the effects of PRF on the regeneration of alveolar bone due to periodontal disease [37].

Effectiveness of the treatment of IBD with OFD alone and OFD along with PRF or TPRF in 90 patients was evaluated. Clinical parameters showed statistically-significant improvements in both PRF and TPRF. Improvements were noted both clinically and radio graphically in both PRF and TPRF groups [38].

The use of PRF in IBD and its effect on fibrobasts of PDL were observed which resulted in reduction of PPD and CAL post 6 months.PRF can upregulate p-ERK expression in human osteoblasts and increase protein expression and elevated ALP activity in a time dependent manner. PRF application exhibited the radiographic defects filled in grafted teeth and they concluded that PRF is effective for treating periodontal IBD [39].

The effect of TPRF along with OFD on GCF and the periodontal treatment outcome were evaluated in 29 patients in comparison with OFD alone.T-PRF showed greater improvements in PD reduction, RAL gain and GML. T-PRF showed that lower RANKL/OPG ratio and higher growth factor concentrations in GCF and the study concluded that TPRF+OFD was superior to OFD alone in improving periodontal healing [40].

Clinical and radiological (bone fill) effectiveness of autologous PRF along with the use of alloplastic bone mineral in the treatment of intra bony defects.PRF could improve the periodontal osseous defect healing, as PRF can up regulate phosphorylated extracellular signal regulated protein kinase expression and suppress the osteoclastogenesis by promoting secretion of osteoprotegerin (OPG) in osteoblasts cultures. Radiographs revealed significant bone fill in the intrabony defect compared to measurements at baseline. It was concluded that the clinical impact of PRF with alloplastic graft material for the treatment of IBD was positive [41].

Efficacy of PRF as a regenerative approach in LAP by evaluating the clinical and radiographic parameters were treated with modified flap alone or with autologous PRF. PRF showed improvements in PD, CAL,RBF (radiographic bone fill). 80 % of PRF sites shows 50 % RBF. The additional benefits of using PRF provided growth factors and stabilization of the clot, prevent retraction, creating a consistency that resists displacement, maintains space, inhibits soft tissue invasion, and acts as a scaffolding for migrating endothelial cells, osteoblasts and other cells [42].

PRF in socket preservation

The preservation of alveolar ridge post extraction with PRF was evaluated. The healing of soft tissue in the experimental group was improved compared with that in the control group, and no symptoms of inflammation were observed. Histological analysis demonstrated that the novel bone formation in the PRF group was significantly increased compared with that in the control group and concluded that PRF was effective in reducing alveolar bone resorption and promoting bone formation in the extraction socket [10].

Evaluation of PRF on alveolar ridge preservation and faster wound healing was evaluated and was found that PRF enhanced early healing of soft tissue covering the socket orifice in the first 4 weeks as seen by mature mucosa over the socket orifice. The ridge height, as well as the buccal and lingual contour of the ridge, demonstrated a better ridge shape preservation and concluded that bone regeneration of bone can be stimulated by PRF without waiting for normal body response [43].

Histological and clinical evaluation of extraction socket healing filled with PRF was evaluated in 47 year old male patient. PRF can stimulate human osteoblast proliferation and induce strong differentiation of osteoblasts and concluded that PRF does not interfere with the clinical healing process when applied to fresh extraction socket and seems to reduce alveolar ridge resorption following tooth extraction and to positively influence socket healing over a 3 month period [44].

The efficacy of PRF in alveolar ridge preservation post extraction was analysed in 28 patients. PRF showed better soft tissue healing and lesser postoperative reaction.

Histological analysis demonstrated that the new bone formation in the PRF group was significantly increased. PRF was effective in reducing alveolar bone resorption and promoting bone formation in the extraction socket. It was concluded that PRF was able to increase the quality and rate of forming bone due to the concentration of growth factors.[45] The effectiveness of autologous PRF in grade II furcation defect in terms of clinical and radiographic parameters on soft and hard tissue were evaluated. A mean PD reduction was better in the PRF group and concluded that PRF has been shown to is an effective modality of therapy in the regenerative treatment of degree II mandibular furcations [46].

PRF in gingival recession

On comparing the outcome of coronally advanced flap (CAF) along with the use of platelet rich fibrin (PRF) versus CAF in conjunction with a resin modified glass ionomer cement (IC) for the management of Millers Class I and Class II gingival recession coupled with no carious cervical lesions (NCCLs). A greater reduction for Relative clinical attachment level (RCAL) and high increase in Keratinised tissue thickness (KTT) which was statistically significant in CAF with PRF. CAF provides a reliable technique for covering exposed root surfaces associated with NCCLs. The use of PRF along with CAF results in increased KTT and promoted better wound healing [47].

The Potential benefits of platelet rich fibrin (PRF) on modified CAF for the treatment of Millers' class I and class II gingival recession in 12 patients. The increase in GT may be attributed to proliferation of gingival and periodontal ligament fibroblasts under influence of growth factors from PRF. It was concluded that the only benefit of the addition of PRF appears to be a significant increase in the thickness of gingiva which may improve the predictability and long term maintenance of achieved soft tissue root coverage [48].

When comparing the effectiveness of the CAF and PRF combined technique and CAF and SCTG in the treatment of bilateral gingival recessions, complete root coverage is achieved, and gingival thickness and keratinized tissue width increased with both procedures. PRF appears to act like SCTG and provides a living-tissue scaffold without the morbidity of graft harvest. Gingival recessions can be successfully treated with the patients' own autologous blood-derived material, without an additional donor site and it can be accepted as a guide for soft-tissue grafting procedures [49].

The effect of I-PRF on root coverage with FGG in patients with Millers class I and II recessions were assessed in 40 patients. The use of PRF that contains platelets, blood plasma, leukocytes proved to increase the rate of wound healing and improved of the process of angiogenesis. I-PRF contains fibronectin, which is an adhesive glycoprotein that it might have an adhesive effect on graft immobilization and concluded that injection of Injectable Platelet-Rich Fibrin (I-PRF) had a positive effect on root coverage in free gingival graft surgery [50].

Evaluation of effect of PRF as palatal bandage post FGG was evaluated in 24 patients. Advantages of PRF is wound protection from surrounding external irritants. PRF bandage, better first-week soft tissue healing in terms of color match, contour, and texture, as well as less pain and discomfort. PRF significantly enriched the palatal bandage and enhances the palatal wound healing along with reducing the morbidity of patients. It was found that PRF palatal bandages reduced pain, discomfort post operatively along with better healing [51].

PRF in implants

Based on the Studies, clinical and radiographic efficacy of immediate implants placed in esthetic zone along with PRF was evaluated at 3 months, 6 months, 9 months and 12 months. Better Osseo integrated over a one year follow-up period with a success rate of 100% with insignificant change in the crestal bone level. During assessment of peri-implant probing depth (PPD) declared that, there was a statistically significant increase in PPD and the mean (MBL) marginal bone level in PRF group [52].

Evaluation of Immediate implant placement in fresh extraction sockets with and without the use of platelet rich fibrin in 20 sites was done. PRF favoured with rapid soft tissue regeneration, diminished vertical bone loss and improve with early wound closure. The mean difference in vertical bone change from baseline to 12 months was significantly less in the test group and they concluded that immediate implants with PRF leads to stimulation and acceleration of bone regeneration and show tendency toward rapid soft tissue regeneration and reduced peri-implant pain and inflammation [53].

On comparison of dental implants inserted in one stage surgical protocol with or without PRF application in 20 healthy patients showed that PRF release growth factors, resulting in cellular proliferation, collagen synthesis and osteoid production. PRF application increased the stability of implants during the first month of healing and seems to provide faster osseointegration [54].

The effect of Platelet PRF on the response of peri implant tissue of on stage implants in maxillary anterior region was evaluated. There was low mean marginal bone loss observed in PRF group. They analysed that high clinical applicability in that it provides information on the effectiveness of PRF on the rehabilitation of anterior maxillary aesthetic zone [55].

Evaluation of Immediate Implant placement in fresh extraction sockets with and without the use of platelet rich fibrin in 20 sites. 10 implants were placed with PRF and 10 implants were placed without any similar adjunct. PRF showed better soft tissue healing and represents a new technology for stimulation and acceleration of bone regeneration without any risk of transmission of diseases as PRF is an autologous source of growth factors prepared by simple technique, minimal cost, and minimally invasive. The mean difference in vertical bone change from baseline to 12 months was significantly lesser among PRF group and concluded that PRF as a viable option in improving success in dental implants [56].

Clinical effectiveness of PRF combined with a new split crest flapless modified technique was evaluated in 2 groups: Group 1 (test) of 5 patients treated by the flapless split crest new procedure; Group 2 (control) of 5 patients treated by traditional technique with deeper insertion of smaller implants without split crest improved results achieved by the association of new developed split crest with the use of autologous PRF and concluded that this modified split crest technique combined with PRF appears to be reliable, safe, and to improve the clinical outcome of patients with horizontal alveolar crests deficiency compared to traditional implanting techniques [57].

PRF in maxillary sinus augmentation

Clinically and radio graphically the effect of using platelet

rich fibrin (PRF) autologous graft on the augmentation results of autologous palatal bone blocks. PRF group showed improved clinical and intrasurgical parameters in relation to the horizontal bone increase and significant decrease in the surface resorption percentage. The rationale behind covering the block graft with PRF is to take advantage of the inherent healing benefits of the autogenous clot and also leads to stabilized blood clot around the graft, resulting in less block surface resorption [58].

Clinically and histologically, use of deproteinized bovine bone along with PRF in pre-implantology sinus grafting of severe maxillary atrophy, in comparison with a control group in which only deproteinized bovine bone (Bio-Oss) was used as reconstructive material in 60 patients. Adding of PRF were constituted by lamellar bone tissue with an interposed stroma that appeared relaxed and richly vascularized and concluded that there is a reduced healing time hence faster placement of implants at 4 months post-surgery [59].

PRF in papilla augmentation

Evaluated the augmentation of interdental papilla with platelet-rich fibrin in 25 sites. The advantage of PRF over connective tissue graft is PRF is easy to procure, less expensive, better healing of surgical site, and no second surgical site required and there was complete fill of the papilla at 3 months and 6 months postoperatively and they concluded the use of PRF achieved successful and predictable results in the management of papillary recession [60].

PRF in depigmentation

PRF's beneficial role in wound healing after depigmentation surgery in 12 systemically healthy controls was assessed. One group received PRF membrane, and in second group non eugenol periodontal dressing was placed. The lack of inflammatory infiltrate and signs of parakeratinized epithelium in PRF may be due to slow polymerization process and entrapment of leukocytes and cytokines which confirmed superior wound healing in the group. PRF membrane post depigmentation provided satisfactory patient comfort and enhanced the wound healing cascade [61].

Comparison of PRF with the commonly used collagen membrane Bio-Gides as scaffolds for periosteal tissue engineering. One possible explanation is that the more physiological natural and progressive polymerization during centrifugation. Higher values for PRF in the examination of proliferation level using BrdU test and SEM test proved that PRF is superior to collagen as a scaffold to periosteal cell proliferation [62].

A standard preparation protocol should be present to evaluate the efficacy of PRF. Freshly prepared PRF clots were compressed using novel PRF compression device into a thin membrane and was examined by SEM and immunostaining. Neovascularisation and cell proliferation was found to be stimulated due to the presence of PDGF isoform in C-PRF. Hence it was concluded that novel compression device would be effective and useful for preparation of biologically active PRF [63].

Conclusion

This library dissertation compiles the various applications of PRF in hard and soft tissue regeneration. There were more promising results of PRF for regeneration especially ridge augmentation, socket preservation which in turn helps in future ridge site development for successful endosseous implants.

PRF has various uses such as reducing infections and making the site more amenable for natural healing process. Periodontal applications like regeneration of furcation defects, intrabony defects, recession coverage. Also the autologous source of PRF makes it economical and less invasive for the patient. Since the Practitioners does not have much clue regarding PRF in regeneration. This Library Dissertation highlights about this ideal biomaterial for regeneration.

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