

Vertical Alveolar Ridge Augmentation Prior to Inferior Alveolar Nerve Repositioning: A Patient Report

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This report describes treatment of a patient using vertical alveolar ridge augmentation performed prior to transposition of the inferior alveolar nerve (IAN). A preoperative computerized tomographic (CT) scan revealed 2 to 3 mm of bone above the canal in the left mandibular molar region. An autogenous bone graft harvested from the chin area was utilized along with a titanium mesh for vertical alveolar ridge augmentation in this area. CT scan after bone grafting revealed 5 mm of vertical ridge augmentation. Bone height above the IAN was 7 to 8 mm after bone grafting procedure. For IAN transposition, an osteotomy was performed to obtain a lateral access window located 4 mm below the crestal bone along the lateral side of the mandible. Two cylindrical hydroxyapatite-coated implants were placed. Autogenous bone from the lateral access window that had been removed en bloc was particulated and placed around the implants. Because vertical alveolar ridge augmentation had been performed, the coronal portion of the implant was not exposed after transposition of the IAN. It is suggested that vertical ridge augmentation may be considered prior to transposition of the IAN in situations where minimal bone height exists above the IAN canal. However, long-term clinical investigations are recommended. INT J ORAL MAXILLOFAC IMPLANTS 2005;20:296-301

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Implants have become a valid treatment modality for the completely¹ or partially² edentulous patient. Resorption of the residual alveolar ridge has prompted the use of various bone grafting techniques³⁻¹⁰ to restore the ridge to a condition that allows placement of root-form implants in situations where excessive bone resorption has occurred. The posterior mandible presents a challenge to clinicians because of the presence of the inferior alveolar nerve

(IAN). Transposition of the IAN (TIAN) has been suggested as alternative treatment to allow placement of longer implants, better initial stabilization, and reduced treatment time.¹¹⁻¹⁹

Jensen and Nock¹¹ were the first to describe placement of dental implants in the posterior mandible in conjunction with TIAN. They used a large round bur to create a channel in the lateral mandibular cortical plate distal to the mental foramen to permit TIAN. Several modifications have been described since then.^{13,14,16}

Several authors have described preparation of a lateral access window to obtain access to the IAN.^{11,13,16,19} Presence of adequate bone coronal to the IAN canal was indicated to provide stability to the implants during placement (Fig 1). The purpose of this patient report was to describe treatment of a patient in whom minimal crestal bone was observed coronal to the canal of the IAN. Vertical alveolar ridge augmentation was performed prior to TIAN.

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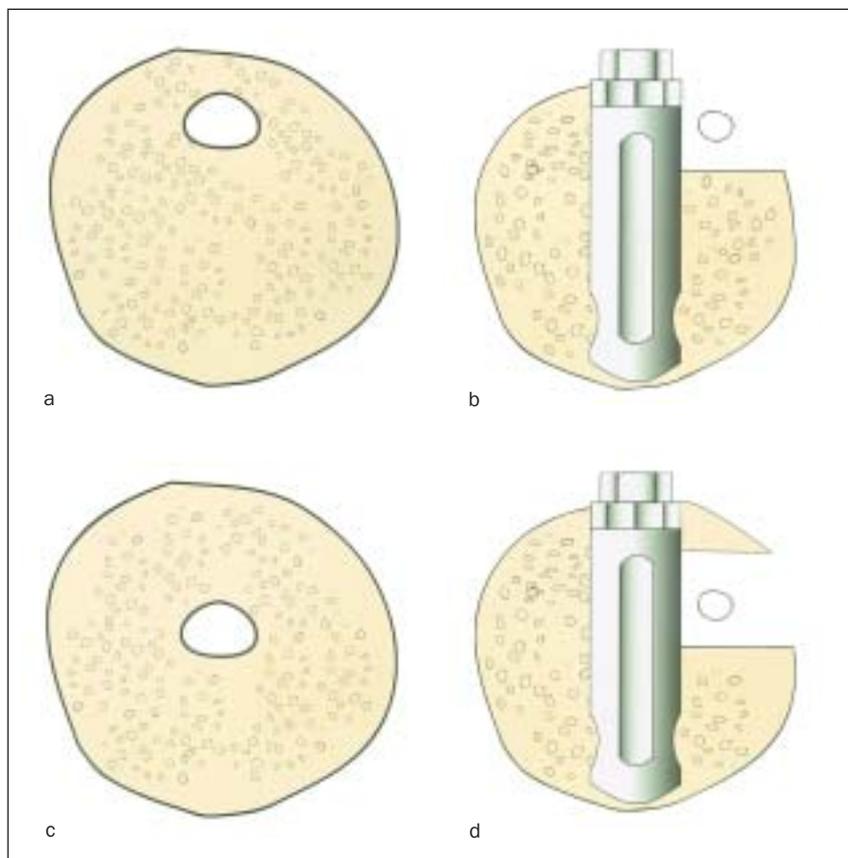


Fig 1 (a) Diagram of a situation where inadequate bone height is observed above the inferior mandibular canal. (b) Osteotomy and nerve transpositioning will result in implant exposure at the coronal area. (c) Preoperative illustration of a situation where adequate bone can be seen above the canal. (d) In this case, preparation of a lateral access window to retract the nerve allows adequate bone around the coronal portion of the implant.

PATIENT REPORT

A 52-year-old male patient presented at the Center for Prosthodontics and Implant Dentistry, Loma Linda University, for treatment of partial maxillary and mandibular edentulism (Fig 2a). Adequate bone volume was present at the right mandibular site for placement of short threaded root-form implants. Maxillary edentulism was treated with a subantral augmentation procedure^{20,21} and implant placement at a second-stage surgery. A computerized tomographic (CT) scan of the mandible indicated 2 to 3 mm of bone above the canal of the IAN on the left side. TIAN was planned; however, bone above the canal of the IAN was inadequate to provide initial implant stability during TIAN as has been recommended in the literature.^{11,13,14,16} In addition, bone height was insufficient to ensure a favorable implant-crown ratio. Thus, vertical alveolar ridge augmentation was planned before TIAN.

Autogenous bone for grafting was harvested from the chin area with a technique that has been previously described.^{3,4} Briefly, a vestibular incision was made at least 2 mm beyond the mucogingival junction. A full-thickness flap was reflected, and 4 to 5 mm of periosteum was left intact at the most coronal part of the surgical site. The bone to be harvested was identified 5 mm below the apex of the mandibular anterior teeth, 5 mm mesial to the mental foramen, and 5 mm above the inferior border of the mandible. A fissure bur and a chisel were used to remove the autograft en bloc. Collagen hemostatic agent (Avitene; Alcon Pharmaceuticals, Fort Worth, TX) was placed at the donor site, and the area was sutured.

Full-thickness buccolingual flaps were reflected at the recipient site (the area of the left mandibular molars). The recipient site was perforated to induce bleeding and promote incorporation of the graft.²² A titanium mesh (Osteo-Tram; Osteomed, Addison, TX)

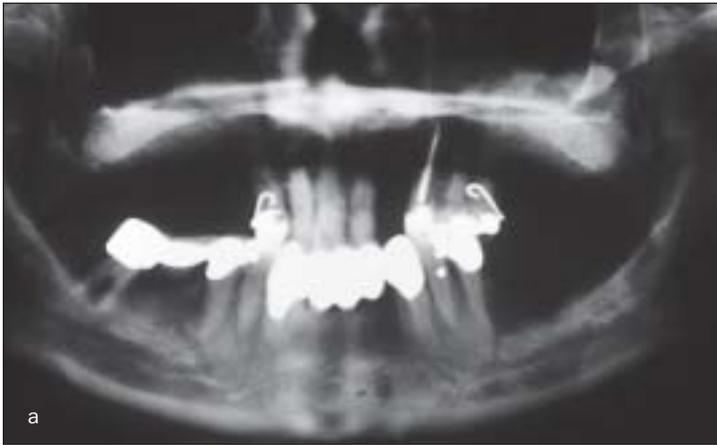
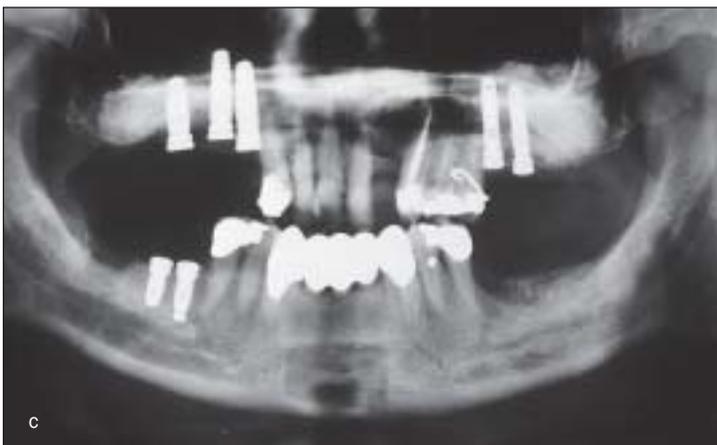


Fig 2 (a) Preoperative view in which minimal bone height can be observed above the canal of the inferior alveolar nerve. (b) A titanium screw-retained mesh was utilized for vertical alveolar ridge augmentation. Autogenous bone graft was harvested from the symphysis area. (c) Postoperative view after ridge augmentation.



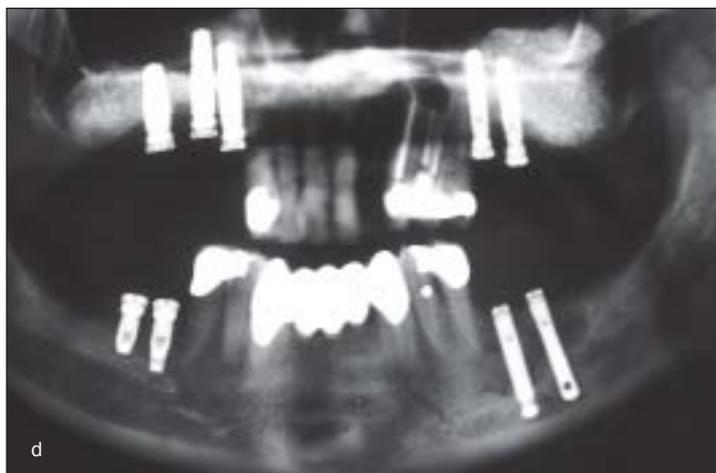
was used to hold the graft material in place (Fig 2b).^{9,10} The titanium mesh was secured in place with 2 fixation screws. Periosteal fenestration²³ was performed along the labial/buccal flap to enable primary closure. The flap was then sutured.

Six months after bone grafting, the titanium mesh was removed (Fig 2c). A new CT scan indicated the

presence of 7 to 8 mm of bone above the IAN canal; approximately 5 mm of vertical alveolar ridge augmentation had been achieved. TIAN was performed 9 months after bone grafting. After performing a crestal incision, full-thickness labial and lingual flaps were reflected. The autogenous bone graft appeared incorporated at the recipient site. A lateral access



Fig 3 (a) After performing a lateral osteotomy to obtain a lateral access window, the inferior alveolar nerve is retracted. (b) Cylindric hydroxyapatite-coated implants are placed. (c) Autogenous bone graft was placed around the implants and the area around the lateral access window. (d) Panoramic radiograph, postoperative view.



window osteotomy was performed and the IAN was retracted (Fig 3a).^{11,13,14,16} Using an acrylic resin surgical guide, 2 cylindric hydroxyapatite-coated implants (Steri-Oss; Nobel Biocare, Yorba Linda, CA) were placed (Fig 3b). The autogenous bone from the lateral access window was particulated and placed around the implants (Fig 3c). The flaps were sutured. A panoramic radiograph was obtained after implant surgery (Fig 3d).

Five months after implant placement surgery, second-stage surgery was performed. The implants appeared clinically osseointegrated; osseointegration was tested with the Periotest unit (Siemens, Bensheim, Germany). Implants were restored with cement-retained ceramometal restorations. The patient reported transient hypesthesia that lasted for 3 months; however, no further symptoms of neurosensory disturbance were observed. Three-year postloading examination revealed no clinical signs of pathosis (ie, mobility, probing depth < 3 mm, pain, bleeding upon probing).

DISCUSSION

There is a paucity of data in the literature regarding the amount of bone needed above the IAN canal

when performing TIAN. Jensen and Nock¹¹ indicated that the superior part of the osteotomy for the lateral access window should be several millimeters below the crest of the residual mandibular alveolar ridge. Similarly, Rosenquist¹⁴ suggested that the cortex lateral to the canal should be removed en bloc and that the coronal part of the block be located several millimeters below the crest of the alveolus. Friberg and colleagues¹³ suggested that the osteotomy for the lateral access window be performed several millimeters below the crest of the residual alveolar ridge. They suggested that special care be taken not to remove excessive bone superior to the canal of the IAN. A close approach to the bone crest may interfere with countersinking and marginal implant bone support. Jensen and associates¹⁶ were the first to introduce some guidelines regarding the presence of bone above the canal of the IAN. They suggested that 3 to 5 mm of bone should be present above the canal of the IAN to perform TIAN. Kan and coworkers¹⁹ reported on TIAN in situations where a minimum of 5 mm of bone was present above the canal of the IAN (average: 6.8 mm, range: 5 to 10 mm).

A specific amount of bone (at least 5 mm) is needed above the canal of the IAN to perform TIAN. However, and to the author's knowledge, no suggestion has been provided for cases in which the

amount of bone above the canal is minimal. Patients treated with TIAN at the Center for Prosthodontics and Implant Dentistry, Loma Linda University, in whom less than 4 mm of bone was present above the canal of the IAN demonstrated excessive marginal bone loss (> 4 mm) 1 to 2 years after implant placement. Excessive marginal bone loss around implants placed in conjunction with TIAN was reported by Rosenquist.¹⁴ In that study, average marginal bone loss was 0.3 mm 12 months postoperatively. However, the range of marginal bone loss was 0.1 to 6 mm. There were 3 instances where excessive marginal bone loss (4 to 6 mm) occurred 12 months postoperatively.

Some authors have demonstrated the potential for placing dental implants several millimeters above original bone level in conjunction with 1-stage bone grafting.^{7,8} In these cases, vertical ridge augmentation and implant placement are performed simultaneously. However, to follow this technique, a minimum of 6 to 8 mm residual bone height is needed above the IAN canal to provide primary implant stability. In situations with excessive resorption of the posterior mandible, as in the case presented, application of this technique is not feasible because of the lack of adequate bone volume to provide primary implant stability.

In the case presented, the symphysis was selected as the donor site for the autogenous bone graft. The ascending ramus can be a donor site as well.⁴⁻⁶ However, the symphysis area provides more autogenous bone marrow compared to the ascending ramus.^{3,4} Autogenous bone marrow provides enhanced vascularity and remodeling activity compared to cortical autografts.^{24,25}

Distraction osteogenesis is a technique described in the literature for alveolar ridge augmentation.²⁶⁻²⁸ While this technique has been mostly studied for the resorbed premaxillary area,²⁸ several reports^{26,27} have demonstrated the potential of distraction osteogenesis for vertical ridge augmentation in posterior mandible. With this technique, a bony segment needs to be released by performing vertical and horizontal osteotomies. A distraction device is placed along the horizontal osteotomy. It would appear that there must be at least 8 mm of bone above the IAN canal to make horizontal and vertical osteotomies and have a large enough segment to fix to and transport with a distraction device.²⁸ Situations with minimal bone height (< 7 mm) above the IAN canal are not suitable for the distraction osteogenesis technique.²⁸

Neurosensory disturbance has been reported after performing TIAN.^{12-16,19} Davis and colleagues¹² surveyed 22 practitioners performing TIAN; 9 of 190

patients experienced a disconcerting level of burning dysesthesia. Friberg and coworkers¹³ reported a 7-month evaluation of 10 patients. They found hypesthesia and paresthesia in 30% of the jaws. Rosenquist¹⁴ noted that 6 of 100 patients had either diminished or no neurosensation at 18 months postoperatively. Jensen and colleagues¹⁶ reported that 10% of patients had signs of neurosensory disturbance. Haers and Sailer¹⁵ detected light paresthesia in 76.5% of their patients at 12 months. Kan and coworkers¹⁹ noted a 52.4% incidence of neurosensory disturbance 41.3 months after surgery. In addition to neurosensory disturbance, Kan and coworkers¹⁸ reported the incidence of mandibular fracture after TIAN. Risks regarding neurosensory disturbance should be considered and explained to the patient during treatment planning.

CONCLUSION

In a clinical situation with minimal bone height above the canal of the inferior alveolar nerve, bone grafting before implant placement and TIAN may be considered. A prospective clinical study and long-term follow-up are needed to validate the use of this technique on a routine basis.

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