



Efficacy of L- PRF Application in Socket Preservation Techniques Following Tooth Extraction

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Abstract

Introduction: Socket preservation strategies are indicated to minimize loss of bone volumetric and density after tooth extraction. Leucocyte platelet rich fibrin is obtained from patient own blood through centrifugation, trapping growth factors and cytokines in the fibrin clot fraction.

Objectives: The aim of this review was to evaluate technique which includes using of platelet- rich fibrin L- PRF. Leucocyte platelet rich fibrin is obtained from patient own blood through centrifugation, trapping growth factors and cytokines in the fibrin clot fraction.

Conclusions: Use of L-PRF accelerates angiogenesis, soft and hard tissue healing, bone formation and tissue cicatrization what can significantly inhibit bone restoration after tooth extraction. Furthermore L- PRF membrane isolate wound from oral cavity environment what can limit inflammation. Leucocyte platelet rich fibrin has also antibacterial effect. Moreover using L- PRF decrease pain level, halitosis and other unpleasant sensations.

Results: The best results are obtained in combination with hydroxyapatite xenograft, better than in techniques where L- PRF or xenograft are used alone. Tooth extraction should be performed flapless and a traumatically using periotomes. Tooth should be sectioned when it is possible.

Keywords

PRF; L- PRF; Platelet rich fibrin; Socket preservation; Extraction socket

Introduction

Socket preservation techniques involve surgical procedures which aim at preventing bone resorption, soft tissue collapse and keeping bone volumetry and density for future implantation. Extraction of a tooth usually leads to atrophy of alveolar ridge caused by resorption and remodeling of the bone. The bone level and volumetry of alveolar process is dependent on tooth and periodontal ligament presence. After extraction the loss of blood supply from periodontal ligament leads to atrophy of bundle bone and serious vertical and horizontal resorption [1,2].

These changes are lifelong and irreversible. The rate of atrophy is most significant during the 3-6 months following extraction [3]. The mandible is usually more affected than the maxilla, and the buccal plate is more commonly affected than its lingual/palatal counterparts [4]. Vertical bone involution varies from 0.7 mm to 1.5 mm in clinical studies and horizontal bone involution from 4.0 mm to 4.5 mm in the first 6 months following tooth loss [5].

Materials for Conservative Socket Preservation

Different biomaterials have been proposed to fill socket following extraction of a tooth [6,7]. There are no clear guidelines which material is the best for application into a tooth socket [8,9]. Systematic reviews concluded that xenografts performed better in comparison with alloplastic materials in natural healing to preserve the level of the ridge [7]. Despite the good results in volumetry following xenograft application, it may cause filling the socket by non-vital bone, remnant particles, and connective tissue [7]. These remnants and bad quality of the bone may decrease the osseointegration and bone-to-implant contact (BIC) [10]. Socket grafted with alloplastic materials provided higher amount of vital bone and least amount of remnant material in comparison with xenograft [7,11].

Flapless Extraction Approach

The most important factor determining success of socket preservation is flapless and a traumatic extraction. Advantages of flapless approach like reduced healing time, discomfort and inflammation, are widely described [12-14]. This method results in preservation of

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good blood supply to inner part of alveolar process- bundle bone and inhibiting the resorption. Tooth extraction should be a traumatic using periotomes and tooth should be sectioned whenever required [2].

Leucocyte Platelet-Rich Fibrin History and Biochemistry

In the recent years, high-platelet fibrin isolates have been used in oral surgery and other fields of medicine. Some of their applications include prevention of bone loss after tooth extraction with the Socket Preservation Technique, treatment of joint degeneration and synovial fluid and capsule restoration, stimulation of nerve repair, aiding hair growth, and regeneration of skin, muscles and ligaments. The regenerative potential of platelets was demonstrated in 1974 by Ross et al. [15]. In 2006 Choukroun et al. recognized Platelet Rich Fibrin (PRF), which can be obtained through centrifugation, trapping growth factors and cytokines in the fibrin clot fraction [16,17].

L-PRF is obtained from the patient's own centrifuged blood. Three biological fibrin phases are separated. A layer of coagulated red blood cells is located at the bottom of the tube. The middle layer is the L-PRF layer –it contains a high amount of platelet aggregates, leukocytes and growth factors and has the form of condensed elastic gel, which can subsequently be compressed into a membrane for application. The top layer is a liquid cell-free filtrate also known as Platelet Poor Plasma (PPP) [18-20]. L-PRF contains 95% of the platelets and 50% of the leukocytes from the original blood sample [21]. High-platelet fibrin has been shown to contain several factors [19,21] such as the platelet-derived growth factor (PDGF), transforming growth factor beta-1 (TGF β 1), transforming growth factor beta-2 (TGF β 2), vascular endothelial growth factor (VEGF), fibroblast growth factor (FGF), insulin-like growth factor (IGF), interleukin 1 beta (IL-1 β), interleukin 6 (IL-6), interleukin 4 (IL-4) [22] and a number of platelet-specific proteins (thromboglobulin) and proteins not specific to platelets (fibrinogen, fibronectin, fibrin, thrombospondin). Additionally, PRF has also been shown to contain CD 34+ stem cells [19,23]. The transforming growth factor beta-1 (TGF β 1) regulates inflammation and is the strongest fibrinogenic factor among cytokines. It induces intensive synthesis of collagen and fibronectin. Platelet derived growth factor (PDGF) regulates the migration, proliferation and viability of mesenchymal cell lines. Moreover, it plays a fundamental role in physiological scar formation [21]. Vessel-derived growth factor (VEGF) is a vascular growth factor with the broadest spectrum of action. It is responsible for initiation of angiogenesis, and various combinations of isoforms of VEGF are responsible for remodeling or rebuilding the vascular network. Interleukin 1 (IL-1) is a mediator of inflammation control and its main task is to stimulate T-helper cells. In combination with TNF-alpha, it activates osteoclasts and stops bone formation [24]. Interleukin 6 (IL-6) is a differentiation factor for B-lymphocytes and a T-lymphocyte activator. It significantly increases the secretion of antibodies in B-lymphocyte populations, which supports the reaction chains that cause inflammation, tissue destruction and remodeling [22]. The tumor necrosis factor (TNF-alpha) activates monocytes and stimulates the remodeling capacities of fibroblasts. In addition, it increases phagocytosis and cytotoxicity of neutrophils and regulates the expression of IL-1 and IL-6 factors [22,25]. Interleukin 4 (IL-4) supports the proliferation and differentiation of activated B-lymphocytes. During inflammation, it supports healing by regulating the inflammatory process. It increases fibroblast collagen synthesis and inhibits IL-1 stimulation of MMP-1 and MMP-2. There are also some reports that IL-4 limits the production of IL-1 β , TNF-alpha and prostaglandins (PG) in response to endotoxin or Interferon gamma (IFN-gamma) activation of cells [26,27]. Studies have also reported the pro-regenerative [22] and antibacterial effects of platelet-rich fibrin [28]. Due to its pro-regenerative nature, platelet-rich fibrin is used for bone reconstruction after tooth extractions, in implantology and as an agent thickening soft tissues in perio-surgical procedures [29]. Based on these biochemical factors researchers proposed using L- PRF to counteract atrophy after

extraction, stimulate soft tissue regeneration, decrease pain level and other unpleasant sensations.

Leucocyte Platelet-Rich Fibrin in Socket Preservation

In recent years many papers have been published on the effect of L- PRF in socket preservation in human body. Soft tissue healing was evaluated in two studies [33, 34]. In both of them application of L-PRF resulted in better condition of soft tissue and faster healing. One study used Landry's soft tissue healing index which includes tissue color, alveolar ridge epithelialization, presence of granulation tissue and suppuration, alveolar ridge epithelialization. The other study used periodontal probe to measure and evaluate the level and rate of soft tissue healing. Postoperative health-related quality of life was rated in one study using questionnaire assessing patients' perception of recovery in four main areas: pain, oral function, general activities and other symptoms. Pain level measured by means of Visual Analogue Scale (VAS) was significantly less intense in the first three days following extraction in the PRF groups [30,31]. Patients in those groups reported also less bad taste, less halitosis and lower food accumulation in post- extraction wounds [30]. Hard tissue healing was evaluated in three studies [32-34] but only two of them concluded that L-PRF significantly reduced bone resorption [32,33] and increased level of trabecular bone and bone volume. In one paper there were no significant improvements in horizontal resorption [34]. Horizontal changes of hard and soft tissue combined with were measured in one study [34] which confirmed that L- PRF has a positive effect on the horizontal bone level 2 months after extraction. Histomorphometric analysis was presented in one study which summarized that number of CD34+ cells and von Willebrand factor was slightly greater after use L-PRF 8 weeks after extraction [35]. In micro-CT analysis- Hauser et al. [32] found greater bone volume in L-PRF group. Farina et al. [35] didn't find statistically significant differences in bone density or volume. More recent papers seem to confirm the conclusions of earlier authors. In the report of De Angelis L- PRF mixed with xenograft results in lower bone resorption than in groups where L- PRF or Xenograft were used alone [2]. Two studies indicated the accuracy of the use of Xenograft combined with platelet-rich fibrin and collagen plug [36,37]. One study Temmerman, et al. [11] confirmed legitimacy of use L- PRF alone and indicates a decrease of vertical and horizontal bone resorption. L-PRF membranes isolate augmented socket from environment of the oral cavity, which precludes open healing state and loss of biomaterials what could affect the outcomes negatively [31]. Due to its antibacterial effect, L- PRF can inhibit inflammation process [28]. Furthermore, L- PRF can accelerate tissue cicatrization, angiogenesis, bone formation and wound covering epithelialization [32].

Summary

Based on above data, the use of leucocyte platelet-rich fibrin L-PRF seems to be very promising for socket preservation. Use of L-PRF accelerates angiogenesis, soft and hard tissue healing. Nevertheless, the best results are obtained in combination with hydroxyapatite xenograft. There is still necessity to conduct more studies and work on procedure guidelines.

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