

The Zygomatic Implant: Preliminary Data on Treatment of Severely Resorbed Maxillae. A Clinical Report

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The Brånemark Zygomaticus implant was used in conjunction with premaxillary standard implants for the reconstruction of resorbed edentulous maxillae. A total of 44 zygomatic implants and 80 premaxillary implants were placed in 22 patients. All implants were stabilized at phase II surgery using a rigid bar. After soft tissues had healed, implant-supported fixed prostheses were fabricated. This article presents a preliminary report on 22 patients followed for 34 months, with a 100% success rate for the zygomatic implants and a 91.25% success rate for the premaxillary implants. (INT J ORAL MAXILLOFAC IMPLANTS 2002;17:861-865)

Key words: dentures, maxilla, zygomatic dental implants

Moderately to severely resorbed edentulous maxillae present complex problems for the restorative dentist. The lack of internal loading of the edentulous alveolar bone leads to further resorption and inability to retain a functional prosthesis.^{1,2} For this compromised group of patients, to allow the fabrication of a stable prosthesis, Adell and colleagues developed a predictable bone

anchorage system for tooth replacement.³ Further resorption of alveolar and basal bone led to research involving reconstruction of the osseous topography of edentulous ridges prior to the placement of endosseous implants. The surgical treatment for this group of patients presents a unique challenge for the implant surgeon.

Historically, many different procedures have been available for treatment of the resorbed maxillae. Adell⁴ and Breine and Brånemark⁵ used composite grafts to re-establish osseous contours and provide a tooth anchorage system. The Le Fort I osteotomy⁶ as well as the iliac block graft^{7,8} have been utilized to provide adequate bony volume for the placement of implants. To create bone mass in the posterior maxillae, sinus lift grafting procedures^{9,10} have also been advocated using a myriad of grafting materials. These treatment options have included multiple procedures and the need for hospitalization and harvesting of bone from distant sites such as the ilium or the calvarium. These adjunctive procedures have prompted the refusal of such treatment by some patients. The inability to wear an existing prosthesis during the bone graft healing period has also limited the number of patients who may have benefited from implant treatment.

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Fig 1 Example of fixed hybrid prosthesis for the restored edentulous maxilla.

An alternative for the treatment of this group of patients is the Zygomaticus implant, introduced by Brånemark in 1988 (Nobel Biocare, Göteborg, Sweden). The implant is a titanium endosteal implant ranging from 30 mm to 52.5 mm in length. The apical two thirds of the implant is 4 mm in diameter and the alveolar one third is 5 mm in diameter. The implant is introduced into the second premolar area, traversing the maxillary sinus, and is fixated into the body of the zygomatic bone. The placement of a minimum of 2 premaxillary implants in the canine position, or ideally 4 premaxillary implants in the canine and the central incisor positions, allows for the fabrication of fixed hybrid prostheses (Fig 1).

MATERIALS AND METHODS

Presurgical Evaluation

A composite defect is defined as the lack of teeth, soft tissue, and hard tissues. The extent of an existing composite defect is evaluated by duplicating in clear acrylic resin the patient's existing denture. A thicker denture base indicates that more vertical alveolar resorption has occurred; the thicker the flange portion of the base, the more horizontal resorption of the alveolus has occurred. Duplication of the patient's existing dentures allows assessment of the presence of the composite defect as it relates to the edentulous ridge and the cervical portion of the denture teeth. If the cervical portions of the denture teeth are immediately on the gingival crest, minimal resorption has occurred and a metal-ceramic type of restoration can be considered. If there is greater than 3 mm of space between the cervical portion of the denture teeth and the crestal gingiva, then a composite defect likely is present, and an overdenture or hybrid prosthesis is indicated to replace the missing teeth, bone, and soft tissues.

Though the zygomatic implant may be used in treatment planning a metal-ceramic fixed prosthesis, the majority of the patients treated with this implant have had composite defects. Required radiographic studies include panoramic radiographs, which generally depict the size and configuration of the maxillary sinuses, the height of the residual ridge, and the position of the nasal floor. The body of the zygoma can usually be visualized. Although computed tomographic (CT) scans may be useful, the authors have not routinely used CT scans in the preoperative evaluation of this group of patients. If the patient's denture is well fitting, it is duplicated and adapted for use as the surgical guide.

Surgical Protocol

The procedure is performed in the office setting under intravenous sedation. Premedication (2 g of amoxicillin) is administered 1 hour prior to the surgical procedure. The patient is sedated and draped, and the administration of a local anesthetic agent is carried out. Circumvestibular infiltration and greater palatine blocks are administered. It is essential that bilateral inferior alveolar nerve blocks be administered, since significant retraction of the tongue, the lower lip, and the mandible is necessary during the procedure. Using a small-gauge needle, bilateral transcutaneous infiltration of the temporal areas over the zygomatic body and zygomatic notch is also administered.

A crestal incision with bilateral releasing incisions is made in the maxillary third molar area. Degloving of the maxilla is performed superior to the base of the anterior nasal apertures and the base of the inferior orbital nerves. Using extraoral bimanual control, the periosteal elevator is guided over the lateral aspect of the zygomatic body in a superior and lateral direction toward the zygomatic notch. Careful upward tenting of the tissue is performed to allow the placement of a toe-out retractor in the zygomatic notch. The index finger of the hand holding the retractor is always placed at the lateral canthus to ensure that instrumentation is not directed toward the eye.

A fine fissure bur is used to create a vertical rectangular sinus opening. The Schneiderian membrane is completely removed, since if it is picked up by the implant during movement through the sinus, the achievement of osseointegration could be compromised. At this point, direct visualization of the path of the implant from the premolar area to the base of the zygoma is possible. Using a straight adapter, the clinician converts the implant handpiece to a straight handpiece. A series of long zygoma drills are used to prepare the osteotomy.

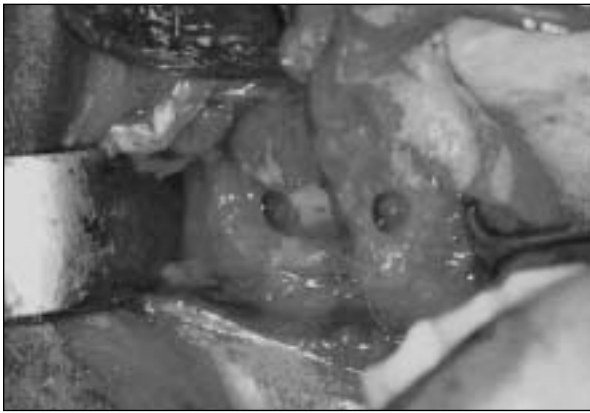


Fig 2 (Left) Site preparation using drills for the zygomatic implant.

Fig 3 (Below) Premounted implant carrier attached to straight handpiece.

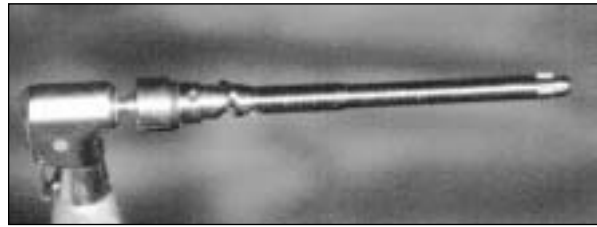


Fig 4a Attachment of the implant head. The long axis of the screwdriver should be perpendicular to the ridge crest.

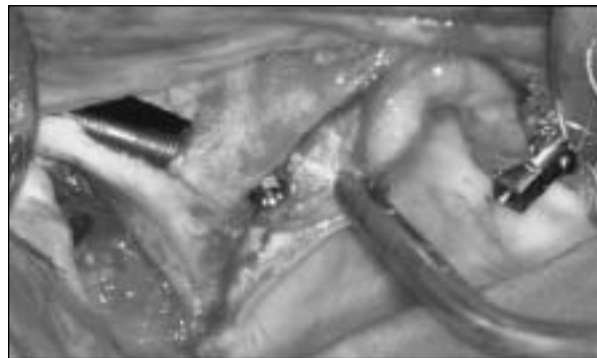


Fig 4b Properly oriented implant head at right angle to the edentulous ridge.

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The apical two thirds of the implant has a diameter of 4.0 mm, and the alveolar one third widens to a diameter of 5.0 mm. To begin the osteotomy, the round bur is used, followed by a 2.9-mm twist drill. A 2.9- to 3.5-mm pilot drill is then used to allow stabilization of the 3.5-mm twist drill, which completes the zygoma osteotomy. The alveolar portion of the implant osteotomy is completed by introduction of the 4.0-mm twist drill, which prepares the crestal bone to its final diameter. Prior to implant placement and at all times during preparation of the osteotomy (Fig 2), the entire surgical paths of the drills are visualized.

The zygomatic implant has an angulated head. This 45-degree angulation allows for the platform of the implant to be in the same plane as the conventional implants in the premaxilla. To facilitate implant placement, premounted implant carriers allow for easy handling of the implant with the straight handpiece (Fig 3). The implant is placed into the osteotomy with copious irrigation. Once

the apical portion of the implant engages 1 to 2 mm of the dense zygomatic bone, the handpiece stalls. Then, with the manual driver ("the onion"), the remaining portion of the implant is seated. To ensure proper orientation of the angulated implant head, a screwdriver is placed onto the implant carrier screw head. The long axis of the screwdriver shaft (Fig 4a) must be at right angles to the edentulous ridge to ensure proper orientation of the implant platform (Fig 4b). When the zygomatic implant has been placed, 2 to 4 regular-platform MK III Brånemark System implants (Nobel Biocare) are placed in the premaxillary region.

Prior to closure of the surgical site, implant-level impressions are made. The resultant soft tissue model allows for fabrication of a rigid bar, which must be placed at stage 2 surgery¹¹ (Fig 5). The surgical wound is closed using 4-0 Vicryl (Ethicon, Somerville, NJ). Relief of the denture base over the zygomatic implants is completed (Fig 6), and the patient is discharged.



Fig 5 Cast rigid bar connecting the premaxillary and zygomatic implants.

Special Considerations

The patient's preoperative denture is relined as necessary during the 6-month period permitted for implant healing and integration. At stage 2 surgery, cross-arch stabilization of the zygomatic implants and the premaxillary implants is recommended. A simplified technique to allow for the fabrication of a passive bar at stage 2 has been described.¹¹ After 4 to 6 weeks of soft tissue healing, impressions are made and the definitive hybrid prosthesis can be fabricated.

RESULTS

Twenty-two patients were considered in this study. A total of 44 Zygomaticus implants were placed. Eight 40-mm, twelve 45-mm, and twenty-four 50-mm zygomatic implants were used. Regular-platform MK III Brånemark System implants were placed in the premaxillary region. Of the 80 premaxillary implants, 37 were 10 mm long and 43 were 13 mm long.

Fixed hybrid prostheses were fabricated for 21 patients, and 1 patient was restored with a metal-ceramic fixed prosthesis. Three patients required premaxillary veneer grafting, and 1 patient received a nasal floor graft to facilitate placement of implants in the central incisor positions.

Forty-one zygomatic implants were restored with standard abutments. Custom abutments were fabricated for 2 zygomatic implants, and a single zygomatic implant received a 17-degree angulated abutment. Seventy-three premaxillary implants were restored with standard abutments.

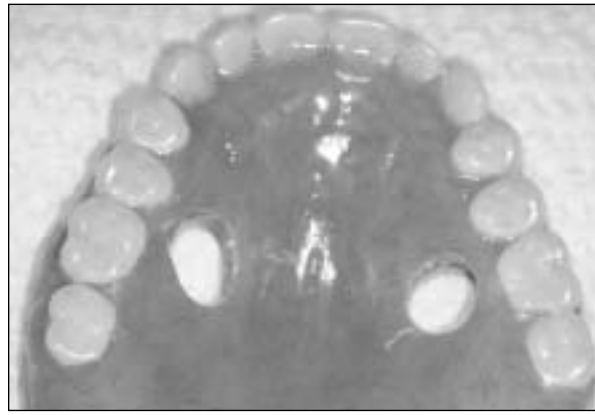


Fig 6 Denture is relieved to accommodate the implants.

Two patients were treated with the initial placement of only 2 premaxillary implants. Nineteen patients had 4 premaxillary implants placed. One patient presented with 5 short premaxillary implants placed by a different surgeon. For this patient, 2 zygomatic implants were placed and the final prosthesis was a metal-ceramic bridge. Three patients lost 1 of their 4 premaxillary implants and 2 patients lost 2 premaxillary implants. These patients did not receive replacements for the failed implants but were restored with fixed hybrid prosthesis, as planned. None of the zygomatic implants failed. The patients in this study have been followed for 34 months with an overall survival rate to date of 91.25% for the premaxillary implants and 100% for the zygomatic implants.

DISCUSSION

Treatment of moderately to severely resorbed maxillae presents a challenge. The typically large pneumatized sinuses in this group of patients require extensive bone grafting if conventional implant placement is envisioned. Grafting of resorbed maxillae with delayed implant placement has been shown to have successful results.^{12,13} However, extended treatment time and the inability to utilize the existing denture during the graft healing period led to a low acceptance rate by patients. Keller and associates reported on reconstruction of compromised maxillae¹⁴ using 118 inlay grafts and 248 Brånemark System implants with an implant survival rate of 87% and a prosthetic survival rate of 95%. In 1999 Rasmusson and colleagues presented

a study of patients who had received one or a combination of autogenous inlay, onlay, combination of inlay/onlay, and or Le Fort I procedures.¹² The implant survival at 3 years was 80%. When implants were placed at the time of bone grafting, the implant survival rate was lower, with 23% failure. The failure rate of implants placed in non-grafted bone was only 11% in the group studied.

Survival of implants in conjunction with augmentation procedures was studied at the 1996 Sinus Consensus Conference.¹⁵ The conclusion reached was similar to that noted in Tolman's report in 1995: The material was so "multivariate and multifactorial that it was difficult to draw definitive conclusions; these must await controlled prospective studies."¹⁶

The zygomatic implant placement procedure does not require any adjunctive procedures. There were no adverse complications associated with this treatment modality. All patients had an uneventful postoperative period similar to conventional implant surgery. The zygomatic implant survival rate of 100%, as well as the prosthetic survival rate of 100% in this clinical report, is extremely encouraging for the treatment of this patient population.

CONCLUSION

The Zygomaticus implant, when placed in conjunction with premaxillary implants, can facilitate the surgical rehabilitation of patients presenting with severe maxillary resorption in the office setting. The ability to immediately utilize existing dentures and the lack of need for hospitalization and bone grafting can result in higher treatment acceptance in this group of patients. A zygomatic implant survival rate of 100% and a prosthesis survival rate of 100% were observed. Conventional techniques used for the fabrication of hybrid dentures by restorative colleagues led to higher treatment acceptance by patients.

REFERENCES

- Pietrokovsko J, Massler M. Alveolar ridge resorption following tooth extraction. *J Prosthet Dent* 1967;17:21-27.
- Tallgren A. The continuing reduction of the residual alveolar ridges in complete denture wearers: A mixed longitudinal study covering 25 years. *J Prosthet Dent* 1972;27(2):120-132.
- Adell R, Lekholm U, Rockler B, Brånemark P-I. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg* 1981;10:387-416.
- Adell R. Regeneration of the periodontium: An experimental study in dogs. *Scand J Plast Reconstr Surg* 1974;11:1-177.
- Breine U, Brånemark P-I. Reconstruction of alveolar jaw bone. An experimental and clinical study of immediate and preformed autologous bone grafts in combination with osseointegrated implants. *Scand J Plast Reconstr Surg* 1980;14:23-48.
- Isaksson S, Ekfeldt A, Alberius P, Blomqvist JE. Early results from reconstruction of severely atrophic (class VI) maxillas by immediate endosseous implants in conjunction with bone grafting and Le Fort I osteotomy. *J Oral Maxillofac Surg* 1993;22:144-148.
- Adell R, Lekholm U, Grondahl K, Brånemark P-I, Lindstrom L, Jacobsson M. Reconstruction of severely resorbed edentulous maxillae using osseointegrated fixtures in immediate autogenous grafts. *Int J Oral Maxillofac Implants* 1990;5:233-246.
- Isaksson S, Alberius P. Maxillary alveolar ridge augmentation with onlay bone grafts and immediate endosseous implants. *J Craniomaxillofacial Surg* 1992;20:2-7.
- Boyne PJ, James RA. Grafting of the maxillary sinus floor with autogenous marrow and bone. *J Oral Surg* 1980;38:613-616.
- Wood RM, Moore DI. Grafting of the maxillary sinus with intraorally harvested autogenous bone prior to implant placement. *Int J Oral Maxillofac Implants* 1988;3:209-214.
- Bedrossian E, Stumpel L. Immediate stabilization at stage II of zygomatic implants: Rationale and technique. *J Prosthet Dent* 2001;86(1):10-14.
- Rasmusson L, Meredith N, Cho IH, Sennerby L. The influence of simultaneous versus delayed placement on stability of titanium implants in onlay bone grafts. A histologic and biomechanical study in rabbit. *Int J Oral Maxillofac Surg* 1999;28:224-231.
- Lekholm U, Wannfors K, Isaksson S, Adielsson B. Oral implants in combination with bone grafts. A 3-year retrospective multicenter study using the Brånemark implant system. *Int J Oral Maxillofac Surg* 1999;28:181-187.
- Keller E, Tolman DE, Eckert SE. Maxillary antral-nasal inlay autogenous bone graft reconstruction of compromised maxillae: A 12-year retrospective study. *Int J Oral Maxillofac Implants* 1999;14:707-721.
- Jensen OT, Shulman LB, Block MS, Iacono VJ. Report of the Sinus Consensus Conference of 1996. *Int J Oral Maxillofac Implants* 1998;13(suppl):11-32.
- Tolman DE. Reconstructive procedures with endosseous implants in grafted bone: A review of the literature. *Int J Oral Maxillofac Implants* 1995;10:275-294.