WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Platelet Rich Plasma in Dentistry

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ABSTRACT

A novel strategy for tissue regeneration known as platelet-rich plasma (PRP) is quickly emerging as a useful addition to a variety of dental procedures, particularly for elderly patients. PRP is made by centrifuging the patient's own blood and adding a variety of growth factors. It plays an important role in the mechanisms that repair tissue. It helps heal wounds. In surgical practice, PRP has several benefits, including decreased bleeding, increased soft tissue healing, and increased bone regeneration. PRP has been used successfully in human research for implant surgery, periodontal surgery, and tooth extraction, among other dental and oral surgical procedures. PRP has also been suggested for the treatment of bisphosphonate-related osteonecrosis of the jaw (BRONJ) in order to speed up wound healing and bone maturation. The effectiveness, efficiency, and risk-to-benefit ratio of PRP, as well as its numerous applications in dental and oral surgery, are the subject of this review. In this study, tooth extractions were followed by PRP injections into the alveolar socket, which had a positive effect on bone regeneration and improved soft tissue healing but decreased a few days after the extraction.

Keywords: PRP, bone regeneration, tooth extraction, periodontal surgery, oral surgery, implant surgery, BRONJ, and wound healing are all examples of dental procedures.

INTRODUCTION

A tissue regeneration technique known as platelet-rich plasma (PRP) has become commonly utilised in a number of surgical disciplines, including as craniofacial surgery, head and neck surgery, otolaryngology, and cardiovascular surgery. PRP is commonly utilised in a gel formulation along with thrombin and calcium chloride. PRP is made by centrifuging autologous whole blood. Significant amounts of platelets and fibrinogen are present in PRP gel.

Platelets are among the first cells to respond to an injury to a wound, and they are essential for the beginning of the healing process. A large source of vital growth factors for platelets can be found in the transforming growth factor-b (TGF-b) family of proteins, which includes platelet-derived growth factor (PDGF), transforming growth factor-b (TGF-b) 1 and 2, and vascular endothelial growth factor (VEGF). [2].

The PRP action mechanism

An autologous platelet concentration in a small amount of autologous plasma is known as platelet-rich plasma (PRP). PRP has a platelet concentration of at least 1,000,000/1 L in a 5 mL volume of plasma, as compared to normal range of 150,000/1 L to 350,000/1 L for human platelets.

Alpha granules are produced from the autologous plasma concentrate once the coagulation process has started at the wound site. These granules include a mixture of growth factors that encourage cell proliferation, chemotaxis, and differentiation—all of which are essential for osteogenesis. [3]

In addition, PRP is a source of growth factors that promote fibroblast proliferation and enhance tissue vascularity, hence aiding in the initiation and maintenance of wound healing [4].

Platelet-rich plasma gel is produced by combining PRP (produced by centrifuging autologous blood) with thrombin and calcium chloride. Biological growth factors are released when thrombin and calcium chloride are added to PRP, including platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-b), vascular endothelial growth factor (VEGF), insulin-like growth factor I, epidermal growth factor (E epidermal GF), and cell growth factor. [5].

PDGF, a key protein for hard- and soft-tissue repair, is the source of PRP's primary effects. It has been demonstrated that PDGF stimulates stem cell chemotaxis, mitogenesis, and replication at the site of tissue injury. [6] This in turn promotes the development of bone matrix and angiogenesis by boosting VEGF levels, resulting in an increase in neo-vascularisation, which accelerates the repair of soft tissues. PDGF also stimulates wound contraction and remodelling by promoting the synthesis of fibronectin, a cell adhesion molecule utilised during wound healing for cellular proliferation and migration. [7]

Two additional cytokines produced by PRP alpha granules, TGF-b1 and TGF-b2, are crucial for bone and connective tissue regeneration. [8] They primarily promote fibroblast chemotaxis and collagen and fibronectin formation in cells, avoiding collagen deterioration by reducing proteases and increasing protease inhibitors. In vitro and in vivo, TGF promotes the growth of osteoblasts and mesenchymal stem cells, leading to bone regeneration. [9] TGF-b2 has been shown to increase both osteoblast and osteoclast activity. By modulating the activity of osteoblasts and osteoclasts, stimulation of TGF-b2 may enhance bone repair. [10].

PRP's application in dental surgery

PRP's healing effects on the alveolar socket following extraction

The extraction of teeth with severe decay, gum disease, irreparable damage, or impacted teeth is a common dental procedure. These procedures can cause a lot of pain after the procedure, especially if third molars are taken out. Additionally, patients, particularly those taking anticoagulants, may experience prolonged bleeding [11]. Post-operative pain has been reduced and tissue regeneration has been accelerated through a variety of methods, including fibrin sponge and LASER bio stimulation [12].

Platelet-rich plasma (PRP) was found by Organdie and colleagues to dramatically lessen discomfort in individuals having surgical extraction of a single impacted third molar. The patients' edema and interincisal mouth opening were also lessened. The PRP group's assessments for lamina dura, trabecular pattern, and bone density improvement were judged to be significant even if the difference was statistically insignificant. [13].

Arenaz-Bua and coworkers (2010) investigated the effectiveness of PRP in promoting bone regeneration after third molar extraction in a prospective split-mouth trial. At six months, there was no statistically significant difference between the groups in terms of pain, edoema, trismus, or infection, and bone development did not speed up further. Similar to this, Gurbuzer et al. (2008) demonstrated via scintigraphy that PRP administration alone to soft tissue-impacted mandibular third molar extraction sockets did not result in an elevation in osteoblastic activity in weeks 1 and 4 following surgery. [15].

Table: 1 Summary of PRP-based RCTs for tooth extraction

Authors	**Publishing year**	**Patients in number**	**Follow-up (wks.)**	**Results**	**PRP effect**
Ogundipe [16]	2011	11	12	Pain was statistically significantly reduced; however, there was no statistically significant change in bone density or swelling/interincisal mouth opening.	moderate
Celio-Mariano [17]	2012	15	1-4-8-12-24	Significantly better bone healing after PRP treatment	strong
Arenaz-Bua [18]	2012	82	12-24	Following PRP therapy, bone growth did not accelerate. Pain, swell- ing, trismus, and infection have not improved.	weak
Gurbuzer [19]	2008	12	1-4	In PRP-treated areas, there was no enhanced osteoblastic activity.	weak

PRP's application in periodontal surgery

PRP growth factors have been shown to improve periodontal soft tissue regeneration and wound healing by promoting fibroblast proliferation, increasing collagen synthesis in the extracellular matrix, and forming fibrin clots [20]. In periodontology, PRP growth factors are extremely beneficial. They also speed up bone healing by increasing osteoblast mitosis and tissue vascularity, which is very helpful for treating sub-osseous anomalies [21]. PRP's efficacy as a periodontal treatment, on the other hand, is still up for debate.

A recent systematic review discovered that PRP could decrease gingival recession in individuals with chronic periodontitis, but not clinical attachment level [22]. Additionally, a study on the treatment of mandibular furcation abnormalities was carried out by Pradeep et al. Autologous PRP has a limited role as a regenerative material, as evidenced by the fact that, despite the significant improvement seen with PRP, furcation defects did not completely disappear [23]. However, It is challenging to assess PRP's effectiveness on its own because the majority of studies have looked at PRP in combination with graft materials to improve the success of regenerative surgery. [24]

Table:2 An overview of PRP-based RCTs for periodontal surgery

Authors	Publication year	Patient number	Treatments	Follow-ups (wks.)	Result	PRP effect
Pradeep [25]	2009	20	Furcation defect treatment	24	Furcation defects have not been entirely eliminated.	weak
Menezes [26]	2012	60	Rehabilitation for infrabony defects	48-192	PRP has a positive effect on infrabony defects when combined with other graft materials, but not when administered alone.	weak
Bharadwaj. [27]	2011	10	Rehabilitation for infrabony defects	24	Significant improvement in PD, CAL	strong

Del Fabbro et al.'s systematic study yielded the following findings: 2011), when used in conjunction with graft materials to repair intrabody defects, PRP may have a significant additive effect. However, gingival recession did not considerably improve as a result of PRP [28]. Similar to this, periodontal sites treated with PRP and the graft material significantly improved over those treated with the graft material alone in two controlled clinical trials examining the effectiveness of PRP combined with other graft materials in the treatment of intraosseous periodontal defects. [29].

Bharadwaj and co. 2011 discovered that human periodontal intrabody defects could be effectively treated by adding PRP to bone grafts. [30].

Utilizing PRP in oral surgery

PRP's usage in implant surgery, bone surgery, and soft tissue surgery

In both animals and humans, PRP accelerates and improves the healing and regeneration of soft tissues [31]. In a recent study, Daif (2012) looked at how autologous PRP affected bone regeneration in mandibular fractures. He discovered that injecting PRP topically along the fracture lines may speed up the process of bone regeneration [32]. Furthermore, Wojtowicz et al. In his study, he examined the benefits of autologous bone marrow transplants, freshly obtained bone marrow mononuclear cells, such as CD34+ cells and PRP, to promote alveolar bone osteogenesis. PRP was found to increase the growth of new bone tissue. The CD-34 population of bone marrow-derived stem cells did not perform as well as this treatment [33].

Table:3 An overview of the RCTs, PRP in soft-tissue and bone surgery, and implant surgery

Authors	Publication year	Patient number	Treatment	Follow-up (wks.)	Results	PRP effect
Wojtowicz et al. [34]	2007	16	enhancement of the mandibular bone	12	Bone marrow contains CD34+ cells, making bone marrow less effective than PRP.	strong
Khairy. [35]	2012	15	Sinus lift	12-24	At six months after grafting, PRP-enriched bone grafts were linked to higher bone density.	strong
Cabbar. [36]	2011	10	Sinus lift	28	There were no statistically significant differences found.	Weak
Daif [37]	2012	24	Mandibular bone healing after fractures	1, 12, 24	In cases of mandibular fracture, direct PRP treatment along the fracture lines may promote bone repairs.	strong

Khairy and colleagues (2012) examined the performance of bone in sinuses that had undergone autogenous bone improvement, either with or without PRP. Six months after grafting, PRP enrichment was linked to superior bone density, but three months later, there was no discernible improvement [38]. When PRP was used in conjunction with a graft material for maxillary sinus augmentation, Poeschl (2012) reported favourable results [39]. In order to enhance the human maxillary sinus in preparation for dental implants, Cabbar et al. examined the use of PRP and a bovine bone xenograft. This study found that the durability of implants or the growth of new bone were unaffected by the combination of xenograft and PRP. [40]

PRP's role in BRONJ surgery

The use of PRP therapy to conservative surgery has been proven to improve bone repair. Due to the inadequate vascularization and supply of the components required for wound healing in the bones of BP patients, many researchers have also argued in favour of using PRP in BRONJ surgery [30]. Growth factors operate as an alternate bone repair stimulant, which is why BRONJ patients receive PRP. PRP growth factors may hasten epithelial wound healing, reduce post-operative tissue inflammation, hasten bone and soft tissue regeneration, and enhance tissue vasculature. Its biocompatibility and safety as an autologous product make it helpful as well [42].

Table:4 Summary of the case reports using PRP in the BRONJ surgery

Authors	Publication year	Patient number	Lesion type	Treatment	Follow - up (Months)	Result	PRP effect
Curi. [43]	2007	3	Jaw lesions		6-8	all injuries are healed	strong
Cetiner [44]	2009	1	Exposed necrotic bone in the alveolus	Marginal resection of the mandibular necrotic bone	6	Alveolar bone and mouth mucosa have fully recovered from the surgery.	strong

According to Cetiner et al., a case of zoledronate-associated BRONJ following tooth extraction was reported in 2009 [45]. The patient was a 68-year-old male with multiple myeloma who received surgical debridement and PRP treatment. The patient's prognosis during the six-month checkup was encouraging. Furthermore, Curi et al. used PRP on three patients in 2007 who had lesions in their jaws. After six and eight months of follow-up, respectively, the patients had successful outcomes [46].

PRP in sinus-floor enlargement and bone remodelling

For sinus floor augmentation, autologous bone, freeze-dried bone allograft, and deproteinized bovine bone mineral have all been used as graft materials with PRP [47]. The value of adding PRP to bone replacement material for sinus-floor augmentation is up for debate [48]. In fact, a number of studies have highlighted significant advantages of combining PRP with autologous bone or freeze-dried bone allograft, including enhanced bone synthesis during sinus floor augmentation or unique bone regeneration potential. Torres et al. claim that PRP can increase the volume of newly formed bone, improving the ability of an organic bovine bone to regenerate. [49] Similar results were seen by Stumbras et al., who demonstrated that the use of PRP in conjunction with bone graft materials greatly enhanced bone development and vascularization in the elevation of the maxillary sinus floor. According to the study, PRP might increase angiogenesis, which would hasten bone mending [50], adding PRP to a beta-tricalcium phosphate graft substitute did not result in any further contributions to the production of new bone. [51]

Conclusion

There are numerous applications for PRP preparations in oral surgery and dentistry. A wide range of oral surgical procedures benefit from its ease of use and safety profile [52]. Since the bulk of RCTs undertaken on the topic used a variety of graft materials and techniques, the scientific data addressing the effectiveness and efficiency of PRP is still debatable [53]. As a covering material for implants, PRP alone has demonstrated promising outcomes. In addition, sinus lifting can be improved by combining PRP with a variety of biomaterials, though the material used is important in this field [54]. The minimally invasive strategy of necrotic bone curettage and PRP administration looks to be very promising for the treatment of refractory BRONJ. PRP can be used as a potential adjuvant to various procedures in oral and dental surgery because it is risk-free for patients, easy to obtain, and simple to apply. However, further RCTs are needed to support the use of PRP in clinical settings. [55]

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