Chapter 10

Immediate Dentoalveolar Restoration in Compromised Sockets: Technique and Bone Biology

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Additional information is available at the end of the chapter

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Abstract

The aim of this chapter is to describe a one-stage technique called immediate dento-alveolar restoration (IDR) which uses autogenous bone graft harvested from maxillary tuberosity in order to restore bone defects in compromised alveolar sockets and also to achieve soft tissue stability along the years. The IDR is a flapless surgical and prosthetic technique established to broaden indications for immediate loading on individual teeth. In this way, tissue loss with varied extensions are reconstructed in the same surgical session as implant placement and provisional crown installation, reducing the number of interventions and retaining esthetic predictability. Successful esthetic and functional outcomes and reestablishment of the alveolar process after bone reconstruction were observed during the follow-up period. The predictable results and soft tissue stability can be achieved following the IDR protocol.

Keywords: compromised sockets, bone harvesting, bone graft, dental implant, maxillary tuberosity, immediate dentoalveolar restoration

1. Introduction

Esthetic rehabilitation in cases of tissue loss in anterior areas represents a major challenge in dentistry with respect to the treatment planning when the choice of therapeutic options is aimed at maintaining the tissue long-term [1]. The developed surgical recommendations require long-term treatment with possible undesirable complications in the tissue architecture [2–6].

These cases can also be successfully treated using immediate dentoalveolar restoration (IDR), a previously described one-stage technique [1, 7] that allows dental extraction, implantation, and provisionalization to occur during the same procedure as the flapless bone reconstruction using a corticocancellous bone graft harvested from the maxillary tuberosity [8–11]. The IDR technique, in addition to having lower overall cost and treatment time, has been shown clinically and tomographically to be effective regarding bone and soft tissue stability [9].

According to the IDR protocol for total loss of the buccal bone wall, the corticocancellous is shaped to the defect size and inserted between the implant and the remaining buccal soft tissue without opening the flap [1, 7, 9, 11]. Then, particulate bone is compacted until it completely fills the gaps between the main graft and the implant surface [7–9]. The provisional restoration is made at the same time. The proper anatomical contour of the prosthetic emergence profile is mandatory to guide the soft tissue healing [9–11].

The key factors that may explain the positive results obtained with immediate and flapless implant insertion and provisionalization using autogenous bone grafts in the esthetic zone are as follows: the flapless procedure may preserve the blood supply of the facial lamella, the sole use of autogenous bone without any bone substitutes and without membranes may prevent resorption due to foreign body reactions, and the placement of the implants along with the palatal cortical border of the extraction socket may increase primary stability and avoid any crossing of the bony envelope [12].

The advantages of IDR include the following: the harvest of maxillary tuberosity is easily performed; the malleability of bone fragment allows adequate adaptation to the receptor region; and the corticocancellous acts as a biological membrane, thereby promoting effective bone and gingival healing [13]. Furthermore, the trabecular nature of grafts harvested from the maxillary tuberosity contributes to the increased revascularization capacity and the release of growth factors to the receptor site [13, 14]. The immediate provisional restoration contributes to tissue healing acceleration and formatting the ideal gingival prosthetic emergence profile [11, 15].

The position of the implant in IDR, as in any other technique, should be considered one of the main reasons to obtain stability of hard and soft tissues. The protocol used for selecting the diameter and position of implants placed in esthetic zones uses the buccopalatal distance from the socket opening as a reference [16]. Regardless of the tooth to be replaced, a gap of approximately 3 mm between the buccal implant surface and the outer buccal bone wall is expected. After gap filling, peri-implant tissue remains stable using this surgical protocol, which has yielded satisfactory as well as predictable esthetic outcomes in a prospective case series [17].

The most challenging stages of the IDR technical application concern the implant primary stability in compromised alveolar sockets to allow immediate provisional fabrication and bone reconstruction in a single procedure [7, 9, 17]. In this context, using the counterclockwise rotation of site preparation would increase implant stability in favor of its IDR execution. The osseodensification allows bone autograft by compaction throughout the depth of drilling laterally and at the deepest part of the perforation [18, 19]. This nonextraction technique utilizes a designed bur that promotes the application of controlled bone plastic deformation due to the rolling and sliding contact of the bur along the inner surface of the osteotomy [20].

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2. Case report

A 63-year-old female presented with the right lateral incisor fractured with abscess, fistula, severe bone loss, and low soft tissue quality (**Figure 1**).

The periapical radiograph and cone beam computed tomography (CBCT) images confirmed the loss of the buccal wall in the right lateral incisor (**Figure 2**).

The gingival architecture showed a very thin periodontal biotype. Intraoral examination with dental probing confirmed that the buccal bone wall had been lost in the right lateral incisor (**Figure 3**).

Considering the esthetic and functional demands, the treatment plan consisted of following the IDR technique using the corticocancellous graft protocol. Antibiotic therapy was prescribed 5 days prior and 7 days after surgery due to the contamination of the affected area. The steps included a minimally invasive dental extraction (**Figure 4**), curettage and cleaning of the socket, evaluation of the extension of the bone defects (**Figure 5**), and site preparation using the osseodensification concept (Densah burs kit, Versah, USA) due to the presence of very soft bone in the anterior area (**Figure 6**). Burs were used in a noncutting action in a counterclockwise (CCW) rotation at 1100 rpm to prepare the immediate implant site trajectory. Installation

Figure 1. Clinical evaluation showing very poor quality soft tissue due to the fracture and infection in the right lateral incisor.

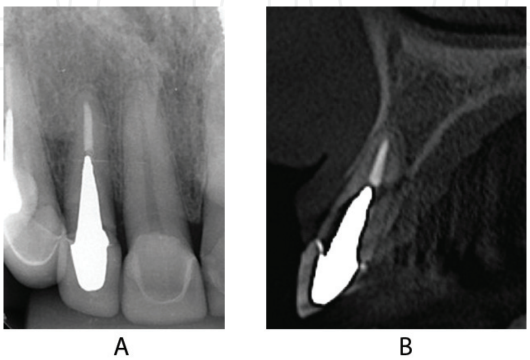


Figure 2. (A and B) Through the X-ray, it is possible to notice the bone available beyond the root apex of the damaged tooth. The CBCT image shows the loss of the buccal bone wall.

Figure 3. (A and B) The probe depth showed approximately 11 mm in height of the buccal aspect. It is possible to notice the periodontal probe underneath the gingival tissue due to the thinness of the soft tissue.

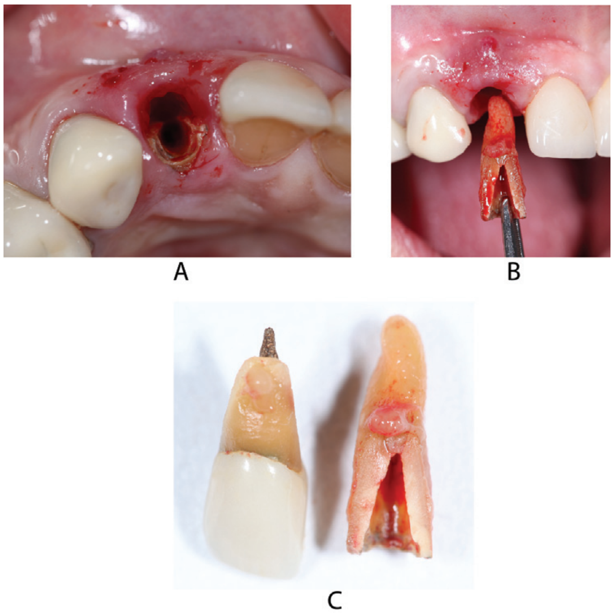


Figure 4. (A–C) The damaged tooth was extracted applying minimally invasive procedures, favoring preservation of the remaining bone walls. A careful curettage of the socket was performed to completely remove the granulation tissue and remains of periodontal tissue.

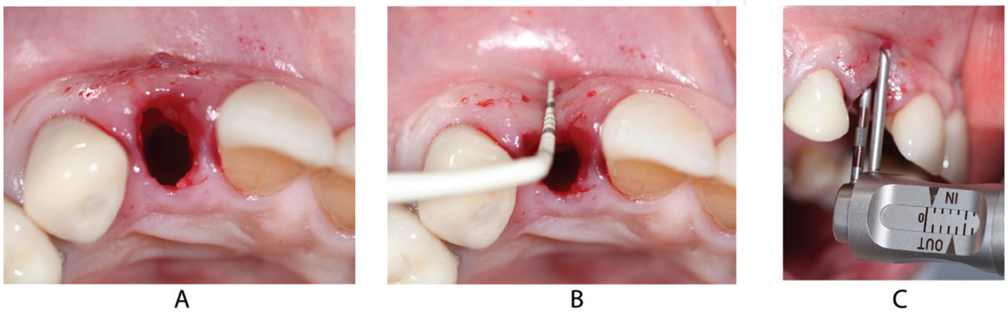
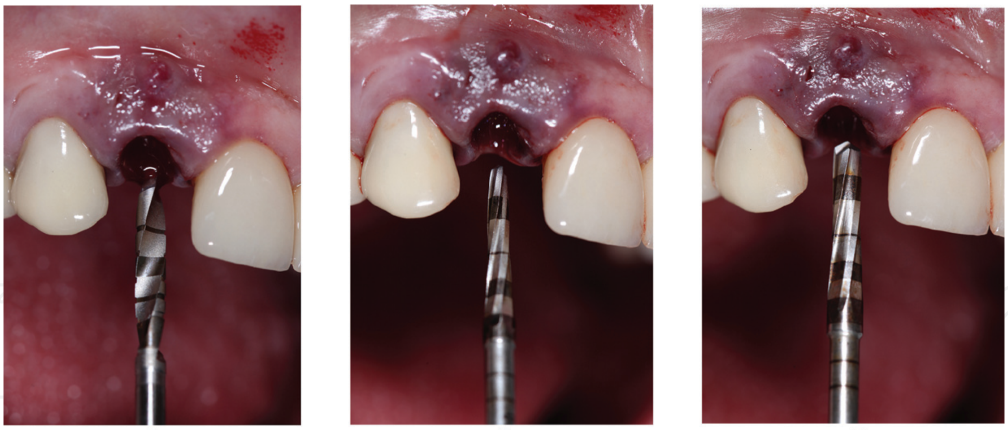


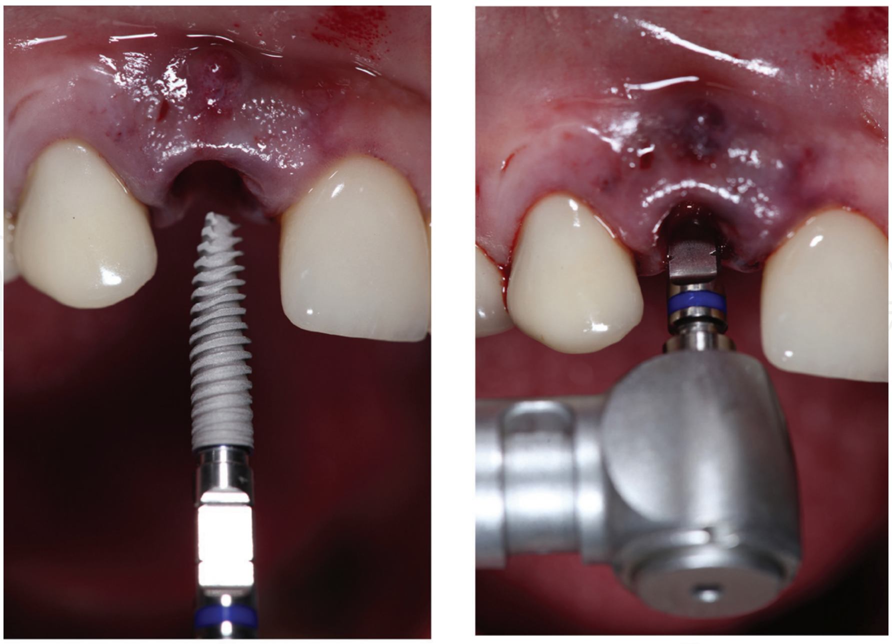
Figure 5. (A–C) The extension of the bone defect at the buccal aspect in the corono-apical and mesio-distal directions was measured. The thickness of soft tissue was measured using a caliper. A very thin periodontal biotype was confirmed.



A B C

Figure 6. (A–C) The site was prepared using the osseodensification concept densifying bone laterally while also increasing the bone volume.

of the immediate implant placement 3 mm from the gingival margin apically (V3 implant—MIS, Israel) in the correct 3D position (**Figure 7**) achieved primary stability, leaving a gap approximately 3 mm at the buccal aspect, construction of a screwed provisional restoration with an ideal emergence profile (**Figure 8**), and reconstruction of the socket bone defects using corticocancellous graft harvested from the maxillary tuberosity (**Figure 9**) with chisels (IDR chisels kit, Schwert, Germany) were performed to restore the bone defects (**Figure 10**). The residual gaps were filled with particulate cancellous bone harvested from the same donor area (**Figure 11**), maintaining the reconstructed bone wall and the surrounding soft tissue. The graft was placed at a biological distance of 2 mm from the bone graft apically to the gingival margin and 3 mm in thickness (**Figure 12**).



A B

Figure 7. (A and B) The implant (V3—MIS, Israel) was anchored at the palatal wall in the 3D position favoring the construction of the screwed provisional crown. A total of 50 Ncm of primary stability was obtained. The 3D positioning of the implant allowed a gap of 3 mm at the buccal aspect.

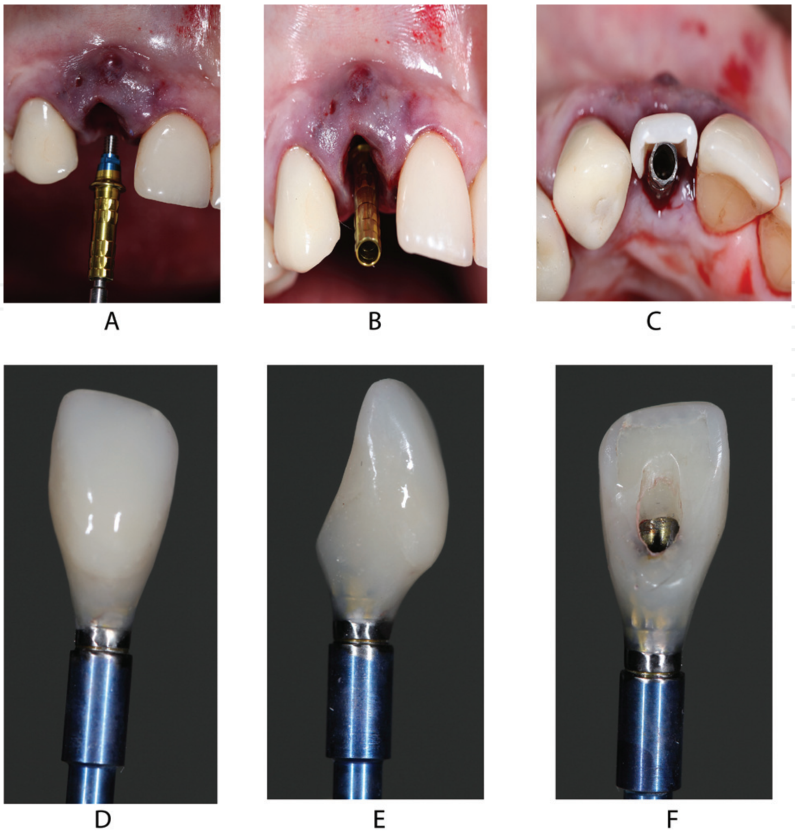


Figure 8. (A–F) A screwed provisional restoration was manufactured with an adequate emergence profile to allow space of correct accommodation of the tissues.

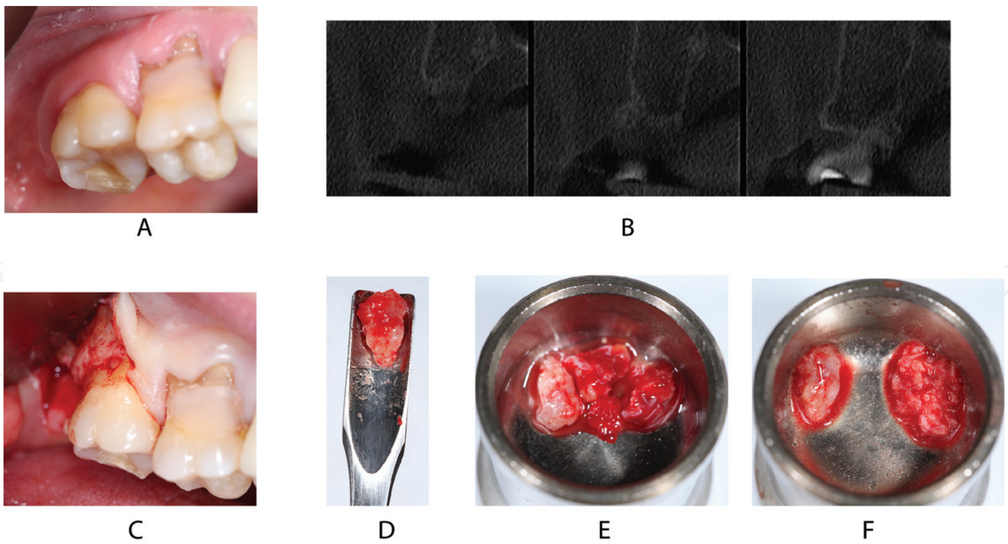


Figure 9. (A–F) Prior to surgery, it was evaluated clinically the donor area of the bone graft and through CBCT scans to assess the bone availability of the maxillary tuberosity. The corticocancellous graft and particulate bone were harvested from maxillary tuberosity using IDR chisels (IDR kit, Schwert, Germany).

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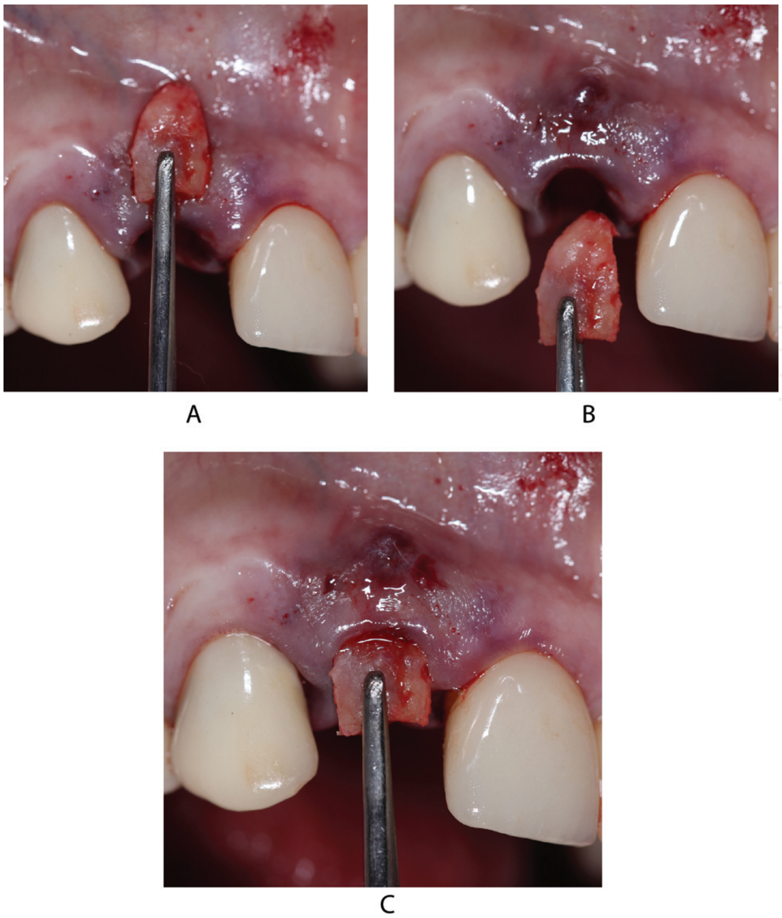

Figure 10. (A–C) The graft was reshaped according to the defect configuration. The corticocancellous graft was inserted and stabilized by juxtaposition into the receptor site.

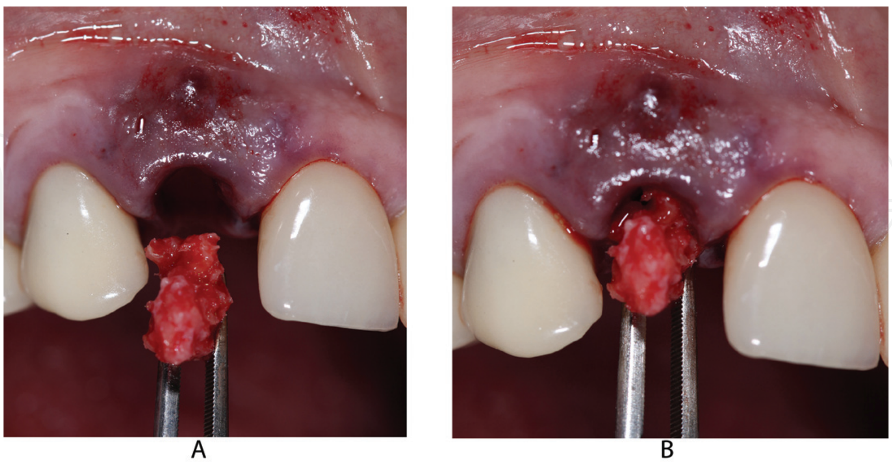

Figure 11. (A and B) Particulate bone was compacted to fully fill the gaps between the marrow portion of the corticocancellous graft and the implant.

The screwed provisional restoration was placed in position immediately and was adjusted out of occlusion (**Figure 13**). The immediate periapical radiograph showed the bone entirely reconstructed (**Figure 14**). A week after the surgery, the soft tissue had improved healing (**Figure 15**).

Three months after the surgery, the soft tissue showed the maintenance of volume and papillae positioning (**Figures 16** and **17**). The definitive restoration was accomplished after 4 months (**Figure 18**).

Clinical evaluation after 2 years showed stability of the soft tissue volume regarding gingival margin and papillae (**Figure 19**) and the CBCT image showed the buccal wall completely restored with relevant thickness in the right lateral incisor (**Figure 20**).

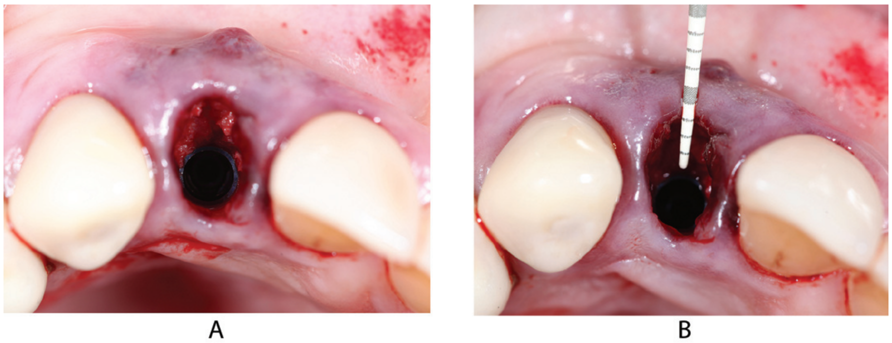

Figure 12. (A and B) 3 mm in thickness of the bone was reconstructed and confirmed through the periodontal probe.

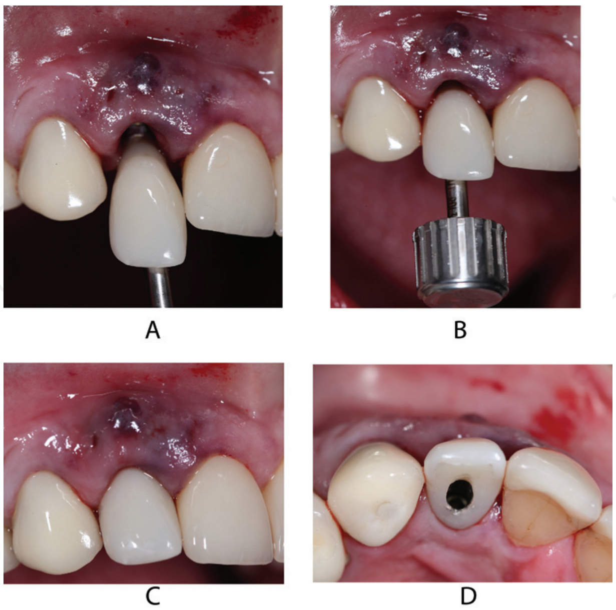

Figure 13. (A–D) A screwed provisional crown out of occlusion was inserted over the implant. It is possible to observe the correct 3D position of the implant.

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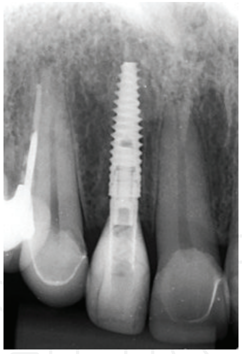

Figure 14. The immediate X-ray showing the bone entirely reconstructed.

Figure 15. Soft tissue healed 1 week after the procedure.

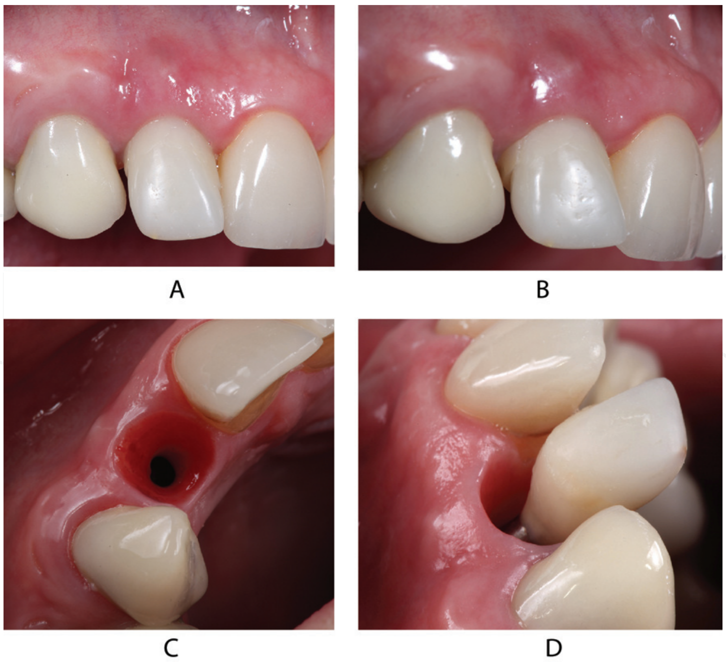

Figure 16. (A–D) Soft tissue was stable in volume and with relevant thickness after 3 months. The anatomical contour of the provisional restoration allowed the correct accommodation of the soft tissue.

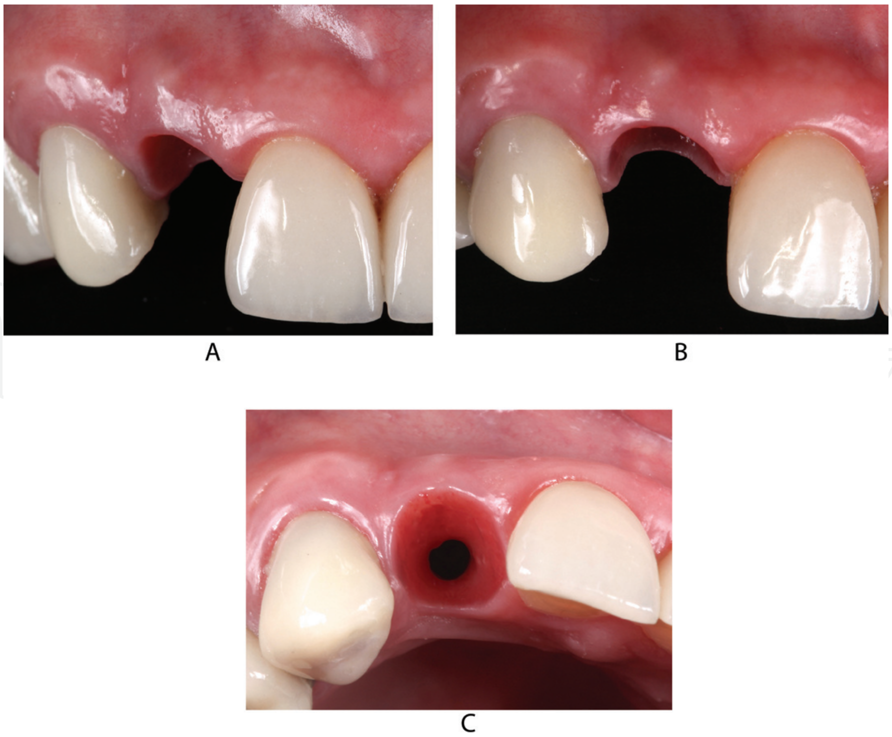

Figure 17. (A–C) Maintenance of the anatomical contour of soft tissue can be observed.

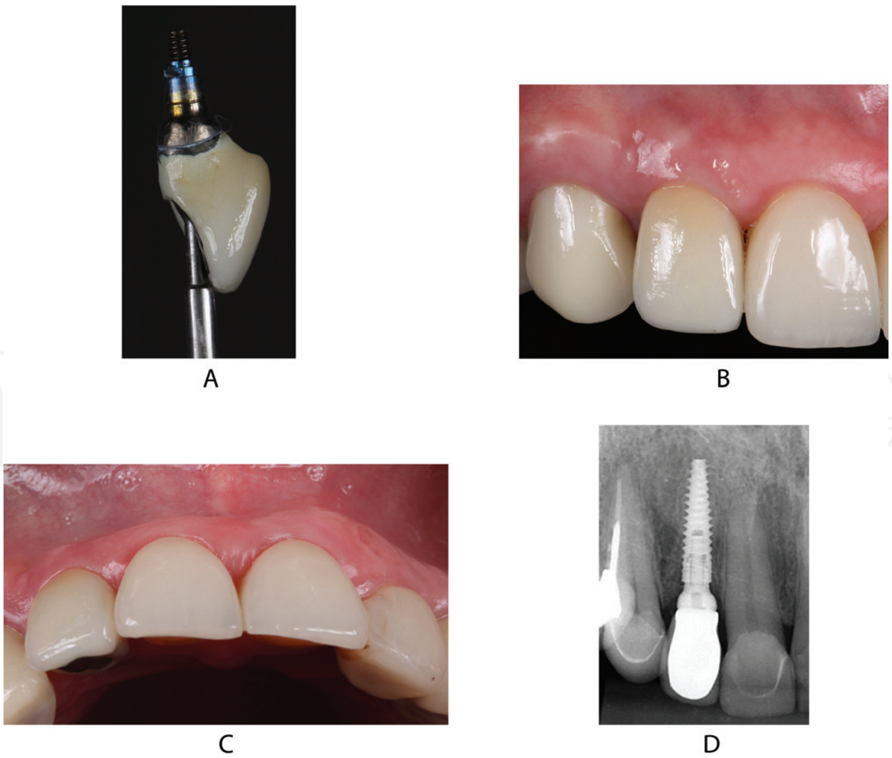

Figure 18. (A–D) Screwed porcelain crown insertion with ideal emergence profile. A periapical X-ray showing bone stability all around the implant.

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Figure 19. (A–C) Clinical follow-up after 2 years showing the stability of soft tissue regarding gingival margin and papillae.

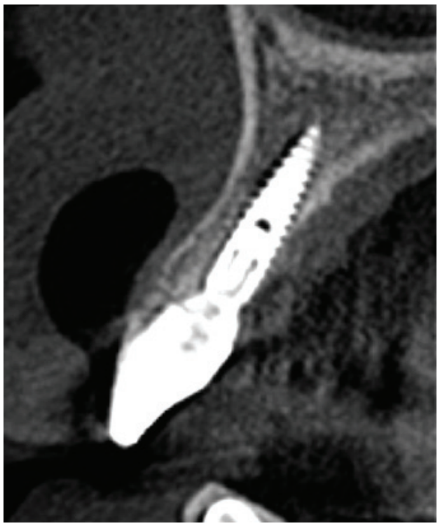

Figure 20. (A–C) BCT image after 2 years highlights the stability of the buccal wall, in terms of thickness and height.

3. Discussion

Different surgical alternatives for bone augmentation in postextraction compromised sockets have been described. However, some of these techniques require longer periods for rehabilitation and are usually costly [3–6]. As an alternative, the IDR technique using maxillary tuberosity grafts presents significant gains in esthetic results and in treatment time, recovery of the alveolar bone defect at the same surgical implant installation and immediate provisionalization without opening the flap and keeping the gingival architecture in the same position [8]. As previously described, if the soft tissue and periosteum remains attached to the buccal bone, the bone supply will be maintained, allowing rapid graft revascularization [13, 14].

Bone density at the buccal, palatal, and basal cortical maxillary tuberosity is lower, compared to other maxillary and mandibular bones [13, 17, 21]. Due to the small thickness of its cortical bone, maxillary tuberosity grafts are easily shaped and its cortical structure can act as a biological barrier, stabilizing the soft tissue and the particulate bone graft around the implant [7, 9]. The total porosity and porous volume indicate that the corticocancellous structure can act as a scaffold structure for cellular and vascular growth [10, 11, 15]. The maxillary tuberosity is a source of osteoprogenitor cells and growth factors [14]. Taken together, the cortical and the cancellous bone from the maxillary tuberosity can be considered as an ideal structure for bone regeneration since it is a natural scaffold filled with osteoblastic cells and growth factors [7, 9–11].

The structural and biological characteristics of the graft removed from the tuberosity and its proper manipulation and adaptation to the recipient site can be identified as one of the reasons for the success of the IDR technique, as it has been shown in studies monitoring long-term results [1, 14, 17].

Osseodensification was utilized in the postextraction site preparation in this case to preserve any remaining apical bone and to produce an intimate osteotomy for the implant. This compaction grafting increased implant primary stability and allowed for the higher insertion torque due to the spring-back phenomenon [18, 20].

Histological evidence has demonstrated that the compacted, autologous bone immediately in contact with the implant will not only enhance the primary stability due to the physical interlocking between the bone and the device but also facilitate osseointegration due to osteoblasts nucleating on the instrumented bone near the implant [19]. This enhanced implant stability allowed the author to predictably restore this case immediately postextraction for the IDR procedure.

4. Conclusions

The IDR allowed dental extraction of the compromised alveolar socket as well as implantation and provisionalization in the same procedure as the flapless bone reconstruction using a corticocancellous bone graft harvested from the maxillary tuberosity.

The clinical case showed adequate implant rehabilitation in the freshly compromised tooth with severe alveolar bone defect and the infected site, which strengthened the clinical outcome of the IDR technique using the osseodensification concept. When properly indicated and performed, the IDR technique exhibits a high success rate.

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References

[1] JCM R, Rosa DM, Zardo CM, Rosa ACPO, Canullo L. Reconstruction of damaged fresh sockets by connective-bone sliver graft from the maxillary tuberosity, to enable immediate dentoalveolar restoration (IDR): A clinical case. The International Journal of Oral Implantology. 2009;**10**:12-17

[2] Huynh-Ba G, Pjetursson BE, Sanz M, Cecchinato D, Ferrus J, Lindhe J, et al. Analysis of the socket bone wall dimensions in the upper maxila in relation to immediate implant placement. Clinical Oral Implants Research. 2010;**21**:37-42

[3] Cosyn J, Eghbali A, De Bruyn H, Collys K, Cleymaet R, De Rouck T. Immediate single-tooth implants in the anterior maxilla: 3-year results of a case series on hard and soft tissue response and aesthetics. Journal of Clinical Periodontology. 2011;**38**:746-753

[4] Buser D, Chappuis V, Bornstein MM, Wittneben JG, Frei M, Belser UC. Long-term stability of contour augmentation with early implant placement following single tooth extraction in the esthetic zone a prospective, cross-sectional study in 41 patients with a 5- to 9-year follow-up. Journal of Periodontology. 2013;**84**:1517-1527

[5] Pieri F, Aldini NN, Marchetti C, Corinaldesi G. Esthetic outcome and tissue stability of maxillary anterior single-tooth implants following reconstruction with mandibular block grafts: A 5-year prospective study. The International Journal of Oral & Maxillofacial Implants. 2013;**28**:270-280

[6] Schneider D, Grunder U, Ender A, Hämmerle CHF, Jung RE. Volume gain and stability of peri-implant tissue following bone and soft tissue augmentation: 1-year results from a prospective cohort study. Clinical Oral Implants Research. 2011;**22**:28-37

[7] Rosa JCM, Rosa ACPO, Rosa DM, Zardo CM. Immediate Dentoalveolar restoration of compromised sockets: A novel technique. The European Journal of Esthetic Dentistry. 2013;**8**:432-443

[8] Rosa JCM, Rosa ACPO, Fadanelli MA, Sotto-Maior BS. Immediate implant placement, reconstruction of compromised sockets, and repair of gingival recession with a triple graft from the maxillary tuberosity: A variation of the immediate dentoalveolar restoration technique. The Journal of Prosthetic Dentistry. 2014;**112**:717-722

[9] Rosa JCM, Rosa ACPO, Francischone CE, Sotto-Maior BS. Esthetic outcomes and tissue stability of implant placement in compromised sockets following immediate dentoalveolar restoration: Results of a prospective case series at 58 months follow-up. The International Journal of Periodontics & Restorative Dentistry. 2014;**34**:199-208

[10] Rosa JCM, Rosa ACPO, Francischone CE, Cardoso MA, Alonso AC, Capelozza L. Post-traumatic treatment of the upper incisors by immediate dentoalveolar restoration with long-term follow-up. Compendium of Continuing Education in Dentistry. 2015;**36**(2):130-134

[11] Rosa JCM, Fadanelli MA, Zimmerman D, Rosa ACPO. The application of rapid prototyping to improve bone reconstruction in immediate dentoalveolar restoration. The International Journal of Esthetic Dentistry. 2017;**12**:258-270

[12] Noelken R, Moergel M, Kunkel M, Wagner W. Immediate and flapless implant insertion and provisionalization using autogenous bone grafts in the esthetic zone: 5-year results. Clinical Oral Implants Research. 2018;**29**:320-327

[13] Martins W, Ferraz EP, Beloti MM, Rosa L, Rosa JCM. Immediate dentoalveolar restoration technique (IDR). Autograft characterization and a case report. Journal of Osseointegration. 2017;**9**(3):305-309

[14] Cicconetti A, Sacchetti B, Bartoli A, Michienzi S, Corsi A, Funari A, et al. Human maxillary tuberosity and jaw periosteum as sources of osteoprogenitor cells for tissue engineering. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics. 2007;**104**. 618.e1-12

[15] Rosa JCM, Romanelli J, Calichio LE. Multidisciplinary approach using slow orthodontic extrusion and the immediate dentoalveolar restoration technique. QDT: Quintessence of Dental Technology. 2018. pp. 2-17

[16] Rosa JCM, Rosa ACPO, Francischone CE, Sotto-Maior BS. Selection of implant diameter in post-extraction sockets: A new approach. Dental Press Implantology. 2014;**8**(2):80-89

[17] Rosa ACPO, Rosa JCM, Pereira LAVD, Francischone CE, Sotto-Maior BS. Guidelines for selecting the implant diameter during immediate implant placement of a fresh extraction socket: A case series. The International Journal of Periodontics & Restorative Dentistry. 2016;**36**:401-407

[18] Huwais S, Meyer EG. A novel osseous densification approach in implant osteotomy preparation to increase biomechanical primary stability, bone mineral density, and bone-to-implant contact. The International Journal of Oral & Maxillofacial Implants. 2017;**32**:27-36

[19] Trisi P, Berardini M, Falco A, Vulpiani MP. New osseodensification implant site preparation method to increase bone density in low-density bone: *in vivo* evaluation in sheep. Implant Dentistry. 2016;**25**:24-31

[20] Lahens B, Neiva R, Tovar N, Alifarag AM, Jimbo R, Bonfante EA, Bowers MM, Cuppini M, Freitas H, Witek L, Coelho PG. Biomechanical and histologic basis of osseodensification drilling for endosteal implant placement in low density bone. An experimental study in sheep. Journal of the Mechanical Behavior of Biomedical Materials. 2016;**63**:56-65

[21] Gapski R, Satheesh K, Cobb CM. Histomorphometric analysis of bone density in the maxillary tuberosity of cadavers: A pilot study. Journal of Periodontology. 2006;**77**:1085-1090