Immediate Function with the Zygomatic Implant: A Graftless Solution for the Patient with Mild to Advanced Atrophy of the Maxilla

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Purpose: *In many edentulous maxillae, posterior alveolar atrophy calls for bone grafting. Patient treatment acceptance is increased by eliminating grafting using tilted implants, especially the zygomatic implant in combination with immediate function. The purpose of this study was to evaluate a protocol for immediate function (within 2 hours) of 2 zygomatic and 4 standard implants (Nobel Biocare) supporting a fixed prosthesis in the completely edentulous maxilla.* ***Materials and Methods:*** *This clinical study included 14 patients with 83 immediately loaded implants (28 bilateral zygomatic and 55 premaxillary implants) supporting a complete maxillary denture converted to a fixed provisional prosthesis immediately following the surgical procedure. After 6 months of use, a new fixed metal-supported prosthesis was fabricated.* ***Results:*** *Fourteen patients treated with immediate loading of zygomatic implants were followed for at least 12 months. All patients reported minimization of postoperative pain and security during speech, animation, and mastication. No failures occurred during the follow-up period.* ***Discussion:*** *The patients in the study could have been candidates for sinus grafting. With the present concept these patients benefited from a less invasive procedure (1 surgical procedure and no grafting) and immediate rehabilitation (prosthesis attached directly after surgery).* ***Conclusion:*** *The high survival rate, increase in patients' immediate functional ability, and reduction of morbidity following the surgical procedure render this procedure a viable treatment option for the completely edentulous maxilla.* (Case Series) Int J Oral Maxillofac Implants 2006;21:937–942

Key words: *atrophied maxilla, edentulous maxilla, fixed maxillary prostheses, immediate loading, zygoma*

Residual ridge resorption is an inevitable consequence of tooth loss and denture wearing.[1–3] This is one of the reasons that dental implants have been used to support stable and functional prostheses. The traditional healing period for dental implants has been described in the literature as 3 to 6 months.[4] To serve this patient population in a more efficient manner, the immediate loading of implants placed in completely edentulous jaws with a stable fixed prosthesis at the time of implant placement has been studied.[5–8] The main advantage in providing the edentulous patient with a stable, fixed, provisional prosthesis is an immediate improvement in the patient's ability to function and a positive boost of their self-esteem. These factors together allow for a higher treatment acceptance.

Restoration of the completely edentulous maxillae with 4 or 6 implants has been shown to be a viable treatment plan.[9] The ability to rehabilitate the edentulous maxilla with a fixed prosthesis has been difficult in patients where large existing sinuses have required adjunct procedures such as bone grafting prior to implant placement.[10] The need to harvest autogenous iliac bone or the use of bovine bone has deterred patients from accepting treatment.

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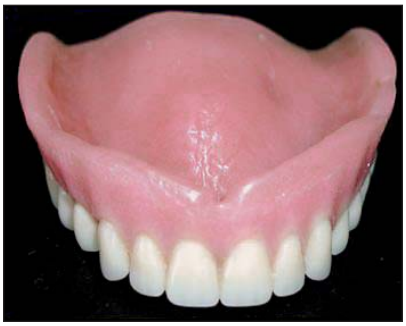


Fig 1 Pre-existing denture that had appropriate vertical dimension of occlusion (VDO) and anteroposterior tooth positioning for use as a provisional prosthesis.

The use of "tilted implants," as in the Marius Bridge concept with delayed loading[11] or the All-on-4 technique[12] with immediate function, has allowed for adequate anterior-posterior distribution of maxillary implants with repeated viable outcomes.[13–15] The zygomatic implant, which was designed with a 45-degree tilted platform, is intended for anchorage in the zygoma. This implant has been used in patients with moderate to severely resorbed maxillae and been demonstrated to be successful in supporting fixed prostheses.[16–19]

The combined use of standard and zygomatic implants, placed into immediate function, is a natural development for rehabilitation of the edentulous maxilla, based on the reported clinical experience. With this concept patients can be offered graftless treatment with immediate function, which provides greater patient comfort and reduces treatment time. The hypothesis tested in this study was that the immediate function protocol with zygomatic implants in the edentulous maxilla would give equally good results compared with the conventional 2-stage protocol. The purpose of this article was to present the clinical results achieved using the immediate zygomatic concept on a routine basis.

MATERIALS AND METHODS

The retrospective study was performed at the University of the Pacific, Oral and Maxillofacial Surgery Residency Program, San Francisco, California. Fourteen patients (6 men and 8 women, mean age 54.2 years) were consecutively included from April 2003 to March 2004, provided they met the inclusion criteria and gave their written consent to participate in the study. The inclusion criteria were as follows: *(1)* need for complete rehabilitation of the edentulous maxilla; *(2)* premaxillary bone height of at least 7 mm; *(3)* posterior maxillary bone height ranging from 1 to 3 mm in the first molar to second premolar region, and *(4)* healthy-looking sinuses. Sinuses were evaluated based on panoramic radiographic and clinical examinations.

Most of the implant sites had type 2 bone quality and quantity of type B or C (Lekholm and Zarb classification[20]).

Opposing Jaws

At the time of implant placement, 6 patients were edentulous in their mandibular arch. These patients received 5 mandibular implants with immediate loading within 6 weeks. One patient received mandibular and maxillary implants in the same procedure, with immediate loading of both arches at the same time. Five patients had fixed prostheses in the mandible. One patient was partially edentulous from the left lateral incisor through the right third molar. One patient had a full complement of mandibular teeth.

Implant Components

Both improved implant surfaces and enhanced thread designs have been used to achieve high implant stability.[21–25] All patients but 1 had 4 premaxillary implants placed in the positions of the right canine, right central incisor, left central incisor, and left canine, and all had 2 zygomatic implants in the right second premolar and left first premolar positions. A total of 55 Brånemark System TiUnite MkIV (4 mm wide) and 28 zygomatic implants were placed, and a straight or angulated (17 degrees) multiunit abutment was attached to each implant (Nobel Biocare, Göteborg, Sweden).

A majority of the standard implants were 13 mm long (n = 32), and the remainder were 11.5 mm (n = 9), 10 mm (n = 10), 8.5 mm (n = 2), or 7 mm long (n = 2). The majority of the zygomatic implants were 40 mm long (n = 16). The remainder were 45 mm (n = 5), 35 mm (n = 3), 50 mm (n = 2), 42.5 mm (n = 1), and 52.5 mm long (n = 1).

Thirty of the abutments on the standard implants were straight and had heights of: 2 mm (n = 14), 1 mm (n = 10), and 3 mm (n = 6), while 25 were angulated and had heights of 2 mm (n = 22) or 3 mm (n = 3). The zygomatic implants had straight multiunit abutments with heights of 2 mm (n = 12), 3 mm (n = 11), and 1 mm (n = 5).

Surgical Protocol

Patients had their maxillary teeth removed at least 12 months prior to the implant procedure. Preoperative treatment planning was performed using a pantomograph and by evaluation of the existing denture (Fig 1). If the vertical dimension of occlusion (VDO) and the anteroposterior tooth positioning were appropriate, the existing denture was used as the provisional pros-

Fig 2a *(left)* MkIV premaxillary implants were placed using the surgical template.

Fig 2b *(right)* All implants were placed at an insertion torque of at least 40 Ncm.

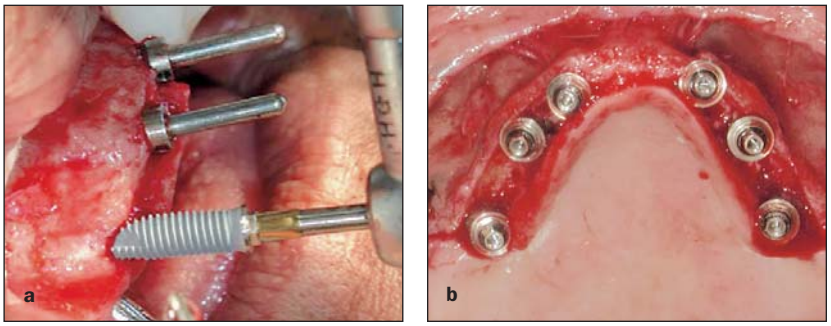
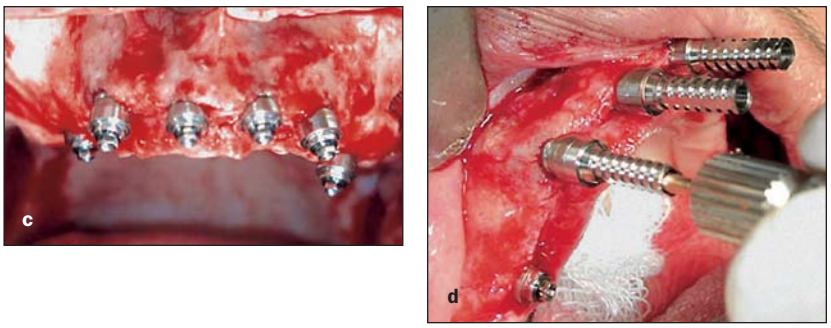


Fig 2c *(left)* Multiunit abutments were placed and tightened to 10 Ncm.

Fig 2d *(right)* Temporary cylinders were placed on each of the multiunit cylinders.



thesis immediately following implant placement. However, if the VDO and the anteroposterior tooth positioning were not correct, a new denture with correct VDO and tooth positioning wascreated prior to the surgical procedure. A duplicate acrylic resin denture was then made and used as the surgical template.

The patients were premedicated with 2 grams of penicillin (Teva Pharmaceuticals, Petach Tikva, Israel) 1 hour prior to the surgical appointment. For patients who were allergic to penicillin, 600 mg clindamycin (Cleocin; Ranbaxy Pharmaceuticals, Jacksonville, FL) were prescribed as the preoperative premedication. Immediately prior to the surgery, patients rinsed with 2% chlorhexadine (Colgate Pharmaceuticals, Canton, CA) for 30 seconds. The patients were asked to rinse with 2% chlorhexadine 3 times daily and were prescribed 7.5 mg Lortab (Watson Laboratories, Corona, CA).

Before the surgical procedure the patients were sedated. A combination of intravenous diazepam (Hospira, Lake Forest, IL) and meperidine (Hospira) was titrated to effect. On average, 15 mg of Valium and 75 to 100 mg of Demerol were used for the 75-minute surgical procedure. The patients were also administered a local anesthetic using 2% lidocaine hydrochloride (Abbott Laboratories, North Chicago, IL). Circumvestibular infiltrations as well as bilateral greater palatine blocks were administered for the maxilla. Bilateral inferior alveolar blocks were also administered to allow retraction of the mandible and tongue without undue stress to the patient. Extraoral infiltrations of the lesser and greater zygomatic nerves innervating the soft tissues over the zygoma were also administered.

The surgical procedure is illustrated in Figs 2a to 2d. The 4 standard implants were placed as dictated by the surgical template, following the protocol set by Adell and associates.[26] The insertion torque of all implants was regulated by the use of Osseocare drilling equipment (Nobel Biocare). The implants were placed with initial insertion torque setting of 20 Ncm. Upon "stalling" of the handpiece, the insertion torque setting was increased to 40 Ncm to allow complete placement and seating of the implants. The 2 zygomatic implants were placed in the right second premolar and left first premolar positions as described by Bedrossian and associates[16] with an insertion torque of at least 40 Ncm. To promote initial stability, countersinking was not performed in any of the osteotomy preparations. The platforms of the implants were placed flush with the crestal bone to ensure the placement of the temporary cylinders at that level. The tissue depth was evaluated by approximating the surgical flaps and measuring the anticipated sulcular depth. Thick tissue was thinned out so that small size abutments could be selected.

Once positioned, the anterior implants were evaluated for angulation and tissue depth. The objective was to have the abutment-cylinder interface at or slightly supragingival upon tissue healing and maturation. The surgical guide was placed to evaluate the screw access trajectory in relation to the position of the teeth. A position lingual to the prosthetic teeth was required to use straight multiunit abutments. If the long axis of the implants was placed more buccally, angulated multiunit abutments were used. Once selected, the abutments were fully seated and hand

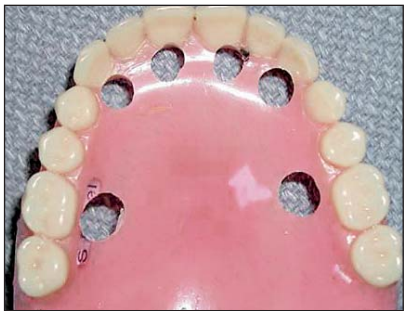


Fig 3a Openings in the denture base allowed contact-free passage of the temporary cylinders.

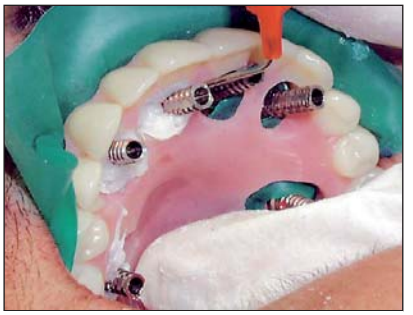


Fig 3b Luting of temporary cylinders to the denture using autopolymerizing acrylic resin.

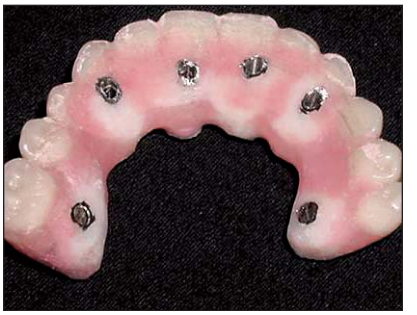
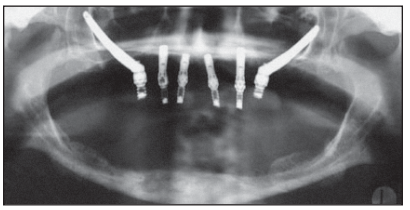


Fig 3c Immediate provisional prosthesis fabricated by converting the preoperative complete denture.



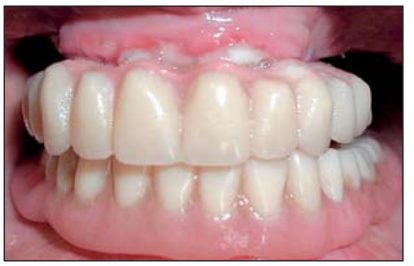


Fig 4 *(left)* Immediate postoperative panoramic radiograph.

Fig 5 *(right)* Follow-up visit 1 week postsurgery. Patients reported minimal postoperative pain and were able to masticate soft food immediately.

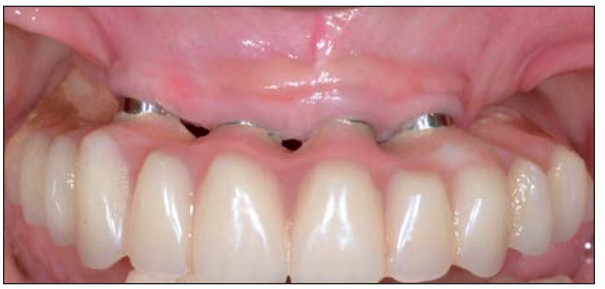


Fig 6 Follow-up visit 6 months postsurgery. Patient was ready to have final impressions made for fabrication of the definitive fixed prosthesis.

tightened. All surgical wounds were closed with 4-0 Vicryl sutures (Johnson & Johnson/Ethicon, Somerville, NJ) after placement of the abutments.

Prosthetic Protocol

Immediate Prosthetic Protocol. The prosthetic procedure is illustrated in Figs 3a to 3c. The existing dentures were converted chairside to fixed provisional acrylic resin prostheses within 2 hours following implant placement. A bullet-nose cross-cut lab bur was used to perforate the denture at each implant site. Titanium temporary cylinders (Nobel Biocare) were placed. The perforated denture was reintroduced intraorally and positioned over the extruding cylinders. Fast-setting autopolymerizing acrylic resin was mixed to a runny consistency and introduced in a disposable syringe. The operator held the denture in place, and the thin resin was injected between the cylinders and the denture. The patient was guided into centric occlusion, predetermined by a presurgical bite registration using the patient's existing prosthesis. The acrylic resin was allowed to set; then the cylinders were loosened and the assembly removed from the mouth.

Acrylic resin powder with liquid was placed with a salt-and-pepper technique in the remaining voids. Upon polymerization of the resin the palate was removed, and all of the acrylic resin nonessential to the shape of a fixed resin implant denture was removed. The occlusion was evaluated; all occlusal contacts were created mesial from the first premolar. For a period of at least 10 weeks, the prostheses were not removed for any reason (Figs 4 and 5).

Definitive Prosthetic Protocol. After 6 months of function with the provisional prosthesis, prostheses supported by a metal framework were fabricated and delivered. Prior to making the final impression, all abutments were checked and tightened to the manufacturer's recommended torque of 35 Ncm for the straight abutments and 15 Ncm for the angulated abutments (Fig 6).

Implant Survival Criteria

Six months following implant placement, an implant was classified as surviving if it fulfilled its supportive function and was stable when tested individually after removal of the provisional prosthesis. Lack of gross mobility as well as the absence of pain upon percussion along with no sign of peri-implant pathology were also survival criteria.

Follow-up and Marginal Bone Level of the Premaxillary Implants

Intraoral as well as panoramic radiograph examinations were performed immediately postoperatively as well as at quarterly visits for the first year of follow-up. For the intraoral technique, a conventional radiograph holder was used. The position of this holder was adjusted manually to ensure orthogonal film positioning. The implant-abutment interface was used as a reference point for bone level measurements.

RESULTS

No patient was withdrawn from the study, and all patients (14 patients, 28 zygomatic implants and 55 premaxillary implants) were followed for at least 1 year (Table 1). At the 6-month follow-up visit, none of the 83 implants demonstrated any sign of failure, and all were classified as survivals.

Table 1 Implant Life Table

Time period (mo)	No. of implants in function	No. of failures	No. of implants withdrawn	Survival rate (%)
Loading to 22	14	0	0	100
23 to 24	11	0	0	100
25 to 34	3	0	0	100

Marginal Bone Level

Postoperative radiographs showed that the premaxillary implants were flush with the bone, which was consistent with the surgical technique.

It was not possible to judge the marginal bone change at the zygomatic implants, as proper placement of these implants orients the platform slightly palatal to the crest, superimposing the marginal bone over the implant platform. However, the premaxillary implants were clearly visible on periapical radiographic examination, and the marginal bone loss at 1 year was between 0 and 2 mm, with an estimated average of less than 1 mm.

Mechanical Complications

No fractures or loosening of abutment or prosthetic screws were observed during the study. For 2 patients a partial fracture was seen in the denture around the zygomatic implant cylinder in the maxillary right second premolar position. This was likely the result of oversized access holes made through the existing denture during its conversion to a surgical template/provisional prosthesis. The fracture was repaired intraorally by adding autopolymerizing acrylic resin to the prostheses. No further problems were seen with these 2 patients. The access holes in the remainder of the patients were made smaller and more precise to minimize weakening of the provisional prosthesis.

Patient Satisfaction

All patients reported no pain or minimal pain postoperatively, which was managed by no more than 2 to 4 analgesic tablets (Lortab) in the first 36 hours following the surgery. The stability of the provisional fixed prosthesis allowed for maintenance of a soft diet that required minimal chewing. Patients adapted to the palateless, fixed prosthesis immediately without any speech disturbance. All patients reported several benefits of the procedure: minimization of postoperative pain and security during speech, animation, and mastication. These features allowed them to be more confident in public. An increase in self-esteem was reported by most patients.

DISCUSSION

The survival rate of the immediately loaded zygomatic implants after 1 year (100%) compares favorably to the 2-stage approach described by Bedrossian and associates[16,17] and Malevez and colleagues.[18] To the authors' knowledge, until now, results obtained with immediate loading of the zygomatic implants have only been reported in case reports.[27,28] A possible explanation for the favorable outcome is the high initial stability of the zygomatic implants and the splinted cross-arch support of the 4 well-anchored standard premaxillary implants. The early bone resorption compares favorably to that of other studies for maxillary rehabilitation.

All provisional prostheses survived the 6-month osseointegration period, with only small adjustments to 2 of them, and all were replaced by metal-based prostheses. The use of all-acrylic resin transitional prostheses in immediate function is reported in the literature, and this study confirms the viability of that concept for easy-to-fabricate, predictable provisional prostheses.[28]

Only patients with posterior maxillary bone height ranging from 1 to 3 mm in the first molar to second premolar region were included, ie, patients who had anterior maxillary walls extending to the first premolar area bilaterally and would have been candidates for sinus grafting. Use of the present procedure instead was less invasive (1 surgical procedure and no grafting) and allowed immediate rehabilitation (prosthesis attached directly after surgery). The patient interviews confirmed the advantages of immediate rehabilitation. Further clinical studies are recommended to investigate immediate function using graftless concepts such as the zygomatic implant as well as the All-on-4 concept.[12]

CONCLUSION

Within the limits of the study, it can be concluded that the use of zygomatic implants in conjunction with 4 premaxillary implants is a promising technique for the restoration of maxillae with mild to advanced atrophy without grafting and with immediate function. The lack of contact between the provisional prosthesis and the surgical site postoperatively reduces postoperative morbidity, and the patient can benefit from a comfortable immediate rehabilitation.

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