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Case Report

Post-Extractive Immediate Implant Placement and Immediate Provisionalization at Sites Requiring Buccal Bone Regeneration: A Clinical Case Series

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Abstract

The modern trend to minimize every biological impact of dental procedures, to lessen the numbers of appointments and to fasten postoperative progress, has brought deep changes in dental daily routine. The greatest challenge in implantology occurs in aesthetically demanding areas, where sometimes bone quantity or quality are not ideal enough. In this study 14 patients have been rehabilitated with post-extractive immediately provionalized implants in sites with buccal bone plate defects, combining regenerative procedures at the same time, and the results were evaluated with CBCT scan, performed at 1 year after the surgery.

Keywords: *Post-Extractive Implant; Immediate Implants; Guided Bone Regeneration; Bone Defects; Cone Beam Computed Tomography; Bone Grafting*

Abbreviations

CBCT: Cone Beam Computed Tomography; g: Gram; mm: Millimeter; 3-D: Three Dimensions

Introduction

The concept of immediate loading was introduced in the first half of the '60s, and it has undergone an incredible evolution, thanks to clinical and experimental researches, in terms of the predictability of results, reliability in time and aesthetic outcomes [1].

Scientific literature offers a considerable variability of timing and loading strategies, since different authors use different terminologies and techniques, often generating confusion or difficulties in comparing clinical works. Currently, it is considered immediate loading the positioning of the prosthetic rehabilitation on the implant in 48 - 72 hours [2].

Experimental studies in animal models have demonstrated with histological evidences, that early and immediate loading does not prevent osseointegration, provided that the micro-movements of bone-implant interface is limited below the threshold of 100 - 150 micron (i.e. tolerated micro-movements). If the amount of these micro-movements exceeds 150 micron due to insufficient primary stability or an excessive load applied to the prosthesis, the healing is more likely to take place by the interposition of fibrous tissue (i.e. deleterious macro-movements) [3].

It becomes of primary importance to obtain an adequate primary stability to minimize these micro-movements, being aware that in the lower arch, thanks to bone structure, the primary stability is generally equal to the secondary, while in the upper jaw the secondary stability is usually always higher than the primary, and this might be another aspect to consider when it comes to treatment planning [4].

Even more, according to biomechanics, a functionalization limited to a physiological range, applied immediately after the insertion of implants that have a primary stability strong enough to limit excessive micro movements, might serve as a positive mechanical stimulus in order to promote the healing process and the subsequent remodeling of the peri-implant bone tissue (i.e. good mineralization of the collagen on the implants surface, faster and qualitatively better peri-implantary bone formation compared to submerged implants) [5].

Stated that primary stability is mandatory to perform a post-extraction implant placement and provisionalization, probably the missing of a bony wall would not be determinant to solve the case, provided that the defect would be favorable to regenerate the missing bone, and would not impair the implant stability [6,7].

The purpose of this paper is to demonstrate the possibility to perform a surgery combining immediate implant placement and immediate provisionalization in a site lacking all or part of the vestibular bone plate even with the contemporary guided bone regeneration of the compromised site, and to obtain optimal results in terms of aesthetic and of regeneration of the bony walls.

Materials and Methods

Study group

Between January and December 2016, 14 patients were treated to rehabilitate mono-edentoulism using 3 Xive implants (Dentsply Friadent, Mannheim, Germany), and 11 Nobel Active (Nobel Biocare, AG, Swiss) based on the authors' preferences, especially for the inner connectors and the platform switch abutment connection.

The study population, which was comprised of 14 patients (5 males and 9 females) who needed implant insertion, was selected from consecutive patients seeking treatment in the author's office.

The patients were selected for inclusion in the study based on the following criteria:

- Single-tooth replacement in the anterior and premolar segments;
- Ideal soft tissue architecture, without parabola recession or papilla missing (no need for soft tissues improving)
- Compromised alveolar socket (3 walls bone defect).

The female and male patients were, on average, 63,5 (range, 58 - 75 years) and 65 (range, 57 - 75 years) years of age, respectively.

For each of the 14 patients, treatment involved the maxilla, the mandible, the canine, and the premolar segments of the dental arches. The distribution of the restored teeth is shown in table 1.

#4	#5	#6	#8	#11	#12	#13	#28	#21	#20
2	3	1	1	1	2	1	1	1	1

Table 1: *Distribution of the restored teeth.*

Patients with a chronic infection or granuloma with major bone loss, severe parafunction, periodontitis, serious gingival inflammation, poor oral hygiene, or high caries rates were excluded from this study, as well as patients with metabolic and/or systemic diseases.

After 6 months, the patients were recalled for oral hygiene, independently on their periodontal conditions.

The study was conducted in accordance with the Helsinki declaration of 1975 as revised in 2000 and being retrospective in nature, was not subjected to the approval of an ethics committee [8].

Surgical procedure

Before surgical procedure, full-mouth professional prophylaxis appointment was scheduled. Patients were covered with 2g penicillin and clavulanic acid (Augmentin 1g, GlaxoSmithKline, Verona, Italy) 1 hour before surgery and continued with 2 g/day for six days.

The first step included the extraction of a compromised tooth, initially by the use of a syndesmotomo, then with a very gentle technique to preserve as much as possible the anatomic site and not to crack the alveolar walls (Figure 1).

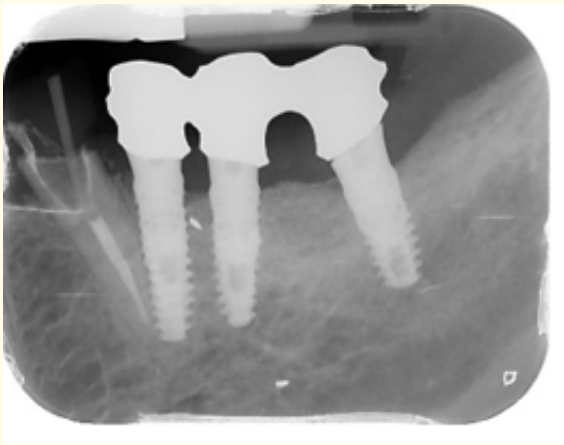

Figure 1: *The initial x-ray with the extremely compromised first premolar*

After having extracted the tooth, the alveolar bone was explored by a periodontal probe to assess the defect presence and dimension, and to establish which implant diameter to use.

The implant was inserted 3 mm apical to the free gingival margin, close to the lingual bone wall with a proper 3-D placement, and sometimes a flap with a single vertical incision was raised to expose the defect [9] (Figure 2).

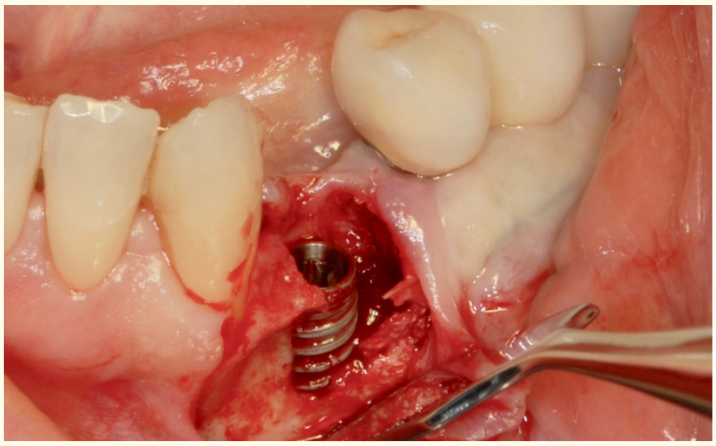

Figure 2: *The immediate post-extraction implant has an optimal primary stability, but note the absence of the buccal bone plate in consequence of a fracture at the cervical third of the root.*

In order to obtain a valid implant primary stability, it was placed an implant a little bit longer of the extracted root every time it was possible, in the other situations the stability was assured anchoring the implant between the mesial and distal bone crest.

Immediately after having relined a provisional crown, the gap between the bone wall and the implant, and the bone defect was filled with Bio-Oss Collagen (Geistlich Pharma AG, Wolhusen, Switzerland) hydrated for at least 10 minutes with saline solution, and covered with a reabsorbable collagen membrane (Creos, Nobel Biocare, AG, Swiss) to recreate a correct buccal bone plate in harmony for quality and dimension with the adjacent bone wall (Figure 3 and 4).

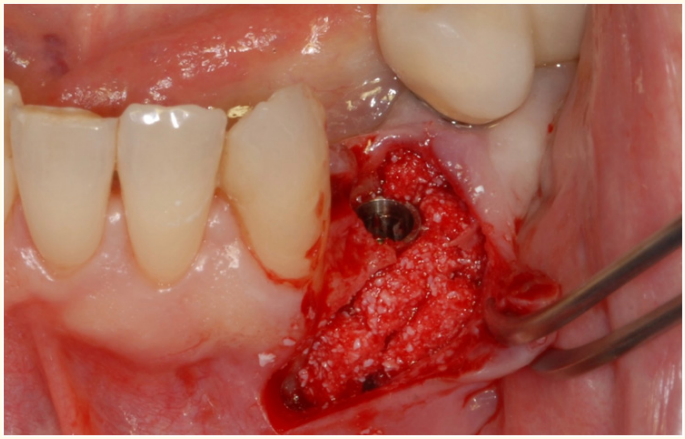

Figure 3: *The defect is filled with some biomaterial (Bio Oss Collagen) avoiding to overfill it.*

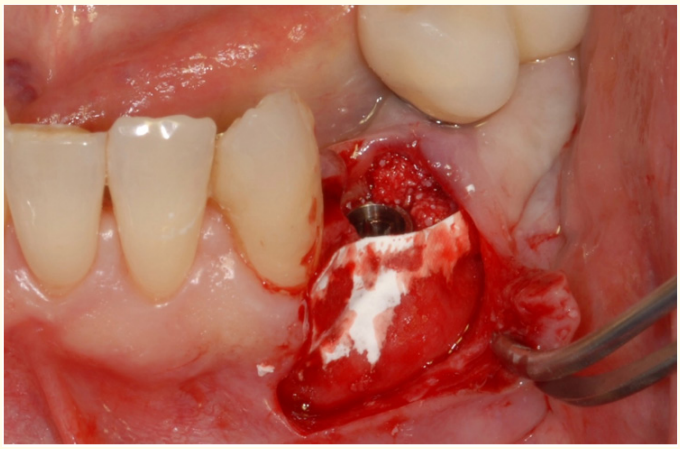

Figure 4: *The grafted biomaterial is covered with a resorbable membrane (Creos, Nobel Bio Care).*

In this study it has always been used reabsorbable membrane, with the purpose to avoid a second surgery to remove the membrane.

Non reabsorbable sutures were used (PTFE (poly-tetrafluoroethylene) 5-0, Omnia, Italy; Surgipro 6-0, Covidien, Medtronic, USA). The sutures were removed after 14 days.

Prosthetic procedure

An individual screwed provisional crown was relined with acrylic resin (Yates and Bird/Motloid, Chicago, IL, USA) up to a provisional titanium abutment. After the resin polymerization, the provisional crown was removed and some resin was added to fill the gap between the crown and the provisional abutment, and then the provisional was finished and the transmucosal part was shaped with a concave design, more pronounced in the buccal side then in the palate and in the interproximal ones.

The provisional was cleansed with some chlorhexidine 0,12, and then screwed by hand, maintaining stability with two fingers so as not to transmit any force to the implant.

Finally, the accessing hole to the screw was filled with some teflon and covered with Telio CS (Ivoclar-Vivadent AG, Schaan, Liechtenstein). The occlusion was checked and both the contacts in centric relation and in protrusive/lateral movements were removed (Figure 5).

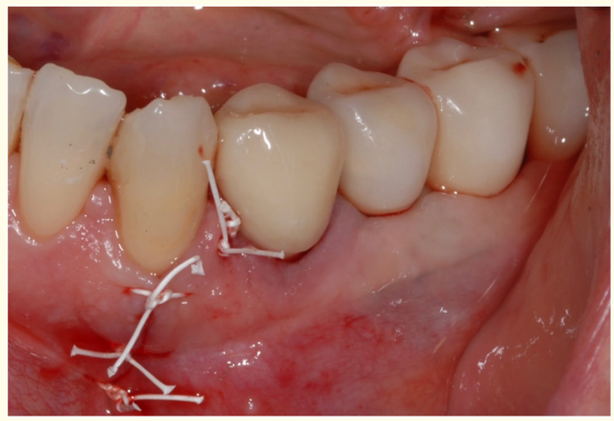

Figure 5: *Immediate postoperative result following extraction, bone regeneration and implant placement. The provisional concave emergence profile gently supports the interdental papillae and it is not compressive on the buccal mucosa, respecting its original parabola shape and papilla contour.*

Patients were instructed to avoid chewing in the treated area for the first three months and to avoid brushing for the first two weeks. A rinse with 0,12% chlorhexidine was prescribed for two weeks. Thereafter conventional brushing and flossing were permitted.

Patients kept the provisional for 6 months, and then an impression, according with the Hinds' method, was made [10].

A zirconium or titanium custom made abutment was manufactured and screwed to the implant at the correct torque; a definitive Zirconia crown was then cemented on it (Figure 6).

Figure 6: *One year postoperative result, with the final restoration, demonstrates proper tissue healing and perfect gingival architecture and thickness.*

Evaluation

Photography and data forms were used as documentation tools in this study. Patients were re-examined by the authors at intervals of 15 days for the first 3 months, and every month thereafter by means of a mirror, a sharp explorer, radiographs, and clinical slides.

Clinical data and digital photographs were evaluated for each patient at the final review appointment. Radiographic examination was undertaken at implant-level the day of the surgery, delivery of the definitive implant crown and review appointments. Non-standardized radiographs were obtained using a parallel long cone radiographic technique and a film holder (Rinn Holder, Dentsply, UK). At 1-year post-surgical a CBCT x-ray was undertaken to evaluate the bone regeneration and its thickness around the implants (Figure 7).

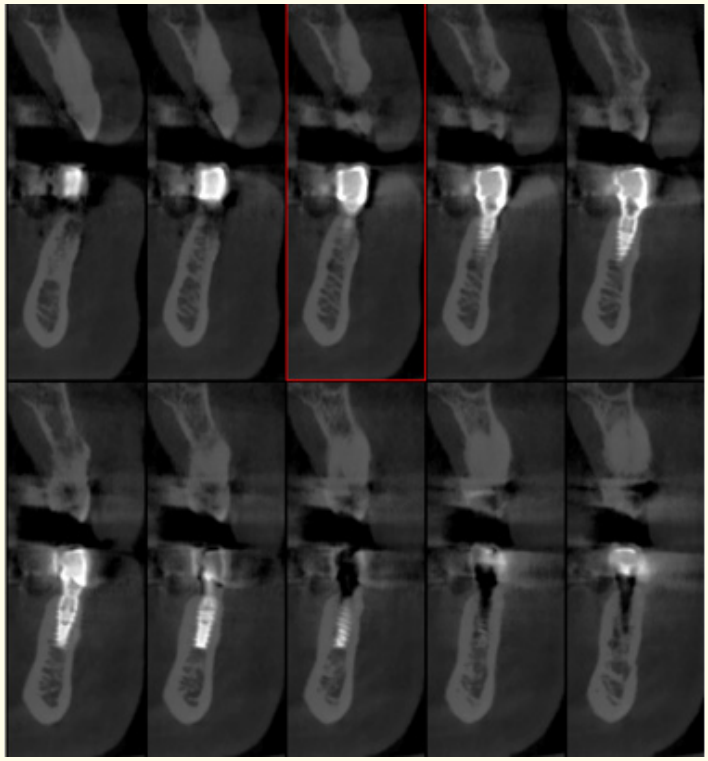

Figure 7: *One year post-op CBCT x-ray control shows the perfect implant integration and the buccal bone plate reestablishment.*

Results

With an interval of 12 months, all the implants remained stable without any signs and symptoms of inflammation and pain. The soft tissue aspect was excellent, with the presence of a thick amount of keratinized pink mucosa with the characteristic aspect of orange peel around the definitive crowns. After a sharp observation, the authors assessed the stability of soft tissue, without macroscopic changes from the beginning of therapy to the end of the follow-up period.

All implants were inserted at the time of tooth extraction and all were restored at the time of implant placement. Healing was uneventful in all cases and all implants integrated successfully. No implant failures happened during the observation time period, neither any problem of membrane exposure occurred.

No prosthetic problems occurred, the esthetic outcome was great, and every patient was very satisfied with the treatment.

On the radiographs, minor bone resorption was detected, and the mesial and distal bone peaks maintained their shape and height with no more then 0,2 mm of vertical bone loss.

At the CBCT examination all the bone defects were completely healed, and the amount of regenerated bone was almost exactly at the same level of the surrounding buccal bone plate, with a mean thickness of about 2 - 4 mm.

Discussion

The finalization of an implant supported rehabilitation that would have a natural and aesthetic appearance, while maintaining adequate peri-implant soft tissues, is one of the most difficult challenges in clinical practice. Even more, if in the initial situation the buccal bone plate is missing!

A good result is achievable only with a correct planning and surgical intervention execution, taking into consideration the amount of the initial bone level, and the realization of a provisional which has to guide and condition the soft tissues during their maturation, and help to protect the blood clot and contain the bone graft particles.

Stable results over time depend on several factors:

- Presence of an adequate amount of keratinized mucosa
- Width and height of interproximal bone peaks and vestibular bone wall
- Correct 3D implant placement
- Appropriate management of the peri-implant soft tissue
- Appropriate management and increase of the missing hard tissue
- Appropriate shape of the prosthetic transmucosal components [9,11,12].

Immediate provisionalization has a real advantage, since the alveolar-gingival and interpapillary fibers are able to preserve the interproximal bone peaks, provided that the interdental and peri-implant tissues are supported immediately by a healing screw or a temporary crown [13].

Furthermore, treating post-extractive immediately provisionalized implants, it is important that the provisional transgingival portion would have a concave shape and would not be compressive, especially in the vestibular area, since this shape, avoiding compression, is able to maintain stable in time the soft tissues supporting adequately the soft tissue submergence profile.

Moreover, a concave abutment leaves more space for the connective tissue around the abutment itself, creating a kind of O-ring, which acts as a barrier of the bone-implant interface [11,13,14].

Sarnachiaro., *et al*. have made a 10 patient study evaluating with CBCT the regeneration in sites with vestibular dehiscence (alveolar type 2 according to the classification of Elian *et al*.) rehabilitated with post-extractive implants and individualized healing abutments. 9 months after the surgery, in all of the rehabilitated sites, the authors found an average increase of 3mm in vestibular bone plate thickness obtained with guided bone regeneration (resorbable membranes and heterologous bone) [15,16].

Lee., *et al*. in 14 immediately provisionalized post-extractive implants, 6 months after surgery in the CBCT examination none of them registered significant loss of the buccal bone plate thickness [17].

In a review of 2013, Viña-Almunia., *et al*. have shown on animals clinical tests that exist various factors that can have a positive influence on the stability of bone levels in rehabilitated sites with post-extractive implants; the use of small diameter implants (3.3 mm), a lingual position of the implant inside the socket and the use of deproteinized bovine bone (BioOss) for the regeneration or preservation of the buccal bone crest [18-20].

Merli., *et al*. in 2016 in a systematic review about bone augmentation at implant dehiscences and fenestrations found that the use of a membrane can contribute to the regeneration of the hard tissue in horizontal one-stage augmentation. No differences were observed comparing non-resorbable ePTFE membranes and resorbable collagen membranes. No substantial differences were obtained using different non-resorbable membranes and grafts, and the results were positive for the variables examined. A high result of heterogeneity was observed in studies dealing with cross-linked membranes [21].

In any case, it's been mandatory to wait a minimum time of 6 months to allow sufficient bone maturation and regeneration, since after this period can be found the presence of approximately 40% of trabecular bone in the extraction site and the regenerated tissue reaches sufficient maturity [22,23].

In the present study the evaluation through CBCT was performed one year after the surgery (instead of 9 months, as described in several studies in the literature and it is therefore more reliable and safe to assess the effectiveness of surgical procedures that have been implemented for the regeneration of vestibular bone plate defect.

Conclusions

There is extensive literature regarding post-extractive implantology, and a good part of it supports immediate loading. However, a very small number of articles can be found with this kind of approach in sites with buccal bone plate defects, especially if searching for reliable radiographic evaluations with at least one year follow-up.

The clinical protocol used in this study was obtained by combining surgical and prosthetic knowledge and skills (guided bone regeneration, immediately loaded implants and implant-prosthetic management), according to the information obtained from scientific research. So, placing an immediate post-extractive implant in contemporary with the positioning of an absorbable membrane, bone graft, and custom healing-provisional restoration into a socket with buccal bone plate dehiscence can reconstitute the buccal bone plate, maintaining the initial correct gingival architecture (good parabola shape and complete papilla) with great satisfactory esthetics results.

The possibility of obtaining this kind of biological and aesthetic results, minimizing the impact and especially the number of surgeries, and obviously the overall treatment time, it is definitely a matter of great interest.

The possible limit of this study might be that no connective tissue augmentation was performed, and this probably might have increased the quality and quantity of the peri-implant soft tissue, and its lasting over time. It remains a matter worthy of development, together with the long-term evaluation of the results that can be easily monitored by CBCT comparison, and with the increase in the number of rehabilitated sites and with the possible histological evaluations of regenerated vestibular volumes.

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