

Restoration of the Atrophied Posterior Mandible with Transverse Alveolar Maxillary/Mandibular Implants: Technical Note and Case Report

John Paul Stella, DDS¹/Haitham Abolenen, DDS²

Restoration of the atrophied posterior mandibular alveolus has been a surgical challenge in the past. Many treatment options have been published, each with unique shortcomings. This study will review and compare these techniques to a new type of implant, the transverse alveolar maxillary/mandibular implant (TAMMI). Using modified Nobel Biocare Brånemark System zygomatic implants that were shortened to 11.5, 13, 15, 18, 20, 22.5, or 25 mm, the authors reconstructed atrophied posterior mandibles. These TAMMIs were placed at a 45-degree angle, engaging both the crest of the ridge and the buccal cortex. Using TAMMIs, atrophied posterior mandibular alveoli as small as 9 mm have been successfully restored without complication to the inferior alveolar nerve. (INT J ORAL MAXILLOFAC IMPLANTS 2002;17:873-879)

Key words: dental implants, mandible, posterior mandibular atrophy, transverse alveolar implants

Atrophy of the posterior mandible is considered a challenging problem facing any surgeon considering reconstruction of this area with dental implants. When sufficient posterior bone is present, varying rates of traditional implant success—between 87% and 98%^{1,2}—have been reported. However, when the residual posterior mandibular ridge is significantly atrophied (ie, to less than 10 mm), surgical problems have arisen.

Several published techniques are available to either circumvent the atrophied posterior mandibular alveolus or to augment bone in this area. Nerve lateralization was first described by Alling in 1977,³ with numerous modifications that followed to help

make a more technically difficult surgery less challenging. Even with modifications and improved surgical procedures, the published neurosensory disturbances have been as low as 5% or as high as 77.8%.^{1,2,4-6} Onlay or interpositional bone grafting of the atrophied posterior mandibular alveolus has also been reported. Unfortunately, resorption rates of up to 50%⁷ over time have been documented. More practically, patients who have advanced posterior atrophy of the mandibular ridge often have concomitant supraeruption of the maxillary posterior teeth. Therefore, the addition of bone to the atrophied posterior mandibular alveolus can further decrease the amount of interarch space, making prosthetic rehabilitation problematic, even after successful implant placement.

Krekmanov⁸ described the placement of traditional implants at various angles to avoid the inferior alveolar nerve and engage the posterior lingual mandibular cortex. The author neglected to point out that as the posterior mandibular alveolar ridge resorbs, the crest of the ridge progressively moves more buccally, creating a buccal crossbite tendency. When the implants are angled lingually, the buccal emergence of the definitive prosthesis tends to be

¹Chairman, Department of Oral & Maxillofacial Surgery, JPS Health Network, Fort Worth, Texas; Co-director, Facial & Oral Surgery Institute of Fort Worth, Fort Worth, Texas.

²Clinical Intern, JPS Health Network, Fort Worth, Texas.

Reprint requests: Dr John Paul Stella, 1625 St Louis Ave, Fort Worth, Texas 76104. Fax: +817-927-1497. E-mail: drstella@facialoralsurg.com

more lateral, thereby further worsening the tendency toward buccal crossbite. Additionally, the lingual mandible offers greater anatomic risks because of the sublingual gland, lingual nerve, and lingual artery. The final position of the angled implant platform requires specialized angled abutments for the fixed prosthesis to engage.

Most recently, authors have recommended the use of distraction osteogenesis⁹⁻¹¹ in the posterior mandible when alveolar atrophy has made routine placement of dental implants nearly impossible. Authors claim that this reduces the incidence of neurosensory disturbances, but the reduction of interarch space can remain a problem, and the inability to prosthetically restore implants limits this application. All of the previously published alternatives for implant restoration of the atrophied posterior mandibular alveolar ridge involve additional surgery prior to implant placement, with each carrying additional cost and possible complications.

The ideal surgical option for these patients is one that would provide optimal bone support for implant placement while maintaining interarch space, reducing the risk of nerve damage, shortening the time required for treatment, and avoiding the expense of any other surgical procedures or prosthetic components in addition to the implant placement. This article will present the transverse alveolar maxillary/mandibular implant (TAMMI) as an alternative treatment for those patients who have limited residual ridge in the posterior mandible.

MATERIALS AND METHODS

Patient Selection

The ideal patient for this surgical procedure is missing 1 or more teeth in the posterior mandible and has insufficient vertical height and/or width of the posterior mandibular alveolus. A minimum of 9 mm of bone above the inferior alveolar nerve is necessary for this technique, regardless of the width of the ridge.

Implant Specification and Design

In conjunction with engineers at Nobel Biocare (Göteborg, Sweden), the authors have modified the currently produced zygoma implants. Zygoma implants range in length from 30 to 52.5 mm; however, these have been shortened to 11.5, 13, 15, 18, 20, 22.5, and 25 mm, so that they may be used in the application described herein.

Presurgical Preparation

The patient is asked to gently bite on a small plastic bite block that has a 6-mm stainless steel ball encased

(Ace Surgical Supply, Brockton, MA). A panoramic radiograph is obtained while the patient occludes on this ball in the area of the missing teeth. This device is then used to calculate the amount of magnification in the proposed surgical area. A specially designed ruler is used to record the diameter of the ball and calculate the millimetric height of bone available above the inferior alveolar nerve in the proposed implant site or sites. The vertical height of the available bone above the inferior alveolar nerve in the proposed implant sites is documented and used later for preparation of a drill guide.

Alginate impressions are obtained of both the maxillary and mandibular arches, along with an occlusal bite registration. Casts are poured and anatomically trimmed. Using articulated casts, the ideal placement of each implant is indicated on the casts. A vertical line marks the anteroposterior position of each implant (Fig 1a) and is extended down the side of the trimmed casts. Two reference holes are drilled (Figs 1b and 1c) for each proposed site of the TAMMI. The first hole is placed on the lingual third of the crest of the ridge where the implant platform of the proposed TAMMI is to finally rest. A second hole is placed at the proposed exit site of the TAMMI on the "buccal cortex" of the casts. The amount of vertical bone available above the alveolar nerve at the proposed implant site is documented from the panoramic radiograph. Since the implant will enter the alveolus at a 45-degree angle, 20% more length can be added to the vertical height above the nerve. Therefore, if 9 mm of bone is available above the inferior alveolar nerve in a given site, a reference hole below the mandibular crest at the proposed buccal cortex penetration site would be measured approximately 11 mm below the crest of the ridge. The 2 holes are connected with a 3-mm twist drill. A 2-mm-diameter wooden dowel (Fig 1d) is placed into the hole and, using a protractor, set at a 45-degree angle to the base of the cast. If the casts are anatomically trimmed correctly, then the base of the casts should approximate the occlusal plane of the patient. The guide pin is then secured in position using sticky wax. Orthodontic acrylic resin is mixed and allowed to set to a putty consistency, and the soft resin is placed completely surrounding the wooden guide pin and covering 2 to 3 teeth adjacent to the proposed TAMMI placement site. After the resin sets, it is removed from the cast and trimmed (Fig 2).

Operative Technique

TAMMI placement can be accomplished either under local anesthesia or supplemented with intravenous sedation. The authors prefer to use a conscious sedation method supplemented with local

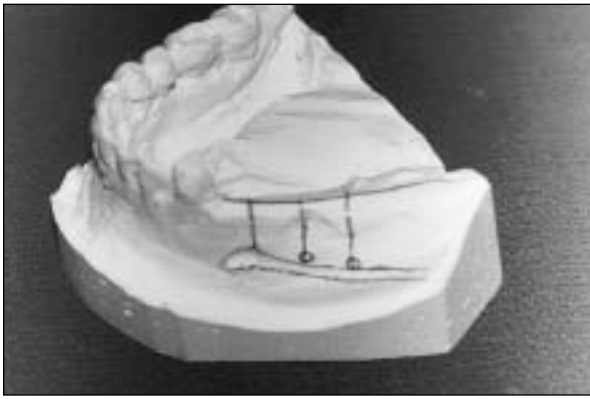


Fig 1a A vertical line marks the anterior/posterior position of each implant.

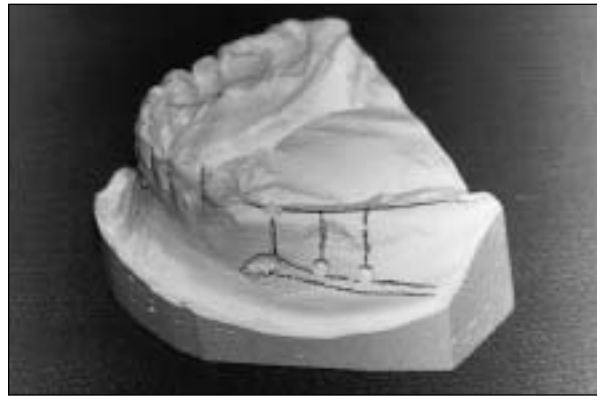


Fig 1b Reference holes are drilled for the entrance and exit of each implant.

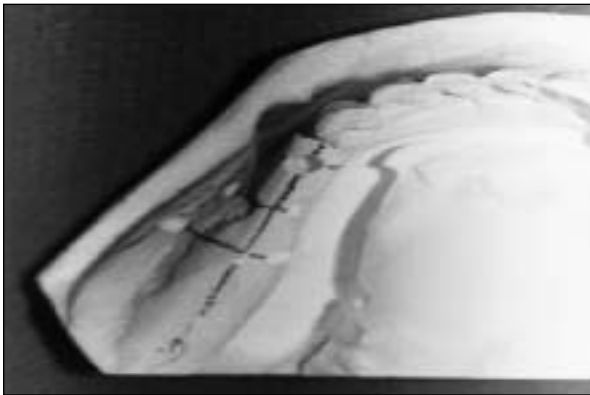


Fig 1c Occlusal view shows the position of the reference holes.

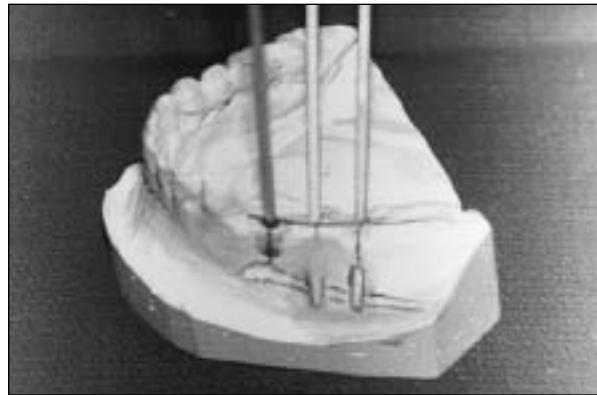


Fig 1d The holes are connected and wooden dowels are placed into the holes to act as drill guides.



Fig 2 An acrylic resin drill guide is fabricated and trimmed.

anesthesia. The TAMMI is a modified Nobel Biocare zygomatic implant that is 4 mm in diameter and can range from 11.5 to 25 mm in length. A crestal incision is made dividing the attached gingiva along the crest of the ridge. A small posterior vertical releasing incision is made to facilitate the dissection along the lateral plate of the mandible. The mucoperiosteum is reflected anteriorly until the superior aspect of the mental nerve is identified. A caliper is then used to measure from the superior aspect of this nerve to the crest of the ridge directly above the nerve; this measurement is used to confirm the calculations made from the panoramic radiograph. The surgical drill guide is then placed on the teeth adjacent to the proposed implant site(s), and 2-mm pilot hole(s) is (are) made (Figs 3a and 3b). Other planned traditional implants should be placed first so they can be used later to help properly orient the TAMMI relative to adjacent teeth and implants.

With traditional implant(s) placed, the TAMMI site is then prepared. The drill guide is used to

place a 2-mm guide hole. A caliper is again used to measure the distance from the hole, which now penetrates the buccal cortex of the mandible to the crest of the ridge. This is compared to the preoperative measurements to ensure that the drill guide



Fig 3a The traditional implant(s) is (are) placed first.



Fig 3b The TAMMI site is prepared; notice the 45-degree angle of the handpiece.



Fig 3c The preparation is completed through the buccal cortex.

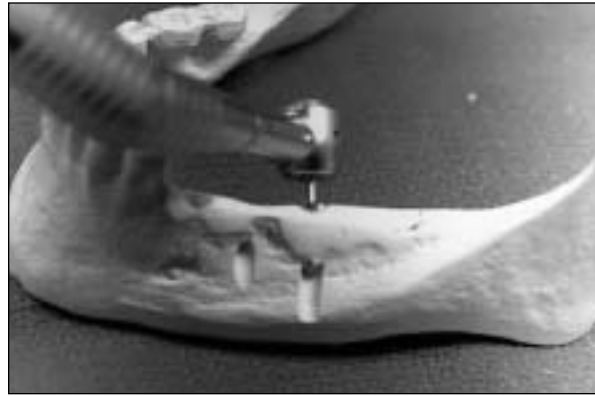


Fig 3d The implant sites are countersunk.

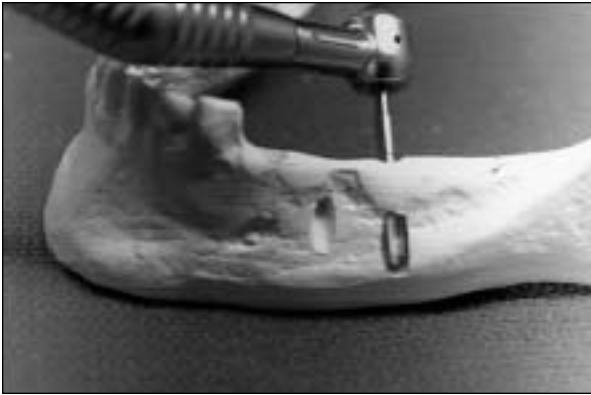


Fig 3e The implant sites should be tapped all the way to the buccal cortex.

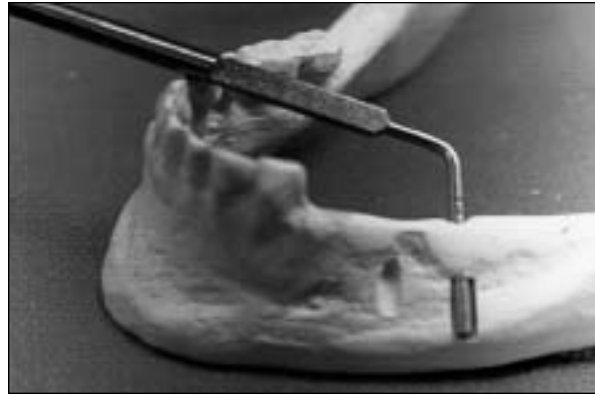


Fig 4 The length of the preparation site is measured, and then the proper TAMMI is selected.

was fabricated properly. Following confirmation of pilot hole placement, a series of Nobel Biocare drills are used, including a 3-mm twist drill (Fig 3c), and finally the preparation is countersunk at the crest of the ridge (Fig 3d). A MK III screw tap (Nobel Biocare) (Fig 3e) is used to tap the preparation site, so that the apex of the tap is clearly visible through the buccal cortex penetration site. The

amount and density of cortical bone around the implant is predictably so dense that tapping is often necessary.

The depth of the preparation is then confirmed with a depth gauge, and the proper TAMMI is selected (Fig 4). In most cases, the implant torque exceeds the drill capabilities after two thirds of the implant has been placed, and a manual wrench must

be used to seat the implant into its final position. While wrenching the implant into place, the surgeon must carefully observe the bone along the buccal cortex and crest of the ridge so that it does not fracture. Overtightening the implant will cause this bone to become increasingly white, with small craze lines developing. The implant platform must be placed properly over the crest of the ridge. This is accomplished by placing the screwdriver into the screw that secures the implant delivery abutment; when the implant is approaching its final position, the screwdriver is placed into the screw and the implant is turned until the screwdriver is properly oriented relative to the adjacent teeth and/or implants along the crest of the ridge. The set screw is then removed and the delivery abutment is removed from the TAMMI. Cover screws are secured, and the operative site is closed with 3.0 chromic sutures in a running continuous fashion. It is imperative that the cover screw of the TAMMI (ie, zygomatic implant) be placed. These screws are slightly larger than standard Brånemark System regular-platform cover screws and will extend the entire length of the threaded implant screw access hole. If the surgeon does not place a cover screw, bone will grow into the access hole from underneath and prevent future placement of the abutment.

Postoperative Care

A patient may wear a partial denture for cosmetic purposes only and is instructed not to chew any foods using the temporary partial denture. Postoperative radiographs include panoramic and posteroanterior cephalometric views.

CASE PRESENTATION

A 49-year-old woman presented with an edentulous left posterior mandible area. The patient had approximately 9 mm of bone above the inferior alveolar nerve canal, as recorded using the panoramic radiograph and stainless steel ball technique (Fig 5a) described previously.

It was noted on clinical examination that the residual alveolar ridge was also quite narrow. A single TAMMI (4.0×11.5 mm) was placed in the area of the missing left first molar and was restored with a premolar-size crown to prevent supraeruption of the maxillary left first molar. The patient had normal neurosensory function along the distribution of the left inferior alveolar nerve, and postoperative radiographs showed the proper alignment of the implant platform (Figs 5b and 5c). The master casts of the mandible showed good parallelism of the

implant to the long axis of the natural teeth. No special angled abutments or other special laboratory measures were needed to restore the implant.

DISCUSSION AND CONCLUSIONS

The TAMMI as presented here has numerous advantages over previously reported techniques to resolve the problem of the atrophied posterior mandibular ridge. The most time-consuming aspect of TAMMI placement is the design and fabrication of the drill guide on preoperative diagnostic casts. TAMMIs can be placed with resultant cortical bone interface, without reduction of interarch space, with less risk of damage to the inferior alveolar nerve, and without adjunctive surgical procedures or special prosthetic abutments. No additional time for the healing of an onlay graft or distraction osteogenesis is necessary. Only the traditional 4-month period for osseointegration is needed prior to uncovering the implants and beginning the prosthetic phase of treatment.

TAMMIs cost approximately 25% more than traditional implants because of the increased complexity of implant fabrication. The overall increase in cost to the patient is also approximately 25%. This increased cost of the TAMMI as compared to a traditional implant is the result of the increased time for preoperative preparation, including radiographic analysis and template fabrication.

To date, the author has placed 4 TAMMIs in atrophied posterior mandibular ridges. All implants have integrated, and no neurosensory disturbances have been reported by patients or by objective neurosensory testing. Since the longest patient follow-up of individuals included in this series is only 6 months, a logical concern is in regard to long-term predictability. The TAMMI, by design and by technique, engages both the cortex of the crest of the mandibular ridge and the thick buccal cortex of the posterior mandible. Therefore, it may be anticipated that the long-term success and predictability of this implant should approximate that of the anterior mandible. This is in contrast to ridge augmentation techniques and distraction osteogenesis, where a longer implant might be placed but the majority of the implant engages only bone marrow.

Currently the TAMMI implant is being clinically tested in the maxilla. Maxillary applications include TAMMI implants being positioned into the pterygoid plates with the platform emerging on the crest of the second molar and angled into the palatal vault in the area of the maxillary premolars.



Fig 5a Preoperative panoramic radiograph; notice the height of the alveolar bone above the canal.



Fig 5b Postoperative radiograph, with the TAMMI placed in the mandibular left first molar site.

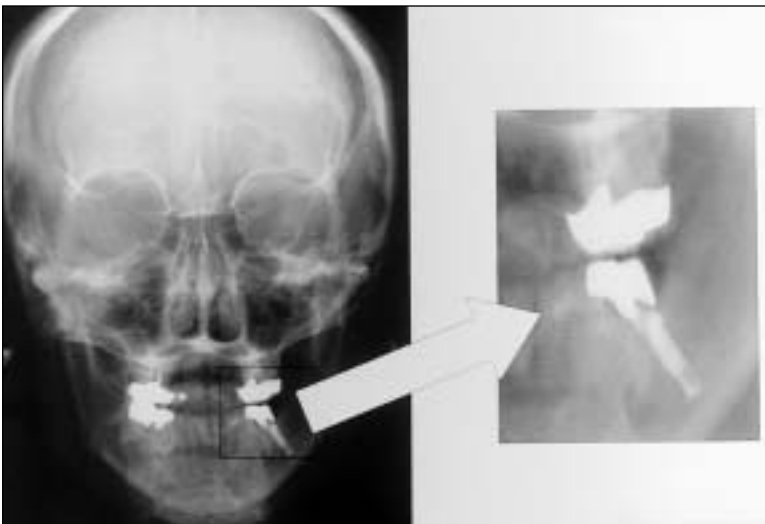


Fig 5c Postoperative posteroanterior cephalometric radiograph; notice the angulation of the TAMMI with respect to the standard implant.

REFERENCES

1. Nocini PF, De Santis D, Fracasso E, Zanette G. Clinical and electrophysiological assessment of inferior alveolar nerve function after lateral nerve transposition. *Clin Oral Implants Res* 1999;10:120–130.
2. Kan J, Lozada JL, Goodacre CJ, Davis WH, Hanisch O. Endosseous implant placement in conjunction with inferior alveolar nerve transposition: An evaluation of neurosensory disturbance. *Int J Oral Maxillofac Implants* 1997;12:463–471.
3. Alling CG. Lateral repositioning of inferior alveolar neurovascular bundle. *J Oral Surg* 1977;35:419–422.
4. Jensen J, Fischel O, Pedersen S. Nerve transposition and implant placement in the atrophic posterior mandibular alveolar ridge. *J Oral Maxillofac Surg* 1994;52:662–668.
5. Garg AK, Morales MJ. Lateralization of the inferior alveolar nerve with simultaneous implant placement: Surgical techniques. *Pract Periodontics Aesthet Dent* 1998;10(9): 1197–1204.
6. Jensen O, Nock D. Inferior alveolar nerve repositioning in conjunction with placement of osseointegrated implants: A case report. *J Oral Surg* 1987;63:263–268.
7. Von Arx T, Hardt N, Wallkamm B. The TIME technique: A new technique for localized alveolar ridge augmentation prior to placement of dental implants. *Int J Oral Maxillofac Implants* 1996;11:387–394.
8. Krekmanov L. Placement of posterior mandibular and maxillary implants in patients with severe bone deficiency: A clinical report of procedure. *Int J Oral Maxillofac Implants* 2000;15:722–730.
9. Gaggl A, Schultes G, Karcher H. Distraction implants: A new operative technique for alveolar ridge augmentation. *J Craniomaxillofac Surg* 1999;27:214–221.
10. Makarov MR, Harper RP, Cope JB, Samchukov ML. Evaluation of inferior alveolar nerve function during distraction osteogenesis in the dog. *J Oral Maxillofac Surg* 1998;56: 1417–1423.
11. Gaggl A, Schultes G, Karcher H. Vertical alveolar ridge distraction with prosthetic treatable distractors. A clinical investigation. *Int J Oral Maxillofac Implants* 2000;15:701–710.