Clinical evaluation of socket preservation utilizing L-PRF prior to implant placement in the anterior maxilla. A case report.

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INTRODUCTION

The quality and quantity of alveolar bone determines the clinician’s ability to restore edentulous spaces with dental implants. Often, the alveolar ridge resorbs considerably as it heals and remodels after an extraction
to thus restricting the placement of a dental implant. Tooth extraction results in alveolar bone loss due to atrophy of the edentulous ridge.2,3 A significant amount of bone resorption occurs in the extraction socket and alveolar ridge in the first 6 months following tooth extraction, and this negatively influences the remaining volume of bone available for dental implant placement.4,5 During the process of healing, an extraction socket gradually changes from a blood clot to a provisional matrix to a mineralized bridge over bone marrow. As the socket heals, a considerable amount of the width is lost, most happening in the first 3 months, and a considerable amount of height is lost as well. Ten Heggeler et al.7 analyzed articles pertaining to socket preservation in non-molar regions in humans. The results varied, but after an extraction, it was concluded that one could likely expect a reduction in ridge width from 2.64.6mm and a reduction in ridge height of 0.4-3.9 mm when the alveolus is allowed to spontaneously heal. Research has demonstrated that the alveolar ridge in the maxillary anterior area can be reduced by 23% in the first 6 months after exodontia, and an additional 11% in the following 5 years.6 Reduction in alveolar ridge height and width may prohibit optimal implant placement, and often compromises the esthetic and functional result9.

Alveolar ridge preservation has been evaluated in many studies.10,11,12,13 There have been several graft regimens and techniques that have been suggested to limit alveolar ridge atrophy and to evaluate the osteogenic capacity of extraction sockets.14,15,16 Multiple bone graft materials have been studied for their ability to enhance bone formation in damaged alveolar ridges9,17 and to evaluate their bone healing and bone-forming capacity in extraction sockets.18,19

Studies have shown that platelet concentrates for surgical use can be used as efficient adjuvants for wound healing and tissue repair.20,21 The growth factors such as platelet-derived growth factors (PDGF), vascular endothelial growth factors (VEGF) and transforming growth factors (TGF-β) as well as the other molecules (fibrinogen, fibronectin, and vitronectin), which are contained in platelets, give rise to these products ability to modulate many phases of the healing process (hemostasis and the neoangiogenesis).22

Platelet-rich fibrin (PRF), described by Choukroun et al.,23 is a second-generation platelet concentrate which consist of fibrin membranes enriched with autogenous cytokines, platelets, and growth factors that originate from anticoagulant-free blood harvest.24,25,26,27 It was first used in implant surgery to improve bone healing25. PRF looks like a fibrin network that has important properties of healing such as harnessing the circulating stem cells, immune control, and wound protection by epithelial cover28, thus leading to more efficient cell migration, proliferation, and angiogenesis. The properties of PRF are considered for promoting both soft tissue and bone regeneration and are suitable for ridge preservation particularly.

Little information is available on clinical and histologic evaluations of extraction sockets with PRF. In this case report, we present the clinical characteristics of a patient who underwent a tooth extraction and had the socket filled with L-PRF as the sole grafting material in preparation for implant placement.

CASE REPORT

A 61-year-old male was referred to the Department of Periodontics, University of Florida College of Dentistry (Gainesville, Florida), with the complaint of pain in his maxillary left central incisor. His medical history is unremarkable. A periapical film (Fig. 1) revealed external resorption on the mesial aspect of the root along with a radiolucency at the apex and extending up the distal portion of the root. This tooth was diagnosed as a combined perio-endo lesion with a possible vertical root fracture. The tooth was planned to be extracted and L-PRF was used to fill the socket in preparation of implant placement after wound healing.

After local anesthesia was obtained, the maxillary left central incisor was removedatraumatically. The socket was curedtted and all granulation tissue and socket debris were removed and rinsed with copious amounts of irrigant. At this time, it was noted that a large fenestration was present in the facial bone plate (Fig. 2). In order to further evaluate the extent of the fenestration, a sulcular incision from #8-#11 with a vertical releasing incision on the distal line angle of #11 was developed, followed by a full thickness flap.

Samples were drawn from the antecubital fossa of the patient into eight separate 10ml blood collecting tubes (Becton

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Dickinson Vacutainer, Franklin Lakes, NJ, USA). The L-PRF was prepared through a single centrifugation of blood according to the protocol of Dohan Ehrenfest et al. (now marketed as Intra-Spin L-PRF kit, Intra-Lock, Boca-Raton, FL, USA) for a period of 12 minutes at 2700 rpm. The blood in the tubes separated into three visible layers: a red blood cell layer (RBC) that occupied the lower most part of the tube, a cell-free layer that occupied the uppermost part of the tube, and an L-PRF layer located between the two. For each tube, the L-PRF layer was removed, and placed into a condensing former to form an "L-PRF plug". A total of eight L-PRF plugs were formed and inserted into the extraction socket site (Fig. 3).

Following the application of the L-PRF, an appropriate sized collagen membrane (Ossix Plus, Orpharma, Israel), was selected, trimmed, and placed to cover the fenestration and extraction socket. The flap was mobilized to permit tension-free closure. The flap was closed with an expanded polytetrafluoroethylene suture (Cytoplast, Osteogenics Biomedical Inc, Lubbock, TX). Single interrupted sutures were placed close to the edges of the flap trying to leave a 4-mm thick connective tissue layer between the membrane and the oral epithelium. The vertical incision was closed with single interrupted sutures. The patient's tooth root was then shortened and the crown was bonded to the adjacent teeth. Sutures were removed 14 days post-surgery.

Post-operative antibiotics (Amoxicillin 500 mg, three times a day for one week) and an anti-inflammatory medication (Ibuprofen 800 mg, three times a day for a week) were prescribed. Chemical plaque control using 0.12% chlorhexidine gluconate solution was used daily from 24 hours post-surgery until the time of suture removal. Postoperative swelling occurred with a maximum swelling at 48 hours post-surgery. It subsided as healing occurred and was completely absent at the time of suture removal. Post-operative discomfort was primarily associated with tension from the swelling and tails from the suture knots and pain was minimal.

After 4 months of uneventful healing (Fig. 4), the extraction site was surgically reentered for implant placement employing the same full thickness flap design (Fig. 5). At the time of implant insertion, the socket was completely filled by a hard material, which exhibited the consistency of bone on probing. An almost completely preserved alveolar volume was measured by a periodontal probe. An osteotomy for implant insertion was performed in an axial apico-coronal direction following manufacturer's protocol, and a single 4.5x12mm implant (BioHorizons Birmingham, Alabama) was inserted in a two-stage manner with a cover screw (Fig. 6). Tissue was reapproximated and sutured with expanded polytetrafluoroethylene suture. After 4 months of healing, a custom abutment (Atlantis, Dentsply, Waltham, MA) was milled and an all-ceramic crown was cemented. The patient was then recalled 1 year later for evaluation including an X-ray (Fig. 8).
DISCUSSION

L-PRF is easy and inexpensive to prepare for frequent use, and it exists in the form of L-PRF clots or membranes (after compression). L-PRF is an immune and platelet concentrate collected on a single fibrin membrane that contains all of the elements favorable for healing and immunity.23,24 L-PRF can be considered a natural fibrin-based biomaterial favorable to the development of microvascularization and had the ability to guide cell migration into a wound. It can accelerate wound healing as the matrix contains leukocytes and promotes their migration into the wound. The membrane releases a significant quantity of autologous growth factors (particularly PDGF, TGF-β, and VEGF), cytokines, and healing proteins.29 Recent studies demonstrated that the L-PRF membrane has a very significant slow sustained release of key growth factors for at least 7 to 10 days and up to 28 days.30 A study by Passaretti et al.32 showed that L-PRF released more than 15-fold VEGF and more than 2-fold TGF-β1 when compared to platelet-rich plasma (PRP).

This case report was designed to show the efficacy of L-PRF in socket healing after tooth extraction. Marenzi et al.31 summarized the effects of L-PRF and showed that they could be related to the biochemical and structural features of the L-PRF25,26,27 which collects a large quantity of leukocytes (about 60% of the initial blood harvest) and platelets embedded in a fibrin matrix.26 The fibrin architecture is organized by connected trimolecular junctions24,25 due to a slow polymerization of the platelet concentrate as well as to the absence of heterologous thrombin. This can induce a flexible fibrin network able to promote the release of growth factors and leukocytes migration.26 The fibrin membrane promotes the mechanical protection of the surgical site and bioologically, it interacts with the physiological mechanisms of healing favoring angiogenesis.23,24 The fibrin induces the expression of αvβ3 integrin by endothelial cells, allowing links with structural proteins, such as fibronectin and vitronectin, and supports the process of capillary formation.23 The immunological properties of the L-PRF, resulting from its leukocyte content, could be useful in the prevention of surgical site infections, with a concomitant reduction of inflammation. The presence of leukocytes is a very important parameter to stimulate healing and wound control.36

Choukrar et al.28 reported neovascularization forms through the PRF clot, an epithelial covering develops, and rapid healing of the wound is observed without pain, dryness, or purulent complications. Clinical results from this case were very similar as there was uneventful healing with no episodes of infection or unfavorable clinical symptoms. Taken together, the use of L-PRF for grafting may improve the clinical healing of a fresh extraction socket.

This case report demonstrates that PRF does not interfere with the clinical healing process when applied to a fresh extraction socket. In addition, it seemed to reduce alveolar ridge resorption following tooth extraction and to positively influence socket healing over a 4-month period. Further documentation using long-term, randomized clinical trials is necessary prior to recommending this new treatment technique for routine clinical practice.

REFERENCES


33. Dohan D. M. Ehrenfest, T. Bielecki, R. Jimbo et al., “Do the fibrin architecture and leukocyte content influence the growth factor release of platelet concentrates? An evidence-based answer comparing a pure platelet-rich plasma (P-PRP) gel and a leukocyte- and platelet-rich fibrin (L-PRF),” Current Pharmaceutical


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