



Use of the Immediate Dentoalveolar Restoration Technique Combined with Osseodensification in Periodontally Compromised Extraction Sites



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This article describes the combined use of the immediate dentoalveolar restoration (IDR) technique and an osseodensification implant site preparation method to improve immediate implant primary stability in periodontally compromised extraction sites. Positioning of soft and hard tissues was evaluated in two clinical cases in which the IDR technique and the osseodensification implant site preparation method were used to replace teeth at sites with severe alveolar bone loss. The results were analyzed by clinical assessment, photography, radiography, and computed tomography scans. Based on this preliminary study, the use of osseodensification can enhance the results achieved using the IDR technique due to improved primary implant stability, as measured by higher insertion torque.
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Immediate implant placement following tooth extraction is considered challenging due to the possible presence of bone defects or infection. The preservation of harmonious soft tissue contours and bone support are key factors for achieving favorable esthetic implant treatment outcomes.^{1,2}

The placement of an implant immediately after extraction in a periodontally or endodontically compromised site is generally considered a high-risk procedure due to the bone loss caused by bacterial spread in the socket. The presence of this active infection is traditionally considered an obstacle to immediate implant placement.^{3,4} Thin tissue biotypes present an additional complexity for such cases due to postextraction shrinkage of soft and hard tissues.⁵

However, a systematic review of the literature on the subject revealed no difference in treatment outcomes related to the presence of infection.⁶ A microbiologic evaluation of the changes in subgingival microflora 1 year after immediate implant placement and provisionalization of severely periodontally involved sites revealed improved soft tissue healing with less pathogenic flora. It is suggested that this microbiologic shift is primarily due to tooth extraction, which eliminates the infected cementum that acts

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as the main source of periodontal pathogenic bacteria.^{7,8} In the current study, the restored periodontally compromised sites were volumetrically evaluated, and the results demonstrate long-term success and the preservation of the preoperative soft tissue architecture.⁹

Many clinical studies support the use of autogenous bone block grafting and/or guided bone regeneration (GBR) for the reconstruction of bone defects in compromised alveolar sockets during or after tooth removal.^{10–13} However, these techniques demand flap surgery and require a long treatment time with delayed implant placement in combination with two- or three-stage procedures.¹⁴

Immediate Dentoalveolar Restoration Technique

Cases with severe bone loss can be successfully treated using immediate dentoalveolar restoration (IDR), a previously described one-stage technique^{1,15} that allows dental extraction, implantation, and provisionalization to occur during the same procedure as a flapless bone reconstruction, using corticocancellous bone graft harvested from the maxillary tuberosity.^{15,16} In addition to having a lower overall cost and treatment time, the IDR technique is shown to be effective in terms of soft and hard tissue stability.¹⁷

According to the IDR protocol, the corticocancellous graft, obtained from the tuberosity, is shaped to the defect size and is inserted between the implant and the

remaining soft tissue without opening the flap, regardless of whether it is missing one or more bone walls.^{1,15,16} Next, particulate bone is compacted until it completely fills the gaps between the main graft and the implant surface.^{15,16} The provisional restoration is made at the same time. Therefore, the proper anatomical contour of the prosthetic emergence profile guides the soft tissue healing.^{17–19}

The advantages of IDR include the simplicity of using autogenous bone harvested from the tuberosity, and the malleability of bone fragments provides adequate adaptation to the receptor region. This corticocancellous graft acts as a natural biologic barrier, thereby promoting effective bone and gingival healing.¹⁷ Furthermore, the trabecular nature of the harvested graft contributes to increasing revascularization capacity and the release of growth factors to the receptor site.^{15–17,20} The immediate provisional restoration contributes to tissue healing and forms the ideal gingival prosthetic emergence profile.^{15–17}

Implant position in the IDR technique, as in any other implant placement technique, is considered one of the primary requisites to stabilize hard and soft tissues. The diameter and position of implants placed in esthetic zones rely on using the buccopalatal width of the socket opening as a reference.¹⁹ Regardless of the tooth being replaced, a gap of approximately 3 mm between the implant and the socket buccal wall is needed. The harvested autogenous bone graft provides a gap filling, which promotes the stability of the

peri-implant tissue and yields satisfactory and predictable esthetic outcomes.²¹

The most significant challenge in applying the IDR technique is providing implant placement with high primary stability to allow for immediate provisional placement and bone reconstruction in a single procedure. Therefore, utilizing the osseodensification implant site preparation method¹ is beneficial for providing the needed implant stability for the IDR procedure.

Osseodensification Concept

A novel implant site preparation technique termed osseodensification was introduced by Huwais.^{22,23} This nonextractive technique utilizes a specially designed bur that promotes the application of controlled plastic bone deformation due to the rolling and sliding contact of the bur along the inner surface of the osteotomy. These densifying burs are designed to have a cutting chisel edge and a tapered shank. Thus, as they enter deeper into the osteotomy, they have a progressively increasing diameter that controls the compaction process.²² These burs are used with a standard surgical engine and can densify soft bone by rotating in the noncutting direction (counterclockwise at 800 to 1,200 rpm). The bur can also be used to cut hard bone by rotating in the cutting direction (clockwise at 800 to 1,200 rpm). Copious irrigation during this procedure provides lubrication between the bur and bone surfaces, which minimizes overheating.²³

Osseodensification site preparation is biomechanically and histologically validated; this procedure results in increased bone mineral density around the periphery of the osteotomy and produces compact autografting along the entire depth of the osteotomy. This provides a spring-back effect into the center of the osteotomy and creates a reverse compression of bone tissue into the implant body, consequently increasing the primary stability of the implant.²⁴ Histologically, the compacted autografted bone particles, which are in physical interlocking contact with the implant threads, provide increased bone volume and bone-implant contact.²⁵ Bone particles were found with greater frequency in the osseodensification sites. These autografted bone particles act as nucleating bridging surfaces, essentially promoting faster new bone formation around the implant.²⁶

Case Reports

Case One

The first patient presented with a thin periodontal biotype and a periodontally compromised maxillary right first molar with an abscess and severe bone loss. Periodontal probing revealed buccal and palatal bone loss, as confirmed by cone beam computed tomography (CBCT) images. Only the interseptal crestal bone remained between the roots (Fig 1).

The treatment plan consisted of following the IDR technique.^{1,15,17,21}

Fig 1 Case 1. (a) Clinical evaluation and (b) a CBCT image of the condemned maxillary first molar, showing total loss of the buccal and palatal walls and the low amount of remaining bone between the roots. Probing heights of approximately 14 mm at the palatal aspect and 10 mm at the buccal aspect were present.



Fig 2 The tooth was extracted using a minimally invasive procedure, thus favoring the preservation of the remaining interdental bone. Careful curettage of the socket was performed to completely remove the granulation tissue and remaining periodontal tissue.



Fig 3 The site was prepared using the osseodensification concept, densifying the bone laterally while also increasing bone volume.

Antibiotic therapy 5 days prior to and 7 days after surgery was prescribed due to contamination of the affected area. The treatment steps included minimally invasive dental extraction (Fig 2), curettage and cleaning of the socket, and site preparation using the osseodensification implant site preparation method (Fig 3). Densifying burs were used according to the manufacturer's guidelines (Versah) in a noncutting action in a counterclock-

wise (CCW) rotation at 1,100 rpm with copious irrigation to prepare the implant site trajectory. Immediate implant placement in the correct three-dimensional (3D) position was achieved with adequate primary stability of 50 Ncm. A gap of approximately 3 mm was intentionally left at the buccal aspect (Fig 4) to allow reconstruction of the socket walls using corticocancellous bone graft harvested from the maxillary tuberosity (Fig 5). The residual gaps



Fig 4 The implant was anchored at the remaining interdental bone. The 3D positioning of the implant allowed a gap of 3 mm at the buccal aspect, which is the suitable amount of space for bone reconstruction. A primary stability of 50 Ncm was obtained.



Fig 5 Corticocancellous graft and particulate medullary bone were harvested from the maxillary tuberosity using chisels.



Fig 6 After reshaping the graft according to the defect configuration, the corticocancellous graft was inserted at the palatal and buccal aspects. Particulate bone was compacted to fully fill the gaps between the marrow portion of the grafts and the implant.



Fig 7 A screw-retained provisional restoration using the natural crown of the patient was manufactured with an adequate emergence profile, allowing space for correct accommodation of the tissues. The provisional crown was adjusted according to the patient's occlusion.



Fig 8 After 3 months, the soft tissue healed and was maintained in the appropriate position.



Fig 9 The porcelain crown in position after 4 months.



Fig 10 A CBCT image taken after 2 years, highlighting the stability of the buccal and palatal walls in terms of their thickness and height.

were filled with particulate autogenous cancellous bone, maintaining the reconstructed bone walls and the surrounding soft tissue. The graft was placed 1 mm above the implant platform (Fig 6). A screw-retained provisional restoration with an ideal emergence profile, using the crown of the patient's tooth, was immediately placed in the ideal position and adjusted to be out of occlusion (Fig 7).

Three months later, the soft tissue showed preservation of volume and papillae positioning (Fig 8). Definitive restoration was accomplished after 4 months using

a screw-retained porcelain crown (Fig 9). After 2 years, clinical evaluation showed soft tissue volume stability in terms of the gingival margin and papillae, and the CBCT scan (Fig 10) showed that the buccal and palatal walls remained stable, with adequate thickness in the maxillary right first molar.

Case Two

The second patient presented a compromised maxillary left second premolar with severe bone loss and a facial abscess. Periodontal

probing revealed a loss of the buccal wall, and the palatal wall was partially lost (Fig 11a). CBCT imaging revealed severe alveolar bone defects that required reconstruction (Fig 11b).

In this case, the IDR technique was performed using the cortico-cancellous graft protocol before implant placement. The residual bone was not sufficient to provide good primary stability of the implant. Therefore, the osseodensification implant site preparation method was used to optimize the implant site and improve implant primary stability (Figs 12 to 14). After initial site preparation, densifying burs were further used in a CCW rotation at a slow speed (150 rpm) to compact the particulate autogenous graft laterally and apically against the remaining socket walls. The implant was placed in the 3D position with a primary stability of 40 Ncm (Fig 15). A screw-retained provisional restoration was constructed using the crown of the patient's tooth and was immediately placed (Fig 16).

The results were clinically evaluated 3 months after the procedure (Fig 17), and definitive restoration was performed after 4 months using a screw-retained porcelain crown (Fig 18). Periapical radiographs showed that the bone reconstruction at the mesial and distal aspects remained well maintained after 2 years (Fig 19a). The 2-year clinical evaluation showed that soft tissue volumes remained stable at the gingival margin and papillae, and CBCT imaging showed stable buccal and palatal walls with adequate thickness (Fig 19b).

Fig 11 Case 2. (a) The patient presented with an abscess in the maxillary second premolar. Periodontal probing revealed heights of approximately 12 mm at the buccal aspect and 9 mm at the palatal aspect. (b) CBCT confirmed the total loss of the buccal wall, partial loss of the palatal wall, and close proximity of the root apex to the sinus floor.

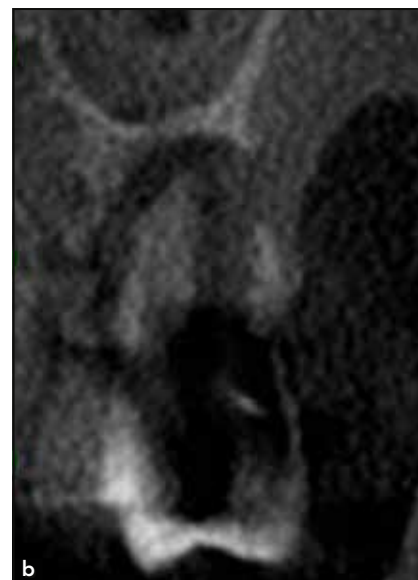


Fig 12 After tooth extraction, careful curettage of the socket was performed to remove the granulation tissue and the remaining periodontal tissue. Before implant placement, the bone graft was harvested from the tuberosity.



Fig 13 The socket was grafted before site preparation and implant placement. Three pieces of cortico-cancellous graft were reshaped according to the defect configuration and inserted: one in the buccal aspect, one in the palatal aspect, and another in the distal aspect. The remaining medullary graft was crushed to reduce the size of the particles, then packed into the socket.



Fig 14 The site was prepared using the osseodensification concept in a counterclockwise rotation, thus increasing the bone volume and compacting the grafted bone laterally and apically.



Fig 15 The implant was inserted in the restored bone, obtaining 40 Ncm of primary stability.



Fig 16 A screw-retained provisional restoration using the patient's natural crown was prepared and installed with an adequate emergence profile and was adjusted to be out of occlusion.



Fig 17 The soft tissue healed with adequate thickness after 3 months. Maintenance of the anatomical contour of the soft tissue can be observed.



Fig 18 The installed porcelain crown after 4 months.

Fig 19 At 2 years, (a) the periapical radiograph shows bone stability all around the implant and (b) the CBCT scan highlights the stability of the buccal and palatal walls.



Discussion

The reconstruction of hard and soft tissues after the loss of periodontally hopeless teeth is one of the most challenging clinical tasks and requires the use of a series of surgical procedures.^{3,4} This approach has also been used successfully for implants placed immediately into intact

extraction sockets of periodontally compromised teeth, subsequently transforming the compromised periodontal tissues into healthy peri-implant tissues.^{5,8} This outcome is apparent even in cases in which the preoperative osseous labial plate has been clinically and radiographically assessed as severely compromised or completely absent.^{6,9,14}

Different surgical alternatives for bone augmentation in postextraction-compromised sockets have been described.¹⁰⁻¹³ However, some of these techniques require longer rehabilitation periods and are usually costly. As an alternative, the IDR technique using a maxillary tuberosity graft presents significant reductions in treatment time. Reconstructing alveolar bone defects, surgical implant installation, and immediate provisionalization are performed simultaneously within the same procedure, keeping the gingival architecture in the same position and without opening the flap.¹⁶ As previously described, if the soft tissue and periosteum remain attached to the buccal bone, the blood supply will be maintained, allowing rapid graft revascularization.^{17,20,21}

The bone density at the buccal, palatal, and basal maxillary tuberosity is lower than that at other maxillary and mandibular regions.^{7,16} Due to the thinness of their cortical bone, maxillary tuberosity grafts are easily shaped; nevertheless, their cortical structure can act as a

biologic barrier, stabilizing the soft tissue and the particulate bone graft around the implant.¹⁶ The total porosity of the graft volume indicates that the corticocancellous structure can act as a scaffold for cellular and vascular growth.²¹ This renders the maxillary tuberosity bone, which is filled with osteoprogenitor cells and growth factors, an ideal structure for regeneration.^{15,16,20}

The structural and biologic characteristics of this graft, as well as its proper manipulation and adaptation to the recipient site, plays a significant role in the success of the IDR technique, as demonstrated by the obtained long-term results.^{17,21}

One of the most challenging steps of immediate implant placement techniques, including IDR, is ensuring implant primary stability, specifically in the maxilla. The clinical cases presented in this article demonstrate the advantages of combining the IDR technique with osseodensification for treating complex clinical cases in compromised alveolar sockets. In both clinical cases, the osseodensification implant site preparation method effectively helped to increase the primary stability of the implant and allowed implant placement in the low remaining bone volume.

Osseodensification preserved the remaining apical bone and provided a compacted graft against the extraction socket walls to produce an intimate osteotomy for the implant. This compact grafting increased implant primary stability and allowed a higher insertion torque due to the spring-back phenomenon.²⁴

In addition, histologic evidence has demonstrated that the compacted bone, which lies immediately in contact with the implant, provides physical interlocking between the bone and the implant surface and acts as a nucleation site for new bone formation to facilitate faster osseointegration.^{25,26}

Conclusions

These clinical cases showed adequate implant rehabilitation in fresh extraction sockets of periodontally compromised teeth with severe alveolar bone defects. The combination of the IDR technique with the osseodensification implant site preparation method allowed for an increase in implant primary stability, as demonstrated by the higher insertion torque achieved.

When properly indicated and performed, both techniques may be mutually beneficial, allowing the implant site preparation and bone reconstruction of the socket to be performed as a minimally invasive approach, thus enhancing bone formation and osseointegration.

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Dr Huwais is the developer of the osseodensification method and the inventor of the Densah bur technology used in these case reports. The remaining authors declare no conflicts of interest.

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