Efficacy of platelet-rich plasma in oral surgery and medicine: an overview

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Abstract

Introduction
Advancements in medicine demand less invasive therapies and faster recovery times for large-area skin damage caused by burns, large ulcers and tumours. To cover the wound and aid in the recovery process platelet-rich plasma is often used as an adjunct for skin grafting. Platelet-rich plasma is a growth factor–enriched with platelet concentrate–and is obtained from whole autologous blood by using density-gradient centrifugation. The platelet concentration of platelet-rich plasma is four times higher than that of whole blood. Platelets when activated can induce the production of a variety of growth factors, such as platelet-derived growth factor, transforming growth factor β², epidermal growth factor and vascular endothelial growth factor. As such, platelet-rich plasma contains not only high levels of platelets but also the full complement of clotting factors. Preparation of platelet-rich plasma is quick, simple and relatively inexpensive. Moreover, because platelet-rich plasma is prepared from the patient’s own blood, the risk of experiencing complications is minimal.

Conclusion
Because platelet-rich plasma (PRP) is a GF–enriched with platelet concentrate–it could be promising in this effort. It is obtained from whole autologous blood by using density-gradient centrifugation. The platelet concentration of PRP is four times higher than that of whole blood³ and on activation, platelets can induce the production of a variety of GFs such, as platelet-derived GF (PDGF-AB), transforming GF β (TGF-β), epidermal GF (EGF) and vascular endothelial GF VEGF⁶,⁷. As such, PRP contains not only high level of platelets but also the full complement of clotting factors. Preparation of PRP is quick, simple and relatively inexpensive. Moreover, because PRP is prepared from the patient’s own blood, the risk of experiencing complications is minimal⁸.

Biological properties of platelet-rich plasma
PRP is an autologous concentration of platelets in a small volume of plasma⁹. Platelets are a rich source of the complex group of proteins called GFs involved in natural wound healing and in regeneration of injured tissues. GFs are active signals for attracting stem cells into the site of injury and triggering proliferation of these cells. These GFs have been shown to be mitogenic for osteoblasts and to stimulate the migration of mesenchymal progenitor cells¹⁰. Chemotactic and mitogenic stimulation of these mesenchymal stem cells occurs and leads to an enhancement of bone repair and regeneration. Degranulation of platelets granules by proteins such as thrombin causes them to actively release these factors and to initiate all wound healing¹¹.

The aim of this review is to discuss the efficacy of platelet-rich plasma in oral surgery and medicine.

Introduction
Advancements in medicine demand less invasive therapies and faster recovery times for large-area skin damage caused by burns, large ulcers and tumours. To cover the wound and aid in the recovery process skin grafting is often used. The materials for skin grafting has gradually developed from autogenous skin, allogeneous skin and even xenoskin to synthetic skin substitute, which was made using the ‘tissue-engineered skin’¹².

Currently, to continue to offer the best treatments available, the major avenues being explored are stem cells, gene therapy and autologous or bioengineered cytokines. However, these therapies are not yet ready for widespread clinical use¹³. So, intense research in regenerative medicine is towards accelerating the healing process by using various biological agents such as growth factors (GFs) that may improve the biological activity of graft substitutes¹⁴ promoting the repair of skin wounds.

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The platelets GFs include three isomers of the PDGF-AA, PDGF-BB and PDGFAB, two isomers of the TGF-A1 and TGF-A2, the VEGF and the EGF. Moreover, PRP contains adhesive proteins such as vitronectin (in the > granules of platelets), fibrin (in plasma) and fibronectin (in plasma). These factors can work both alone and synergistically to adhere to the wounded area in early stages of trauma, providing a good basis for wound repair and shortening repair time. So, by applying PRP alone or in combination with a bone graft, the concentration of the GFs and cell adhesion molecules will increase locally in the area of the bone defect, which seems to lead to faster and more effective bone regeneration, while the handling of the particulate bone grafts is significantly improved. This review gives an overview of the efficacy of PRP in oral surgery and medicine.

Objectives
A search on PubMed database was performed considering the literature from 2000 to 2012, using the following key words: PRP, wound healing, bone regeneration, dental surgery, oral surgery, tooth extraction, periodontal surgery and implant surgery. After abstracts screening, the full texts of selected papers were analysed and the papers found from the reference lists were also considered. The search focused on clinical applications documented in studies in the English language: levels of evidence included in the literature analysis were I, II and III. Literature analysis showed 35 papers that fulfilled the inclusion criteria: 12 randomised controlled trials, 4 comparative studies, 10 case series and 9 case reports.

Discussion
Obtainment of autologous platelet-rich plasma
Autologous PRP, useful for tissue healing and regeneration, is obtained from patient with a simply and minimally invasive procedure. After screwing the needle on the vacutainer butterfly, the tube is inserted in the system-vacutainer needle butterfly (Figure 1). About 9 mL of venous blood are collected from the patient. Thanks to this vacutainer, blood volume enters in the tube containing the anti-coagulant acid-citrate dextrose-A (sodium citrate), necessary for the division between the serum PRP and the packed cells of the blood. The tube is centrifuged for 15 min at 2200 rcf in a pre-setted speed and timer centrifuge equipment (Figure 2).
After centrifugation, following three phases can be observed in the tube (Figures 3 and 4):

Figure 1: System-vacutainer needle butterfly.
Figure 2: Centrifuge equipment.
Review

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Clinical application

Despite a recent explosion of clinical interest in PRP, the concept of harnessing a patient’s own blood to facilitate healing has existed since the early 1980s17. Currently, proponents of PRP believe that it will not only expedite the healing process but also improve the quality of the damaged tissue.

Generally, the clinical use and the benefits of PRP may enable patients to increase the hard- and soft-tissue wound healing with shorter recovery times, decrease of post-operative infection, oedema, ecchymosis, blood loss and pain during recovery.1,16–20.

Several publications report the use of PRP for different clinical applications, including periodontal21 and oral surgery (e.g. implantology)15–22, maxillofacial surgery (e.g. jaw reconstruction surgery)8, aesthetic plastic surgery (e.g. cleft palate surgery, soft-tissue defects and combination with fat grafting)23–26, orthopaedic surgery (e.g. treatment of chronic tendinopathy, tennis elbow, anterior cruciate ligament repair, rotator cuff repair, Achilles tendon...
Moreover, because GFs promote the tissue regeneration, clinically they have been applied in the treatment of chronic wounds, soft tissue damage, bone defect, wrinkle elimination, and acute trauma. Crovetti et al. found better and faster growth of granulation and epithelial tissues for healing cutaneous chronic wounds after PRP application. In plastic surgery and orthopaedics, PRP through PDGFs can even reduce the chance of second-time surgery and the occurrence of osteomyelitis, giving them good prospects of development in these fields.

**Conclusion**

As PRP is a vehicle of mitogenic and chemotactic cytokines and GFs, it shows to possess a beneficial effect for several clinical applications and makes its use more attractive than the use of a single recombinant GF. However, much of the existing published data on PRP have few laboratory studies documenting the content of the PRP, mechanism of action or short- and long-term outcomes.

**Abbreviations list**

EGF, epidermal growth factor; GF, growth factors; IGF, insulin-like growth factor; PDGF, platelet-derived growth factor; PPP, platelet poor plasma; PRP, platelet-rich plasma; TGF, transforming growth factor; VEGF, vascular endothelial growth factor.

**References**

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**Figure 5**: Autologous PRP after centrifugation. PRP, platelet-rich plasma.

**Figure 6**: PRP ready for clinical use. PRP, platelet-rich plasma.
Review


