A Study of 25 Zygomatic Dental Implants with 11 to 49 Months' Follow-up After Loading

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Purpose: *The purpose of this study was to evaluate indications, surgical problems, complications, and treatment outcomes related to the placement of zygomatic implants. A second aim was to determine any prosthetic difficulties and complications.* ***Materials and Methods:*** *Twenty-five zygomatic implants were placed in 13 patients between April 1999 and December 2001. The patient age range was between 49 and 73 years, with a mean age of 59 years. All patients showed severe resorption of alveolar bone in the maxilla. All but 2 patients were smokers. Two patients had a history of cleft palate surgery, and 2 patients were known to be bruxers. Standard recommended surgical protocol was followed, and treatment was performed under general anesthesia. After abutment surgery, 9 patients received bar-retained overdentures, and 4 patients received fixed prostheses.* ***Results:*** *No implants were lost, and few surgical complications were experienced. The follow-up period was 11 to 49 months.* ***Discussion:*** *Although surgical problems precipitated by difficult anatomy in cleft patients and a patient with reduced interarch access were experienced, the results were favorable. Fabricating a functional and esthetic prosthesis can be a challenge.* ***Conclusion:*** *Zygomatic implants provide a treatment option for patients with severe maxillary resorption, defects, or situations where previous implant treatment has failed. In this experience, treatment with zygomatic implants was a predictable method with few complications, even in a group of patients that would not be considered ideal for implant treatment.* (Case Series) INT J ORAL MAXILLOFAC IMPLANTS 2006;21:421–425

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Zygomatic implant therapy has been introduced as a method for accomplishing dental implant osseointegration without bone grafting in difficult cases.[1] With lengths ranging from 30 mm to 52.5 mm, the zygomatic implant is a titanium endosseous implant designed to achieve bone anchorage in the zygoma. General indications for zygomatic implant placement have included restoration of severely atrophied edentulous maxillae with or without previous failed implant treatment and provision of anchorage for the prosthetic restoration of maxillary defects.

In addition to having a shorter overall treatment time compared to bone grafting, it has also been suggested that the procedure results in shorter patient hospitalization, reduced pain, and reduced risk of morbidity.[2] Even though the trabecular zygomatic bone is less favorable for implant placement, zygomatic implants can achieve good stability because of anchorage provided by at least 4 cortical portions.[3] By adding 2 or more conventional implants in the anterior maxilla combined with the rigid splinting of all implants, the foundation for a stable dental prosthesis can be achieved.[4,5] Disadvantages of zygomatic implant treatment are the difficult surgical accessibility and visibility as well as the potential risk of orbital injury. Because of the anatomy of the resorbed maxilla, in combination with problems of accessibility, emergence of the implant will most often be on the palatal side of the alveolar ridge. This location can present a prosthetic challenge, especially in the fabrication of a fixed prosthesis.

A study[5] at the Brånemark Osseointegration Center of 63 implants placed in the zygomatic region of patients with maxillary defects had a 100% success rate. Many of these implants were observed for as long as 6 or 7 years. Shorter studies with follow-up periods of 9 months[6] and up to 30 months[7] have also

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Table 1 Indications for Treatment with Zygomatic Implants and Previous Grafting Procedures

Patient no.	Main indication for treatment with zygomatic implants	Age at zygomatic implant surgery	Previous grafting/ type
1	Extreme maxillary bone resorption	57	No
2	Loss of implants	73	No
3	Loss of implants	54	No
4	Extreme maxillary bone resorption	69	No
5	Extreme maxillary bone resorption	62	Iliac crest
6	Loss of implants	64	No
7	Extreme maxillary bone resorption	55	No
8	Loss of implants	56	Iliac crest
9	Loss of implants	53	No
10	Loss of implants	49	No
11	Loss of implants	69	Chin to sinus
12	Cleft palate, extreme resorption	50	No
13	Extreme maxillary bone resorption	51	No

reported 100% survival rates. In another study, 2 zygomatic implants were lost of 67 placed; these losses were because of a retrozygomatic emergence of the implants' apical part.[8]

Modifications of the recommended surgical technique have been suggested in several studies.[9–11] One study has also described placing up to 3 zygomatic implants on each side of the maxilla.[12] Controlled, uniform studies using only Brånemark System zygomatic implants (Nobel Biocare, Göteborg, Sweden) including information on prosthetic aspects and follow-up have been published. The aim of this investigation was to evaluate indications and identify surgical problems and complications with the zygomatic implant in the severely atrophic maxilla. A second aim was to determine any prosthetic difficulties and complications.

MATERIALS AND METHODS

At Haukeland University Hospital, Bergen, Norway, indications for treatment with zygomatic implants have included severe resorption of the posterior maxilla after failed implant therapy and maxillary defects related to a cleft palate. Unsuccessful bone grafting or refusal to undergo bone grafting were other indications for treatment (Table 1). Contraindications for treatment were pathology in the maxillary sinuses or extremely reduced alveolar ridge crest height. Standard protocol for the use of zygomatic implants in the edentulous maxilla states that there should be enough bone in the anterior maxilla for the placement of at least 2 additional conventional implants.[1]

Thirteen consecutive patients (7 women, 6 men) with severely atrophic maxillae were included in this study and treated with zygomatic implants between April 1999 and December 2001. The patients ranged from 49 to 73 years old, and the mean age was 59 years. All patients, except 2, were smokers, and 2 had signs of bruxism. Four of the 13 patients were edentulous in the mandible. Three had severely resorbed maxillae without any previous surgical treatment. Ten patients had a history of implant failure resulting in bone loss and aggravated maxillary atrophy. Five of these 10 patients had been treated with blade or bicortical implants in an undocumented procedure by the same private practitioner and had experienced a total loss of all implants as well as reduced bone volume. Five patients had been treated with Brånemark System implants and had lost 1 or more implants, which made it difficult to perform the desired prosthetic treatment. These 5 patients had 2 to 5 Brånemark System implants remaining in the maxilla before the placement of zygomatic implants. Three patients had received bone grafts to the maxilla or maxillary sinus at the Haukeland University Hospital before they were evaluated for zygomatic implant treatment. Indications and a summary of previous grafting procedures and implant therapy are shown in Table 1.

The surgical procedure and placement of zygomatic implants were done according to the clinical procedure recommended by the manufacturer,[1] with minor modifications (Fig 1). Instead of the recommended Le Fort I incision, a palatally oriented crestal incision was used. Preoperative computed tomographic (CT) scans of the patients were routinely obtained as part of the pretreatment evaluation. The patients were given penicillin preoperatively and for 2 to 5 days postoperatively. In all cases, the zygomatic implants were placed with the patient under

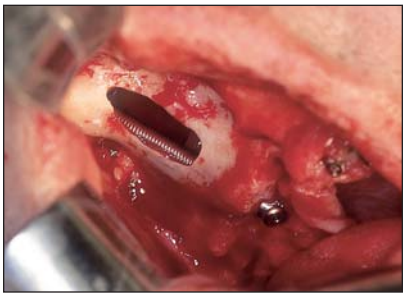

Fig 1a In patient 11, a zygomatic implant was placed according to standard procedure and is partly visible through the sinus window.

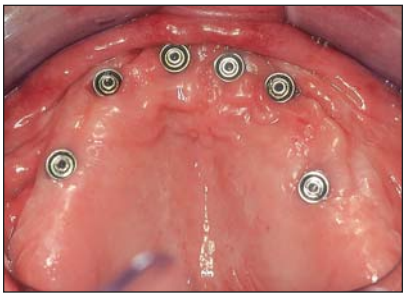

Fig 1b Placement of implants; notice the palatal position of the maxillary right zygomatic implant compared to the remaining conventional implants.

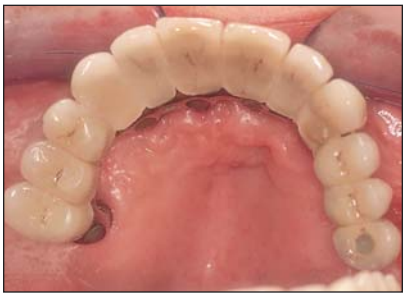

Fig 1c The definitive prosthesis design. Notice the buccal extension in the area where the zygomatic implant was placed.

general anesthesia. Bone grafting was performed in the anterior maxilla in conjunction with zygomatic implant surgery in 2 patients. Both patients had been treated for cleft palate and had residual maxillary defects. Monocortical block grafts were harvested from the iliac crest in 1 of the patients and from the chin in the other. In all 13 cases, a 2-stage procedure was performed, with abutment placement 6 months after implant placement.

Prosthetic treatment started 3 to 6 weeks after abutment connection. Impressions were made using Impregum (3M ESPE, St Paul, MN) in customized impression trays according to standard impression techniques. Nine patients were provided with cast gold bars and overdentures, and 4 patients received fixed implant-retained prostheses. Overdentures were fabricated when the number of implants was insufficient for a fixed prosthesis or where a fixed prosthesis would not provide the desired facial support. The patients have been followed continuously with clinical examination and panoramic radiography. Follow-up examinations for the sample occurred between 11 and 49 months after prosthesis loading.

RESULTS

Thirteen patients were treated with 25 zygomatic implants and 30 conventional implants, including 16 existing Brånemark System implants. Zygomatic implant lengths used were eleven 50 mm, twelve 45 mm, one 40 mm, and one 35 mm. In 8 patients conventional Brånemark System implants of the Mk II, III, or TiUnite type were placed in the anterior part of the maxilla. These patients all received 2 standard implants, except 1 who received 3 implants and 1 who received 5 implants. The zygomatic implant surgeries went well, with few surgical complications overall. Of the 13 patients treated, 3 developed suborbital hematomas. One patient received a burn wound on the lip during implant site preparation as a result of contact with the rotating drill. In a cleft patient, it was difficult to place 1 zygomatic implant in an optimal position because of the atypical anatomy. No zygomatic implants have failed since placement (Table 2).

To achieve a rigid connection between implants, a cast bar with overdentures was used in most cases. Different bar designs are shown in Figs 2a to 2c. Four patients were treated with fixed prostheses. One of these patients had lost the most distal implant on 1 side of a full-arch restoration (patient 11). The prosthesis was shortened by 3 units as the failed implant was removed. After healing, a zygomatic implant was placed, and 6 months later the patient was fitted with a new full-arch prosthesis (Figs 1a to 1c). Patient 9 was first treated with an overdenture supported by 4 implants and a gold bar, but she developed an allergy to the gold alloy (high precious alloy type Delta 2, 73% gold and 2.3% platinum). Both standard implants in the anterior maxilla were lost; 5 additional implants were placed, and the gold bar was replaced with a fixed titanium prosthesis. The third patient (patient 10) lost the most posterior implant on each side of a full-arch prosthesis with 6 implants. The failure was caused by a complete breakdown of a cast titanium framework laser-welded to titanium cylinders. A temporary overdenture was adapted to the remaining 4 implants and was used until a new fixed prosthesis could be fabricated. In the case of the fourth patient (patient 1), restoration with a fixed prosthesis was planned from the onset.

DISCUSSION

The patient material was a widely distributed group of patients in terms of history of bone transplantation, implant failure, smoking habits, and parafunction. This reflects the variety of cases that are treated in a referral-based hospital setting. Except for suborbital

Table 2 Number of Zygomatic and Conventional Implants in Relation to Type of Prosthesis and Loading Period

Patient no.	No. of zygomatic implants	No. of standard implants*	Months since loading	Prosthesis received
1	2	3	44	Fixed
2	2	2	47	Overdenture
3	2	2	39	Overdenture
4	2	2	26	Overdenture
5	2	2	36	Overdenture
6	2	2	35	Overdenture
7	2	2	32	Overdenture
8	2	2	49	Overdenture
9	2	5	46	Overdenture and fixed†
10	2	4	36	Fixed
11	1	5	40	Fixed
12	2	3	14	Overdenture
13	2	2	11	Overdenture

*Including conventional Brånemark System implants in place before zygomatic implant treatment.
†An overdenture was replaced with a fixed prosthesis.

Fig 2 *Different bar designs used in conjunction with the zygomatic implants. In the resorbed maxilla, implants are usually placed palatal to the desired tooth positions. A bar construction should be used to provide proper load distribution. In addition, the bar construction must be contained within the overdenture.*

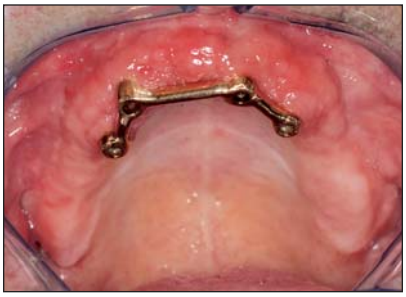

Fig 2a Standard gold bar on implant level. To avoid overload, no extensions were used. The prosthesis was retained with gold clips.

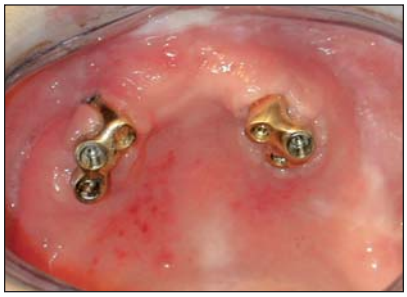

Fig 2b A curved span between the anterior implants. Two separate bars with Ceka attachments (Preat, Santa Ynez, CA) provide a less bulky prosthesis.

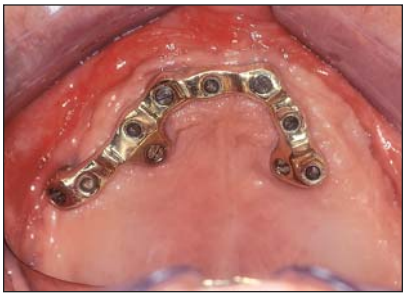

Fig 2c Short conventional implants and palatal positioning of the zygomatic implants. The bar had to be extended buccally. To secure load distribution between the implants, a rigid cast gold bar with Ceka attachments was chosen.

hematomas, few postoperative complications were seen. In 1 patient treated after the inclusion period for this study, it was not possible to place zygomatic implants because of reduced access, as the handpiece with the mounted drill was obstructed by the mandibular teeth. This lack of access was discovered intraoperatively. It is imperative to closely evaluate access to the surgical site preoperatively, even if the patient will be under general anesthesia. Commonly used zygomatic implants have lengths of 45 to 50 mm. Only 2 of 25 implants were of shorter lengths. Within this limited sample, smoking did not seem to have an influence on the success rate of the zygoma implants. It has been suggested that it is not necessary to take preoperative CT scans[2]; however, it was found useful for the evaluation of existing bone morphology, especially in cleft palate patients, and for excluding sinus pathology.

Conventional implants placed in grafted maxillary bone have shown a success rate of 90 percent or more.[13] Even higher rates of implant survival have been reported when using delayed implant placement in maxillary grafted bone compared to simultaneous implant placement.[14,15] The inability to utilize an existing denture during graft healing and the extended treatment period can sometimes be of concern to patients. Normally, treatment with zygomatic implants does not require such additional surgical procedures. However, in 2 of the 13 patients it was necessary to perform bone grafting to be able to place additional conventional implants. In the remaining patients, bone grafting was avoided.

Designing the prosthetic restoration can be a challenge to the prosthodontist and the dental technician, not because of the zygomatic implants per se, but mainly because of the anatomic limitations affecting implant placement. Zygomatic implants are used when there is a lack of bone, often in cases where implant treatment would not have been performed with traditional treatment methods. Some of the patients included in this study were definitely borderline for implant treatment. However, they were severely orally handicapped, and zygomatic implant therapy was a last resort. Four patients were treated with fixed prostheses. Buccal extension from the zygomatic implant may increase the risk of overload; however, there have been no problems with hygiene or discomfort in relation to the palatal shape of the restoration. In only 1 patient was a fixed prosthesis planned from the onset of treatment. In such a case the prosthetic treatment differs very little from standard implant treatment.

When designing retention elements for overdentures, the palatal part of the prosthesis can be bulky because of the palatal position of zygomatic implants. To some extent this problem can be reduced by the use of angled abutments and by placing the bar on the buccal side of the abutment and gold cylinder. In some cases there is need for a rigid bar to connect short implants and retain control of load conditions. This type of bar design requires more space than an ordinary round or oval bar. In 2 patients 2 separate small bars were fabricated on each side of the maxilla to avoid a long curved span over the anterior maxilla. In 1 of the cleft palate patients, the anatomy was so atypical that both implant placement and bar design were unorthodox. Overdentures with cast gold bars and Ceka attachments (Preat, Santa Ynez, CA) needed more frequent adjustments than standard round gold bars with clips, especially in the 2 bruxers. If oral hygiene is not optimal, there is a great tendency of mucosal overgrowth/hyperplasia closing the space between the alveolar ridge and the bar. This occurs more frequently with cast bars, where cleaning with interdental brushes is required. Extreme palatal emergence of zygomatic implants can cause technical problems when designing the prosthesis. This situation can occur in patients with a narrow maxilla and low alveolar ridge.

CONCLUSION

In this patient population zygomatic implants could be used for patients with severe maxillary resorption or for patients with whom previous implant treatment had failed. The use of zygomatic implants proved to be predictable, with few surgical complications. Prosthetic problems and complications were mainly related to the compromised oral situations of the patients in this study rather than to the use of zygomatic implants.

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