Is platelet-rich fibrin really useful in oral and maxillofacial surgery? Lights and shadows of this new technique

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Abstract
Introduction
The healing of hard and soft tissues is mediated by a wide range of intra and extra-cellular events that are regulated by protein signals. It is known that platelets are involved in the process of wound healing through blood clot formation and release of growth factors that promote and maintain the wound healing.

Platelet-rich fibrin is a second generation of platelet concentrates which allows fibrin membranes to get enriched with platelets and growth factors, starting from an anticoagulant free blood harvest. Platelet-rich fibrin is similar to a fibrin network that allows cell migration and proliferation and consequently a more efficient cicatrisation.

Many growth factors such as platelet-derived growth factor and transforming growth factor are released from platelet-rich fibrin. Recent studies have demonstrated that platelet-rich fibrin has a very significant slow sustained release of key growth factors, which means that platelet-rich fibrin could stimulate the surrounding environment to a more rapid wound healing. This review aims to analyse the clinical results of platelet-rich fibrin in periodontology, oral surgery and head and plastic surgery.

Conclusion
The platelet-rich plasmas failed to demonstrate significant benefits that justify the daily use, and the use of platelet-rich fibrin is limited to some very specific applications in which satisfactory results were achieved. Only a new simple, inexpensive and efficient technique such as the leucocyte- and platelet-rich fibrin will continue to develop in oral and maxillofacial surgery in the next years.

Introduction
Platelet concentrate fibrin is an evolution of the fibrin glue widely used in the oral surgery. The principle of this new technology is based on concentrating platelets and growth factors in a plasma solution, and activating them in a fibrin gel in order to improve the healing of surgical wounds. This platelet suspension, defined as platelet-rich plasma (PRP), as the platelet concentrate used in transfusional medicine, is the precursor of another autologous derivated, the platelet-rich fibrin (PRF), a solid fibrin-based biomaterial. There are many different techniques to get the platelets concentrations, but its applications have caused some confusion, as each different method led to different products with different biological potentials and applications.

A recent classification of the different platelet concentrates divided them into four different categories depending on the leukocytes and fibrin content: pure platelet-rich plasma (P-PRF), such as cell separator PRP, Vivostat PRF or Anitua’s PRGF; leucocyte- and platelet-rich plasma (L-PRP), such as Curasan, Regen, Plateltex, SmartPReP, PCCS, Magellan or GPS PRP; pure plalet-rich fibrin (P-PRF), such as Fibrinet and leucocyte- and platelet-rich fibrin (L-PRF), such as Choukroun’s PRF. This classification allows us to analyse the successes and failures that have occurred so far in oral surgery, and direct research towards further applications of these technologies.

The different applications of the PRF were tested in various fields of surgery and particularly in periodontics, oral and maxillofacial surgery, ear–nose–throat plastic surgery.

In fact, these preparations are not limited to the concentration of growth factors, but associate many factors of healing such as leukocytes, fibrin matrix, circulating progenitor cells and are as complex as blood itself.

If platelet concentrates have been used to improve healing of surgical wounds (such as fibrin glue enriched with growth factors), further developments of these preparations include applications in regenerative medicine and tissue engineering. Obviously the future of these products is related with the scientific consistency of their applications. The aim of this review was to discuss PRF in oral and maxillofacial surgery.

Discussion
PRF applications in periodontology
The topical use of platelet concentrates is recent, and its efficiency remains controversial in periodontology for treatment of gingival recession. A 6-month randomised controlled clinical study has compared the results achieved by the use of a PRF membrane or connective
tissue graft (CTG) in the treatment of gingival recession and evaluated the clinical impact of PRF on early wound healing and subjective patient discomfort. No difference could be found between PRF and CTG procedures in gingival recession therapy, except for a greater gain in keratinised tissue width obtained in the CTG group and enhanced wound healing associated with the PRF group.

The same result was reached in another study, that did not demonstrate any clinical advantage of the use of PRF compared to enamel matrix derivative in the coverage of gingival recession with the coronally advanced flap procedure, but the enamel matrix derivative group showed a higher success rate in increasing wide keratinised tissue with respect to the PRF one.

The addition of an autologous PRF clot to a modified coronally advanced flap (MCAF) (predictable treatment for multiple adjacent Miller Class I or II recession-type defects), would improve the clinical outcome compared to an MCAF alone for the treatment of multiple gingival recessions. In fact the addition of a PRF membrane positioned under the MCAF inferior root coverage, has shown an additional gain in gingival/mucosal thickness at 6 months compared to conventional therapy.

PRF may be considered as the second generation of platelet concentrates widely used in surgery to facilitate wound healing. Another study evaluated the effectiveness of PRF and PRP in the treatment of periodontal intrabony defects in chronic periodontitis. The results showed similar pocket depth (PD) reduction, clinical attachment level (CAL) gain, and bone filling at sites treated with PRF or PRP compared with conventional open-flap debridement. Because PRF is less time consuming and less technique sensitive, it may seem a better treatment option than PRP.

Other studies investigated the clinical and radiological effectiveness of autologous PRF in the treatment of intrabony defects of chronic periodontitis patients, and the results showed there was greater reduction in PD, more CAL gain and greater intrabony defect filling at sites treated with PRF than the open flap debridement alone.

The association between PRF and bovine porous bone mineral promotes bone regeneration in periodontal defects, thereby reducing PD, improving CALs and promoting defect filling.

**PRF and oral surgery**

The regenerative medicine techniques are applied in dentistry to restore the bone loss: the PRF was tested for the first time in France by Dr. Choukroun. In Choukroun’s PRF protocol, blood is collected without any anticoagulant and immediately centrifuged. A natural coagulation process then occurs and allows for the easy collection of a L-PRF clot, without the need for any biochemical modification of the blood, that is, no anticoagulants, thrombin or calcium chloride are required.

**Figure 1:** Centrifuge.

**Figure 2:** Kit for blood sampling.

**Figure 3:** Blood separation after centrifugation.

**Figure 4:** PRF as it appears after centrifugation.
bone regenerative techniques include sinus lift for implant placement, which is considered one of the most predictable procedures for augmenting bone maxilla. Several approaches have been developed and are currently used to assess the relevance of simultaneous sinus lift and implantation seems to be a reliable surgical option promoting natural bone regeneration. Early reviews of the osteotome-mediated sinus floor elevation technique for localised sinus floor elevation and implantation have demonstrated a high degree of safety and success at sites with 5- to 8-mm residual subantral bone height.

PRF-based membranes have been used for covering the alveolar ridge augmentation side in several in vivo studies. A study has compared the use of PRF with the commonly used collagen membrane Bio-Gide as scaffolds for periosteal tissue engineering. PRF appears to be superior to collagen (Bio-Gide) as a scaffold for human periosteal cell proliferation. PRF membranes are also demonstrated to be suitable for in vitro cultivation of periosteal cells for bone tissue engineering.

The implant success is reached if implant is placed in an ideal anatomical position to facilitate a functional and aesthetic rehabilitation. However, this is not always possible, and in some cases techniques of alveolar bone augmentation are required to compensate for bone tissue loss. These interventions sometimes require complex surgery and the use of graft material derived from animal sources. L-PRF is a new platelet concentrate used with great success in a number of surgical procedures to optimise the wounds healing. Several studies demonstrated LPRF has the property of new bone formation. Advantages of PRF alone include less surgical time, elimination of techniques and potential healing difficulties associated with membranes, and less resorption during healing, as compared to guided bone regeneration procedures.

Another study analysed from a clinical and histological point of view, the potential use of PRF with the piezosurgery associated with deproteinised bovine bone (Bio-oss) as graft material in the augmentation of the maxillary sinus in case of severe bone atrophy comparing with a control group in which only Bio-oss was used. The use of PRF reduced healing times by promoting optimum bone regeneration. At 106 days was observed a good primary stability of endoesseus implants.

PRF for facial plastic surgery
It’s known that platelets play a role in homeostasis, but in recent years has been studied as they improve wound healing. It was demonstrated that platelet concentrate accelerates wound healing. The use of a new preparation, platelet-rich fibrin matrix (PRFM) for plastic surgery of the face, as volume augmentation, fat transfer supplementation, represent a new technique in aesthetic surgery. In fact injection of PRFM into the deep dermis and subdermis of the skin stimulates a number of cellular changes that can be harnessed for use.

Although platelet concentrates have enjoyed some success in plastic surgery a few years ago, interest has been gradually disappearing, because of the cost, the amount of blood, equipment, space, staff and the lack of evidence of benefit. A new simple method of preparing an autologous platelet derivative (Selphyl; Aesthetic Factors, Princeton, NJ) allows a rapid and inexpensive PRFM that can be used to improve healing after aesthetic facial interventions as well as to rejuvenate the face without tissue manipulation. The PRF produces an autologous and natural platelet concentrate that releases growth factors and stimulates the regeneration of the surrounding tissues for cosmetic applications.

A randomised clinical trial has studied the effect of topical PRF on epithelialisation of donor sites and meshed split-thickness skin autografts. The results have concluded that epithelialisation of donor wounds or the interstices of autografts was not significantly influenced by PRF treatment.

Fat grafts have always been induced neoangiogenesis. A study was designed to compare the efficacy of first- and second-generation PRPs combined with a fat graft during facial lipostructure surgery. The first comparative study highlights the efficacy of the platelets concentrates for adipocyte grafts. The results suggest that the combination of fat grafts and PRF is more effective than the combination of fat and PRP for facial lipostructure surgery.

Conclusion
The use of PRF allowed the reconstruction of the alveolar ridges at the gingival and bone levels. The PRF
makes it possible to overcome some technical limitations of an implant-supported oral rehabilitation. As a general conclusion it can be said that we live in a period of transition in the use of PRP and PRF in oral and maxillofacial surgery.

The PRFs failed to demonstrate significant benefits that justify the daily use, and the use of PRF is limited to some very specific applications in which satisfactory results were achieved. Only a new simple, inexpensive and efficient technique such as the L-PRF will continue to develop in oral and maxillofacial surgery in the next years.

References
2. Bielecki T, Dohan Ehrenfest DM. Platelet-rich plasma (PRP) and platelet-rich fibrin (PRF): surgical adjuvants, prepa-


cbicidal properties of leucocyte- and platelet-rich plasma/fibrin (L-PRP/

sus terminology in the field of platelet concentrates for surgical use: platelet-

rich plasma (PRP), platelet-rich fibrin (PRF), fibrin gel polymerization and leuc-

23. Mazor Z, Horowitz RA, Del Corso M, Prasad HS, Rohrer MD, Dohan Ehrenfest DM. Sinus floor augmentation with simultaneous implant placement using
Review

Choukroun’s platelet-rich fibrin as the sole grafting material: a radiologic and histologic study at 6 months. J Periodontol. 2009 Dec;80(12):2056–64.


