

Influence of PRF in the healing of bone and gingival tissues. Clinical and histological evaluations

M. MARRELLI, M. TATULLO

Tecnologica Research Institute, Biomedical Section, Crotone, Italy; and
Calabrodental Clinic, Maxillofacial Surgery Unit, Crotone, Italy

Abstract. – INTRODUCTION: The healing of bone tissues around dental implants is based primarily on a correct osseointegration.

BACKGROUND: Typically, implants stability and peri-implant tissues health are anticipated to decrease during the early weeks of healing; this is followed by an increase in stability.

AIM: The aim of the present study is to assess a predictable protocol in order to increase the peri-implant tissues maintenance around post-extractive dental implants, thanks to the use of Platelet-Rich Fibrin (PRF) membrane.

MATERIALS AND METHODS: This is a retrospective observational study of 127 tapered dental implants placed in the immediate post-extraction sites of maxillary bone of 59 patients.

Atraumatic dental extraction and flapless implant surgery was performed in all reported cases. The cortical bone position relative to the implant reference point was evaluated at implant placement and 10 to 24 months following implantology. The gap between bone tissue and the implant surface was measured up to a maximum of 3 mm. After placing implants we have filled the surgical site with a PRF gel, so as to fill the gap between bone tissue and the implant surface, and then we have covered the surgical site with a PRF membrane, so as to coat the gap between the alveolar crest and the implant.

RESULTS: In all cases, we observed the complete covering of the dental implants, with newly formed soft tissue of variable thickness between 1 and 3 mm. Cortical bone adaptation from the time of implant placement up to 30 months following prosthetic restoration ranged from 0.4 mm to 1.7 mm.

CONCLUSIONS: Our study showed a series of successful rehabilitations, with post-extraction implantology technique, in 99.8 percent of cases, despite the success rates in the medium and long-term post-extraction implantology reported in the literature range between 92.7 percent and 98.0 percent. Long-term maintenance of crestal bone and the rapid healing of soft tissue dimension with maintenance of peri-implant papilla were observed as outcomes after post-extractive implants insertion.

Key Words:

Post-extractive implants, Peri-implant tissues maintenance, Platelet-Rich Fibrin.

Introduction

The healing of bone tissues around dental implants is based primarily on a correct osseointegration¹. Placement of dental implants in both maxillary bones leads to a series of healing events, including necrosis followed by resorption of the traumatized bone around the implant surface concomitant with new bone formation. Typically, implants stability and peri-implant tissues health are anticipated to decrease during the early weeks of healing; this is followed by a new increasing of implant stability².

This is related to the biologic reactions of the bone and soft tissues to surgical trauma. After implant insertion, one millimetre of the bone around the implant undergoes to necrosis; this process is followed by new bone apposition initiated by osteoblastic activity³. Early crestal bone loss of about 1.5mm is often observed during the first year after implant loading: crestal bone loss of course produces several changes in soft tissues level around implant⁴.

Considering that hard and soft tissues modifications may cause aesthetic and biological concerns, the planning of a protocol that improves the peri-implant tissues maintenance provides the best approach to an immediate post-extractive implantology highly predictable.

Background

Platelet-Rich Fibrin

A new supplement to procedures of tissues regeneration is represented by a platelet concentrate

Table I.

Diameter of implants	No. of cases	No. of implants	No. of implant failure	Implant success (%)
4.5 mm	52	106	1	99.6
3.5 mm	7	21	0	100
Total	59	127	1	99.8

called PRF (*Platelet-Rich Fibrin*): it was tested for the first time in France by Choukroun et al⁵.

PRF is able to regulate inflammation and to stimulate the immune process of chemotaxis. This natural material actually seems to accelerate the physiological wound healing; besides, in association with bone grafts, it seems to accelerate new bone formation⁵.

In the last years, PRF concentrates have been widely used as a supplement to tissue regeneration procedures⁶.

The immediate post-extractive implants have problems related to the healing of the surgical site based on the osseointegration as well as to the difficult closure of the surgical site by the peri-implant soft tissues.

Aim

The aim of the present study is to investigate if and how PRF could improve the peri-implant hard and soft tissues maintenance around post-extractive dental implant.

Materials and Methods

This is a retrospective observational study of 127 tapered dental implants placed in the immediate post-extraction sites of upper maxillary bone of 59 patients (30 males and 29 females aged between 42 and 64 years) involved in this study: all surgical procedures were carried by the same two oral surgeons between April 2008 and July 2010 in the maxillofacial surgery unit of Calabrodental Clinic, Crotone, Italy.

Before treatment, patients were adequately informed about the surgical procedures, first verbally and then with a written form for the informed consent.

Exclusion criteria were ongoing steroid therapy, non-compensated diabetes, recent cardiovascular diseases, recurrent sinusitis, previous radiant therapy for neoplastic pathologies, smoking habit (smoking more than 15 cigarettes per day), bruxism, pregnancy, bleeding disorder and severe untreated periodontal diseases.

Atraumatic dental extraction and flapless implant surgery was performed in all cases.

The cortical bone position relative to the implant reference point was evaluated at implant placement and 10 to 24 months following implantology. Cone beam computed tomography were performed respectively at 10 and 24 months following implantology and the tomographic images were assessed using a software for the managing of the images. The gap between bone tissue and the implant surface was measured up to a maximum of 3 mm, instead the implant diameters used for each fixture were 3.5 or 4.5 mm (Table I).

The relationship of the peri-implant mucosa to the incisal edge of the definitive prosthesis was recorded.

The factors that influence success of post-extractive implantology are varied, however, the Authors agree to give the greater importance to the achievement of primary stability and to the management of peri-implant hard and soft tissues. During the planning of implant placement is important to assess an adequate implant length: we think that the height of the cortical bone, measured from the base of the socket to the marginal ridge, must be at least 3 mm longer than the length of the dental implant. All these parameters were fulfilled in our reported case series. Finally, after placing implants we have filled the surgical site with a PRF gel, so as to fill the gap between bone tissue and the implant surface, and then we have covered the surgical site with a PRF membrane, so as to coat the gap between the alveolar crest and the implant; the coverage of PRF was sutured by means of separate stitches. Antibiotic (Amoxicillin 1000 mg every 12 hours) and anti-inflammatory (Ketoprofen 100 mg every 12 hours)⁷ therapy was prescribed for 72 hours after surgery, in addition, an anti-edema therapy (Bromelain 40 mg were administered every 4 hours) was given to reduce postoperative swelling⁸.

Results

In our study we have evaluated 127 immediate post-extractive dental implants placed in maxil-

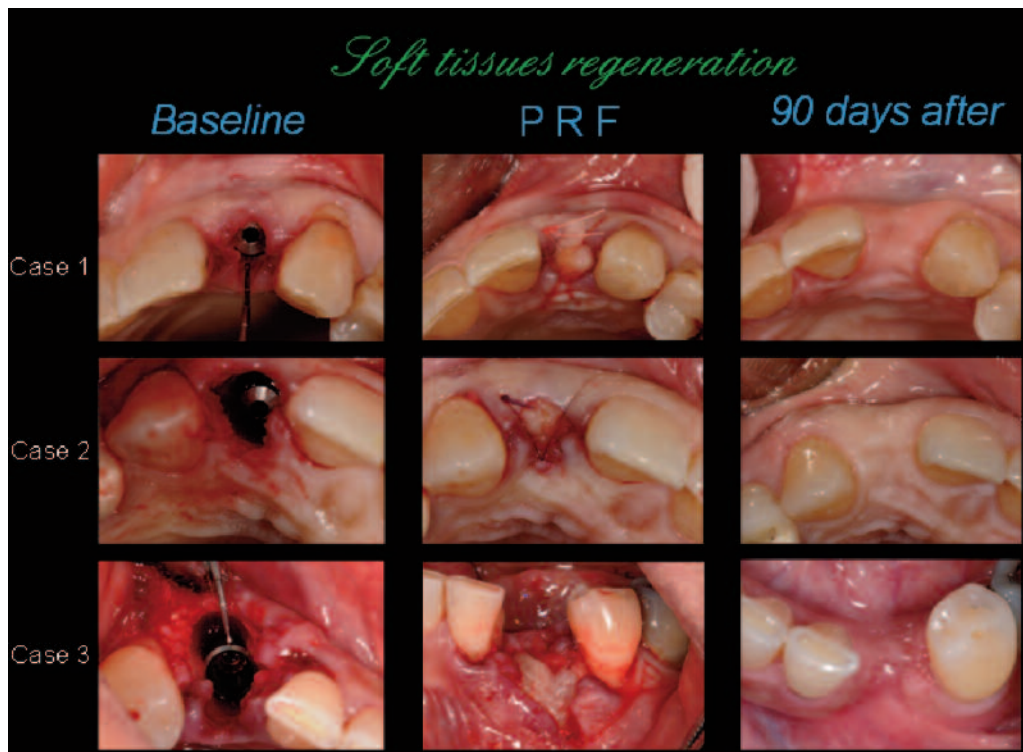


Figure 1. Our results with PRF membrane, covering surgical site.

lary bone of 59 patients; our follow-up for each of the cases assessed, is at least 24 months.

In all cases, we observed the complete covering of the dental implants, with newly formed soft tissue of variable thickness between 1 and 3 mm (Figure 1).

In one case the newly formed tissue was excised by means of circular scalpel and was analyzed under optical microscope confirming the formation of gum-like tissue.

Cortical bone adaptation from the time of implant placement up to 30 months following prosthetic restoration ranged from 0.4 mm to 1.7 mm (average, 1.1 ± 0.6 mm mesially and 0.7 ± 0.3 mm distally). The mean cone beam computed tomography (CBCT) measurements from the interproximal crestal bone to the contact point were 5.2 ± 0.9 mm (mesial) and 4.2 ± 1 mm (Figure 2).

Moreover, the mesial and distal papilla showed an initial decrease, even if < 1 mm ($0.4/-0.3$ mm), then instead, 10 months after the surgery, a slow stabilization of the variation of papilla was observed in all the evaluated patients.

With regard to the clinical cases analyzed, the respect of surgical protocols and the correct planning of the case allow us to achieve a successful

rehabilitation, with post-extraction implantology technique, in 99.8% of cases. The single case of implant failure has occurred with a 4.5 mm diameter implant inserted into bone quality D4, according to Misch classification. The reason was a bacterial peri-implantitis due to low patient compliance with oral hygiene instructions (Table II).

The evaluations of the clinical, histological and radiographic responses of peri-implant tissues suggest that a proper immediate post-extractive implant placement is followed by a supracrestal biological width formation along the abutment. The use of PRF helps to achieve the preservation of tooth-like tissue contours and a mature bone tissue around placed implants (Figure 3).

Discussion

Our study showed a successful rehabilitation, with post-extraction implantology technique, in 99.8% of cases, despite the success rates in the medium and long-term post-extraction implantology reported in the literature (range between 92.7% and 98.0%)⁹.

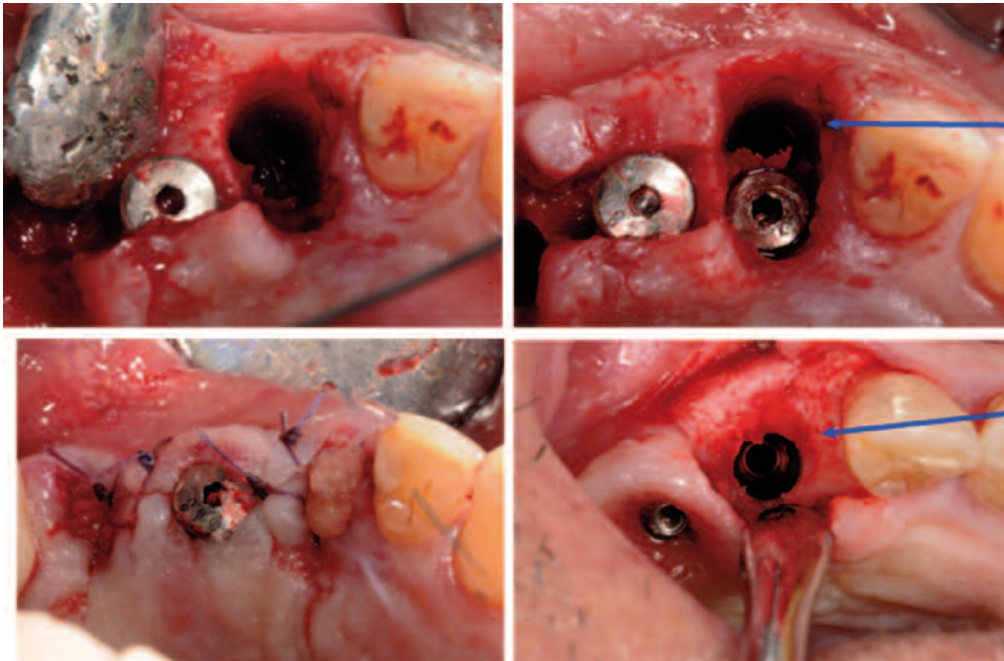


Figure 2. A new bone gain after filling with PRF, immediately after implant placement. Comparison between baseline and 90 days after.

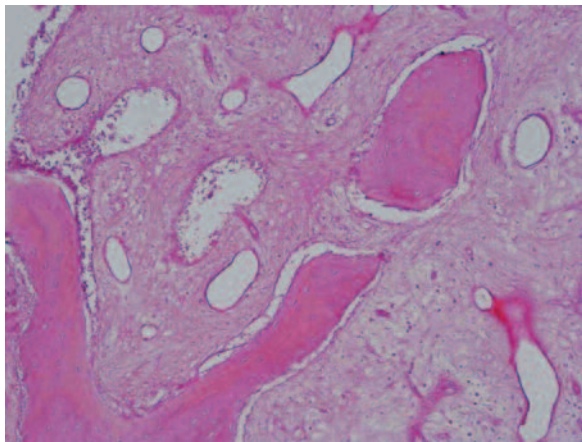


Figure 3. H&E staining of a mature bone sample taken from the implant site grafted with PRF and regenerated after 90 days.

Immediate implants shorten the time to completion of rehabilitation while also reducing bone reabsorption of the residual alveolus and avoiding the need for a second surgical intervention¹⁰.

Several studies¹¹ have analyzed resorption patterns following tooth extraction. The literature reports highlighted as the width of the alveolar ridge can decreased up to 50% in the 10 months following extraction¹².

Moreover, several clinical works have demonstrated the effectiveness of PRF in promoting the healing of extraction sockets, the PRF has, in fact, platelet growth factors that can improve the vascularization of the surgical site, promoting neo-angiogenesis⁶.

Table II.

Bone quality (According to Misch Classification)	No. of implants	No. of implants with Diameter 4.5 mm	No. of implants with diameter 3.5 mm	No. implant failure
D1	48	39	9	0
D2	34	27	7	0
D3	34	30	4	0
D4	11	10	1	1
	127	106	21	1

Conclusions

The achievement of implant success is subject to a correct management of each case, from the planning of the implant insertion to the management of intra-and post-operative phases, and this management should be even more accurate in the case of post-extraction implants.

Long-term maintenance of crestal bone and the rapid healing of soft tissue dimension with maintenance of peri-implant papilla were observed as outcomes after post-extractive implants insertion.

Compliance with the protocols and the use of modern technology allow us then to perform a post-extractive implant surgery highly predictable, capable of ensuring both the function and aesthetics to our patient.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Acknowledgements

We want to thank all the Day-Surgery Unit of Calabro-dental. A special thank to dr.ssa Raffaella Mingrone and to Antonella Bianco.

References

- 1) BRÄNEMARK PI, ADELL R, BREINE U, HANSSON BO, LINDSTRÖM J, ÖHLSSON A. Intra-osseous anchorage of dental prostheses. I. Experimental studies. *Scand J Plast Reconstr Surg* 1969; 3: 81-100.
- 2) BISCHOF M, NEDIR R, SZMUKLER-MONCLER S, BERNARD JP, SAMSON J. Implant stability measurement of delayed and immediately loaded implants during healing. *Clin Oral Implants Res* 2004; 15: 529-539.
- 3) JOHANSSON C, ALBREKTSSON T. Integration of screw implants in the rabbit: a 1-year follow-up of removal torque of titanium implants. *Int J Oral Maxillofac Implants* 1987; 2: 69-75.
- 4) OH TJ, YOON J, MISCH CE, WANG HL. The causes of early implant bone loss: myth or science? *J Periodontol* 2002; 73: 322-333.
- 5) Dohan DM, Choukroun J, Diss A, Dhoan SL, Dhoan AJ, Mouhyi J, Gogly B. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006; 101: e37-44.
- 6) INCHINGOLO F, TATULLO M, MARRELLI M, INCHINGOLO AM, SCACCO S, INCHINGOLO AD, DIPALMA G, VERMESAN D, ABBINANTE A, CAGIANO R. Trial with Platelet-Rich Fibrin and Bio-Oss used as grafting materials in the treatment of the severe maxillar bone atrophy: clinical and radiological evaluations. *Eur Rev Med Pharmacol Sci* 2010; 14: 1075-1084.
- 7) INCHINGOLO F, TATULLO M, ABENAVOLI FM, MARRELLI M, INCHINGOLO AD, INCHINGOLO AM, DIPALMA G. Non-Hodgkin lymphoma affecting the tongue: unusual intra-oral location. *Head Neck Oncol* 2011; 3: 1.
- 8) INCHINGOLO F, TATULLO M, MARRELLI M, INCHINGOLO AM, PICCIARIELLO V, INCHINGOLO AD, DIPALMA G, VERMESAN D, CAGIANO R. Clinical trial with bromelain in third molar exodontia. *Eur Rev Med Pharmacol Sci* 2010; 14: 771-774.
- 9) GRUNDER U, POLIZZI G, GOENE R, HATANO N, HENRY P, JACKSON WJ, ET AL. A 3 year prospective multicenter follow-up report on the immediate and delayed immediate placement of implants. *Int J Oral Maxillofac Implants*. 1999;14: 210-216.
- 10) TOLMAN DE, KELLER EE. Endosseous implant placement immediately following dental extraction and alveoloplasty: Preliminary report within 6-year follow-up. *Int J Oral Maxillofac Implants*. 1991; 6: 24-28.
- 11) SCHROPP L, WENZEL A, KOSTOPOULOS L, KARRING T. Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. *Int J Periodontics Restorative Dent* 2003; 23: 313-323.
- 12) PIETROKOVSKI J, MASSLER M. Alveolar ridge resorption following tooth extraction. *J Prosthet Dent* 1967; 17: 21-27.