PLASMA THERAPY [PRP] IN DENTISTRY: - AN OVERVIEW

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ABSTRACT

Plasma therapy is a transfusion of plasma into the diseased body to fight an infection. Most commonly used plasma therapy is Platelet-rich plasma (PRP). It is an approach to tissue regeneration and plays a major role in promoting healing in many dental and oral surgical procedures; it has shown significant results in aging patients.[1] Plasma contains important growth factors that ensure tissue repair and influence wound healing. PRP is used in many dental procedures like tooth extractions, periodontal surgery, and implant surgeries and many more.

Keywords - PRP, Periodontal surgery, Implant surgery, BRONJ.

BACKGROUND

Platelet-rich plasma (PRP) is a modality used for tissue regeneration: it is widely used in various surgical procedures, including dental surgery, head & neck surgery, cardiovascular surgery, maxillofacial surgery, and otolaryngology.[2] During wound healing, platelets respond first at the wound site to initiate the healing process. Platelets are a rich source of important growth factors, such as platelet-derived growth factor (PDGF), transforming growth factor-b (TGF-b) 1 and 2, and vascular endothelial growth factor (VEGF); all of these are involved in wound healing.

Recently, PRP has become a valuable adjunct to promote wound healing in many procedures related to dental surgery and oral surgery. They include: - ablative surgical procedures, mandibular reconstruction, surgical repair of the alveolar cleft, treatment of intrabony periodontal defects, and periodontal plastic surgery, etc. The use of PRP has also been proposed for the management of bisphosphonate-related osteonecrosis of the jaw (BRONJ) or avascular necrosis, which is caused by other factors (e.g., radio-osteonecrosis), to increase wound healing and bone regeneration.[3]

Mechanism of PRP

The major effects of platelet-rich plasma are derived from PDGF (platelet-derived growth factor), which is an important protein for the healing of hard and soft tissue. PDGF stimulates chemotaxis and the replication of stem cells at the wound site. This leads to the formation of matrix bone and angiogenesis by stimulating increased levels of VEGF (vascular endothelial growth factor), to accelerate soft tissue healing due to neo-vascularization. TGF also increases the proliferation of mesenchymal stem cells and osteoblasts, which helps in bone regeneration. (4)

PDGF has been shown to stimulate chemotaxis, mitogenesis, and the replication of stem cells at the site of a wound to the site of tissue injury. This results in the formation of matrix bone and angiogenesis by stimulating increased levels of VEGF. This, in turn, may lead to accelerated soft-tissue healing due to neo-vascularization. PDGF also stimulates the production of fibronectin, a cell adhesion molecule used in cellular proliferation and migration during healing, including osteoconduction and hyaluronic acid, and it assists in promoting wound contraction and remodelling.

Preparation

Platelet-rich plasma gel is formed by mixing PRP (derived from the centrifugation of autologous whole blood) with thrombin and calcium chloride. Adding thrombin and calcium chloride to PRP automatically activates the alpha granules to release the following biological growth factors: platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-b), vascular endothelial growth factor (VEGF), insulin-like growth factor I, epidermal growth factor (EGF), and epithelial cell growth factor.[5]

Implications of PRP in dental surgery

Healing of the alveolar socket following tooth extraction

PRP has been obtaining high concentrations of growth factors involved in tissue healing and regeneration. Patients

untreated with PRP experienced more complications, like dry sockets and acutely inflamed alveolar tissue, etc. PRP can improve healing after tooth extraction by creating a stable clot and providing growth factors that promote soft tissue healing and bone regeneration. This can lead to faster recovery, reduced pain, and a lower risk of complications like dry socket (alveolar osteitis). The procedure involves a dentist collecting a small amount of the patient's blood, concentrating the platelets, and applying the resulting plasma gel to the empty socket.[6]

Periodontal regeneration

Periodontal regenerative surgery aims to regenerate alveolar bone, cementum and functional periodontal ligament. PRP is assumed to increase the predictability of periodontal regeneration procedures. When platelets are activated, they exocytose their internal granules; this process is mediated by molecular mechanisms. Growth factors are subsequently released from platelet granules and contribute to chemotaxis, differentiation, mitogenesis and metabolism of cells involved in wound healing. During periodontal wound healing after the exogenous application of PRP, the delivery of autologous platelets to periodontal wounds increases the local concentrations of growth factors, which then exert regulatory effects on the homeostasis of periodontal tissues and modify the responses of periodontal soft and hard tissues to enhance healing outcomes.

Bhardwaj et al. reported that the addition of PRP to bone graft appeared to be beneficial in the treatment of human periodontal intrabony defects. In another case report, the authors treated intrabony defects by adding PRP to a bone allograft in guided tissue regeneration and observed significant improvements in clinical insertion and bone filling. (7) Camargo et al. compared the results of bovine porous bone mineral and guided tissue regeneration with and without the addition of PRP. They evaluated changes in probing depth (PD), clinical attachment level (CAL) and defect filling at 6-month follow-up, and concluded that PRP treatment provided no statistically significant resolution of intrabony defects.

Soft tissue surgery, bone tissue surgery, and implant surgery

In the field of bone tissue surgery, a recent study by Daif (2012) investigated the effect of autologous PRP for bone regeneration in mandibular fractures. He concluded that direct application of the PRP along the fracture site may enhance bone regeneration as well as soft tissue regeneration.[8] The conclusion was that without PRP, there is no significant improvement observed in bone density at 3 months post-grafting, but PRP-enriched bone grafts were associated with superior bone density at 6months post-grafting.

Management of BRONJ surgery

BRONJ (Bisphosphonate-Related Osteonecrosis of the jaw) is currently recognized as a significant complication, which is related to the bisphosphonates (BPs). The bones of patients treated with BPs are, therefore, poorly vascularized, and a poor quantity of the substances necessary for wound healing can be used in the surgical management of BRONJ to enhance wound healing and promote bone regeneration. It is often used after surgical debridement or resection of necrotic bone to stimulate tissue repair, improve bone maturation, and aid in soft tissue closure.[9] Some studies show high success rates for this combination therapy, especially in refractory cases, and it is considered a promising, minimally invasive approach.

Sinus-floor augmentation and bone remodelling

PRP has been added to graft materials, including autologous bone, freeze-dried bone allograft, or deproteinized bovine bone mineral for sinus-floor augmentation. The beneficial use of PRP as an adjunct to bone substitute material for sinus-floor augmentation is controversial. In fact, some articles reported significant advantages of adding PRP to autologous bone or freeze-dried bone allograft, such as certain bone regeneration potential or enhanced bone-formation rate during sinus-floor augmentation. Torres et al. reported that PRP can improve the regenerative potential of an organic bovine bone by increasing newly formed bone volume. Similar results were reported by Stumbr et al. that PRP combined with bone graft materials effectively enhanced bone formation and vascularization in maxillary sinus floor elevation.[10] The study suggested that PRP might accelerate bone regeneration by promoting angiogenesis

Endodontic healing

Regenerative endodontics aims to regenerate damaged/necrotic pulp–dentin complex tissues, such as dentin, pulp tissue, and root structures, In order to restore

pulp functions. After proper disinfection, pulp-like tissue maybe potentially be formed by a variety of pre-existing dental stem cells in the presence of suitable growth factors and scaffold medium. Autologous PRP has been widely used in several branches of dentistry because of its ability to release a rich source of healing-promoting growth factors that favour stem cell multiplication and differentiation, and because of its ability to act as an ideal three-dimensional scaffold medium. (11,12) PRP has recently emerged as a possible tool for supporting cell growth and differentiation of vital tissues in the canal after disinfection, thereby enhancing endodontic regeneration. Indeed, the minimally invasive technique of revascularization is an effective treatment modality for the management of immature permanent teeth with compromised structural integrity.

Risk / Benefit

PRP is an autologous preparation, utilizing the patient's own blood in small quantities. The doubtful success of PRP may not justify the cost to the clinician of buying the PRP-processing system and the disposable kits, or the cost to the patient for paying for this treatment.[13] On the other hand, PRP has the advantage of being easily obtainable and less time-consuming for the patient or clinician. Even if preparation of PRP involves an additional step to the surgical procedure, it takes approximately 30 minutes and is best performed by a surgical assistant under the supervision of a trained dental surgeon.

CONCLUSION

PRP therapy has been proposed for several uses in dental and oral surgery. The scientific evidence regarding the efficacy and efficiency of PRP is still controversial, given the paucity of RCTs related to this topic, and the majority have been conducted using different graft materials and applying different procedures.[14] This Review suggests that the use of PRP in the alveolar socket after tooth extractions is certainly able to improve soft tissue healing and positively influence bone regeneration, it revealed better results in periodontal therapy in association with other materials.

REFERENCES

1. Carlson NE, Roach RB. Platelet-rich plasma: clinical applications in dentistry. J Am Dent Assoc. 2002;133:1383-1386.
2. Kao RT, Murakami S, Beirne OR. The biological mediators and tissue engineering used in dentistry. Periodontol 2000. 2009;50:127-153.
3. Anitua E, Ardanza B, Andia I, Nurden P, Nurden AT. Autologous platelets, source of proteins for wound healing and tissue regeneration. Thromb Haemost. 2004;91:4-15.
4. von Woedtke T, Metelmann HR. Editorial. Clin Plasma Med. 2013;1:1-2.
5. Samukawa S, Hori M, Rauf S, Tachibana K, Bruggeman P, Kroesen G, et al. J Phys D. 2012;45:253001.
6. Laroussi M, Lu X. Room-temperature atmospheric pressure plasma plume for biomedical applications. Appl Phys Lett. 2005;87
7. Stoffels E, Kieft IE, Sladek REJ, van dem Bedm LJM, van der Laan EP, Seinbuch M. Plasma needle for in vivo medical treatment: recent developments and perspectives.
8. Kolb JF, Mohamed AAH, Price RO, Swanson RJ, Bowman A, Chiavarini RL, et al. Appl Phys Lett. 2008;92:241501.
9. Jiang C, Chen MT, Gorur A, Schaudinn C, Jaramillo DE, Costerton JW, et al. Nanosecond pulsed plasma dental probe. Plasma Process Polym. 2009;6:479-83
10. Laney WR. The emphasis on aesthetics. Int J Oral Maxilla Implants. 2001;16:625.
11. Anselme K, Bigerelle M. Statistical demonstration of the relative effect of surface chemistry and roughness on human osteoblast short-term adhesion. J Mater Sci Mater Med. 2006;17:471-9
12. Sharma A.Chopra A,Parimoo R,Verma V,Neha Tondon Various Sharma A. Chopra A, Parimoo R, Verma V, Neha Tondon Various applications of platelets rich plasma in the field of dentistry: A review,IP i Indian J Ortho Dentofacial Res 2020;6(4):197-200
13. Placko HE, Mishra S, Weimer JJ, Lucas LC. Surface characterization of titanium-based implant materials. Int J Oral Maxillofac Implants. 2000;15:355-63.
14. Mustafa K, Wennerberg A, Wroblewski J, Hultenby K, Lopez BS, Arvidson K. Determining optimal surface roughness of TiO(2) blasted titanium implant material for attachment, proliferation and differentiation of cells derived from human mandibular alveolar bone. Clin Oral Implants Res. 2001;12:515-25