

THE VALUE OF PLATELET RICH FIBRIN IN BONE REGENERATION FOLLOWING TOOTH EXTRACTION

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ABSTRACT

Aim of the study To determine the effect of platelet-rich fibrin (PRF) on hard tissue healing following tooth extraction. **Material and methods** The study included 63 patients and a total of 183 extractions were performed. The study had a split-mouth design. Each patient had a study side where the sockets were filled with PRF and a control side, where the postextractional sockets underwent natural healing, by clot formation. After 3 months, for the evaluation of hard tissue quality, a bone density measurement was done using a Cone Beam Computer Tomogram (CBCT). **Results** Statistical analysis revealed a significant increase in bone density in the postextractional sockets where PRF was used as filling material. **Conclusions** It can be concluded that through the use of PRF as an augmentation material after tooth extraction the hard tissue healing process is significantly enhanced.

Key words: Platelet Rich Fibrin, Bone regeneration, Tooth Extraction

INTRODUCTION

Tooth extraction is the most common procedure performed by oral surgeons. The postoperative physiological progress consists in a modification of the bone-alveolar structure (1) and a three-dimensional resorption pattern (2). Nowadays, to avoid the postextractional alterations, more frequent the tooth extraction is finalized with a variety techniques of bone augmentation.

In recent years, attention was directed towards the use of platelet rich fibrin (PRF), as an augmentation autologous biomaterial.

PRF is a second-generation platelet concentrate and consists of a three-dimensional fibrin matrix, in which are incorporated platelets, growth factors, leukocyte, cytokines and circulating stem cells (3-5). This combination and due to the fact that the fibrin matrix is denser than a blood clot, PRF enhances soft and hard tissue healing and regeneration (6).

PRF contains a large variety of growth factors and some of them play an important role in osteoblast activity, modulating their response. Through this complex process, it could be explained the effectiveness of PRF in improving bone healing (7).

MATERIAL AND METHODS

A split-mouth study was conducted in the Oral and Maxillofacial Surgery Department, “Sf. Spiridon” Emergency Clinical Hospital Iasi, Romania. The ethical board approved the study protocol and all patients signed informed consents.

In the study were included a total of 63 patients, 21 male and 42 female, between 18 and 58 years of age, who needed bilateral dental extractions. A number of 183 extractions were performed, 109 in maxilla and 75 in mandibula. Also, being a split-mouth study, each patient had a study side where the sockets were filled with PRF and a control side, where the postextractional sockets underwent natural healing, by clot formation. The inclusion criteria for tooth

extractions were presence of retained roots, no restorable caries or orthodontic indications.

The surgical procedure

All the patients received, before the surgical procedure, a panoramic radiography and all were treated by the same operator. The extractions were performed under local anesthesia, being administrated an alveolar nerve block infiltration, using 2% mepivacaine hydrochloride. Tooth extractions were performed following atraumatic techniques, without raising a full-thickness mucoperiosteal flap. After the extraction, the alveolar walls were intact, in order to have the support not only for the blood clot but also for the PRF clot. All sockets were closed using a conventional mattress suture (X suture). Postoperatively, the patients received antibiotic (amoxicillin 875 mg and clavulanic acid 125 mg) 3 times /day for 5 days. All patients were recommended to use, after the surgical interventions 0,12% chlorhexidine mouthwash, for 2 weeks. The sutures were removed on the seventh postoperative day.

The preparation protocol of the PRF clot

The preparation of PRF required:

- A table centrifuge PC-02 (Fig.1)



Fig.1. Centrifuge

- Blood collection kit including a 24-gauge butterfly needle

- 10 ml collection tube
- PRF-Box (Fig. 2)



Fig.2. PRF-Box

Before the surgical procedure, a venous blood sample was taken from the patient's forearm, without anticoagulant, in 10 ml tubes and immediately centrifuged at 1500 rpm for 14 minutes. The total amount of tubes collected was related to the dimensions of the alveolar sockets, with the purpose of filling them completely. After centrifugation, the final product was formed of three layers: at the top, the acellular plasma, at the bottom, the red blood cells and in between, the fibrin clot (Fig.3).

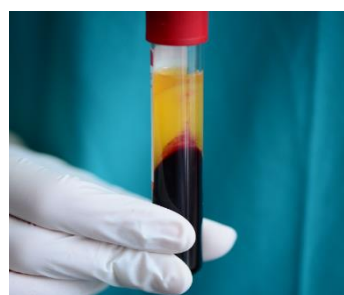


Fig. 3. Final product after centrifugation, with the three layers: the acellular plasma, the fibrin clot and the blood cells

The PRF clot was removed from the tube, was separated from the red blood cells with the help of a sterile forceps (Fig. 4).



Fig.4. PRF clot

The clot was placed in the PRF box. For the extractions sites, the PRF was prepared as a plug in the white cylinder from the box with the help of a metal piston (Fig.5a, 5b).



Fig.5a. Preparation of the PRF plug with the help of a metal piston

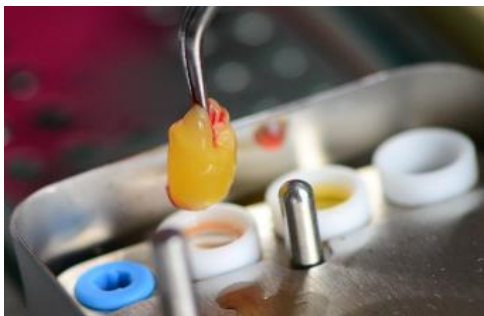


Fig.5b. PRF Plug

The PRF plugs were introduced in the extraction sites and secured with a 'X' suture.

Steps of clinical assessment

Patients were followed after one week postoperatively, when the sutures were removed and the surgical sites were inspected. The level of postoperative pain was also evaluated. For the evaluation of hard tissue quality, a bone density measurement was done using a CBCT, after 3 months. For the evaluation of the bone density on the reconstruction from CBCT

scans we chose a region of interest: the central area from the root socket.

RESULTS

All of the patients completed the study and there were no complications regarding the wound healing, such as postextractional bleeding or alveolitis. The patients declared less pain in the sockets where the PRF plugs were used. After 7 days, when the sutures were removed, the clinical outcome in the PRF alveolar sockets was significantly improved: no swelling, no bleeding on palpation and the wound margins were very good epithelised. After 3 months, the bone density evaluated on CBCT was measured for every root socket. Accordingly to the p-value, a statistically significant difference was observed between PRF and control group.

The bone density on the CBCT images was evaluated using Hounsfield units (HU). By the monoradicular teeth where the PRF plugs were used, the bone density was undoubtedly increased ($p=0.00484$) in compare with the control side. By the pluriradicular teeth, the bone density was measured for every root socket: by the mandibular molars, mesial und distal root, and by the maxillary molars, mesiobuccal root, distobuccal root and palatal root. The bone density was considerable enhanced both for the mesial ($p<<0.001$) and distal roots ($p=0.00304$) for the mandibula. The same results were obtained for the maxilla where the augmentation with PRF was performed: the mesiobuccal ($p<<0.001$), distobuccal ($p<<0.001$), palatal ($p<<0.001$) roots.

Moreover, due to the high image quality of CBCT we could observe a dense trabecular bone structure in the sockets where PRF was used as filling material (Fig.6).

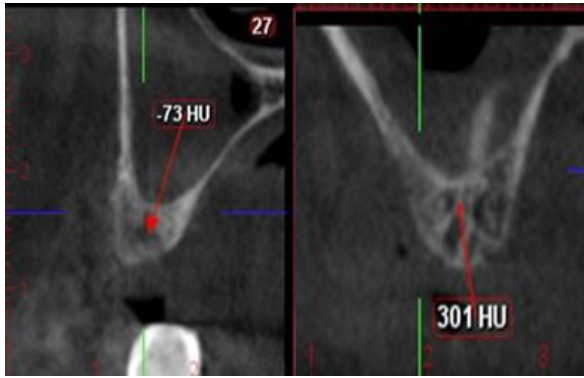


Fig.6. Trabecular bone pattern, alveolar socket with no PRF (left), alveolar socket

DISCUSSIONS

Our study establishes that the use of PRF as an augmentation material following teeth extractions improves bone healing and architecture.

PRF is an autologous biomaterial. Platelets and leucocytes are enmeshed within the three-dimensional fibrin network and they store a variety of growth factors, which are slowly release allowing gradual angiogenesis, immune control, circulating stem cells trapping and wound-covering epithelization (8). J. Kim et al. determined the bone regeneration capability of PDGFs (Platelet-derived growth factor) and TGF- β (Transforming growth factor β), growth factors within PRF. Their study showed that PRF, which contains a large amount from these growth factors, engages in osteoblast activity and tissue regeneration, accelerating the bone healing process through osteoblast proliferation, differentiation and finally bone generation (7).

Based on these remarks, our study has evaluated the bone regeneration after 3 months following tooth extraction, by measuring the bone density using a CBCT upon monoradicular and pluriradicular teeth. The bony walls were preserved before and after the extraction for a better support of the blood and PRF clot. This criteria has influenced the bone regeneration and subsequently the bone density. The statistical analysis demonstrated that by using PRF as a filling material of the alveolar sockets, the bone quality was

with PRF (right). It is visible newly formed bone trabeculae in the alveolar socket with PRF

superior to the control side, enhancing the bone regeneration.

These findings correlate with the results of Girish Rao et al. They conducted a study with 22 patients requiring bilateral transalveolar third molar extractions and one side was randomly chosen for the use of PRF (9). Their study evaluated the effects of PRF on bone regeneration. The bone formation was measured using serial radiographs at day 0 and one, three and six months. The results demonstrated higher mean pixels in the PRF group, but unfortunately the reported difference between study and control group was not statistically significant, because the sample size (number of patients) was too small. In our study were included a total of 63 patients, who needed bilateral dental extractions.

Furthermore, the evaluation of the alveolar sockets filled with PRF on the image reconstruction from our CBCT scans revealed a higher number of newly formed bone trabeculae. Haser et al carried out one of the first studies, which included 24 patients, and showed that PRF is capable of inducing new bone formation in postextractional sockets (10). They analyzed the bone healing with a microcomputed tomography and proved that with the help of PRF both the bone formation and architecture were improved. Their study also demonstrated that by performing a surgical extraction with a mucosal flap, the clinical effects of PRF are reduced. For these reasons, in our study the tooth extractions

were performed following atraumatic techniques, without raising a full-thickness mucoperiosteal flap.

Anwandter et al published a non-comparative study with 18 patients analysing the bone healing in alveolar sockets after the use of PRF, being the first who has used as a measurement instrument the CBCT (11). The study demonstrated that the use of PRF can be effective in reducing dimensional changes in comparison with natural healing. However, the authors mentioned the limitations of the study, because both a split-mouth design and a higher sample size are necessary to assess the role of the PRF in reducing bone resorption.

Temmerman et al. evaluated in a split-mouth, randomised study, with 22 patients, the influence of PRF as a socket filling material on ridge preservation (12). A CBCT scan was performed at day 0 and after three months. The study showed that when using PRF as a socket filling material, the horizontal and vertical ridge dimension can be preserved. The limitation of the study is the low number of the included patients.

Marenzi G. et al. conducted a split mouth study consisting of 26 patients and proved that PRF improves the early healing phases, reducing the inflammatory process

and the risk of infection (13). In our study, after 7 days, when the sutures were removed, the clinical outcome in the PRF alveolar sockets was also significantly improved: no swelling, no bleeding on palpation and the wound margins were very good epithelised. The fibrin network acts like a mechanical protection membrane on the surgical site and because of its content in leucocytes, PRF prevents the surgical site infection (14).

The clinical experience shows that PRF is a autologous biomaterial that accelerates physiological healing, reducing the postoperative symptoms and complications (15).

CONCLUSIONS

The present study showed that bone tissue healing improves with the help of PRF. Bone density measurements using postoperative CBCT demonstrated that by filling the postextractional sockets with PRF the bone quality can be improved, enhancing the bone regeneration. Moreover, the application of platelet rich fibrin reduces the postoperative pain and supports the soft tissue healing process in the first days after the extraction. But more research is needed to evaluate the effect of PRF on bone regeneration.

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