Abstract. Despite refinements in surgical technique, including bone grafting and sophisticated prosthetic reconstructions, there are limitations to what can be achieved with bone-anchored fixed prostheses in patients with advanced atrophy of the maxillae. A new approach was suggested by a long-term study on onlay bone grafting and simultaneous placement of a fixture based on a new design: the zygoma fixture, and the aim of this study was to assess its potential. Twenty-eight consecutive patients with severely resorbed edentulous maxillae were included, 13 of whom had previously had multiple fixture surgery in the jawbone that had failed. A total of 52 zygoma fixtures and 106 conventional fixtures were installed. Bone grafting was deemed necessary in 17 patients. All patients have been followed for at least five years, and nine for up to 10 years. All patients were followed up with clinical and radiographic examinations, and in some cases rhinoscopy and sinoscopy as well. Three zygoma fixtures failed; two at the time of connection of the abutment and the third after six years. Of the conventional fixtures placed at the time of the zygoma fixture, 29 (27%) were lost. The overall prosthetic rehabilitation rate was 96% after at least five years of function. There were no signs of inflammatory reaction in the surrounding antral mucosa. Four patients with recurrent sinusitis recovered after inferior meatal antrostomy. To conclude, the zygoma fixture seems to be a valuable addition to our repertoire in the management of the compromised maxilla.

Key words: dental implants, zygoma, maxilla, surgery, bone-grafting, rhinoscopy, sinoscopy.

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endosseous fixture placement in a group that was sufficiently large (n = 165) for statistical analyses (1). All patients were followed for at least two years, and some for up to 15 years. An overall prosthetic rehabilitation rate of 95% after five years and 93% after 10 years was found. The survival rate of originally installed fixtures was 80%. Nine percent of the patients lost more than four original fixtures, 23% lost two or more, and 35% lost one or more. Placement of additional fixtures was indicated in 23% of the patients to alleviate or prevent complications, but their survival rate was somewhat lower (77%) than that of the originally installed fixtures. This study led to the development of the zygoma option (Fig. 1a–e). The new zygoma fixture was a direct response to the acknowledged need for improvements in onlay grafting procedures, particularly for improved stability of fixtures and to minimise the need for further surgery.

The objective of the present study was to report the outcome of the first patients with a follow-up time of at least five years in whom zygoma fixtures were used in the treatment of the compromised edentulous maxilla and compared with bone grafting procedures.

PATIENTS AND METHODS

Patients
The study comprised 28 consecutive patients treated at the Bränemark Osseointegration Center (BOC) in Göteborg, Sweden, for bone-anchored rehabilitation of severely resorbed edentulous maxillae. The inclusion period started when the first patient was operated on in May 1990, and ended in August 1995. All patients have therefore been followed up for at least five years. All patients had severely compromised maxillary anatomy (Fig. 2).

Among the 28 patients, 13 had previously had fixtures placed in the jawbone, and 11 had required bone grafting. Seven had had multiple operations and seven had lost all their fixtures. Among the six patients with fixtures remaining, one fixture remained in two patients, two fixtures in another two patients, and three and four in one patient each, respectively.

Preoperative evaluation
Baseline characteristics are presented in Table I. The resorption pattern of the anterior maxilla was classified according to the Lekholm & Zarb index (5). Most patients (n = 21, 75%) had a resorption pattern equivalent to type D or E. Twenty-four of the patients (86%) had a compact basal layer of the maxilla that was judged to be extremely thin. In addition, in three of the maxillae (11%), bone density was reported as low. Anatomy of the jaw was also evaluated with respect to jaw relations, intermaxillary distance, occlusion, and condition of the opposing dentition. In addition, we made a thorough evaluation of general health to assure us that the patient could withstand an operation under general anaesthesia. The patient’s history was also scrutinised for signs of inflammatory sinus disease.

Preoperative radiographic examination
Panoramic, lateral (profile), and intraoral periapical radiographs were obtained to detect any pathological changes within the jawbone and to establish the anatomical prerequisites. To clarify whether four conventional fixtures could be placed in the frontal region, attention was paid to the expansion of the maxillary sinus as well as the degree of bone resorption. Tomography, computed or conventional, was used to evaluate the volume of zygomatic bone and to detect any sinus disease. The mean total bone height of the frontal jawbone was 6.9 mm (range 1–13 mm). The corresponding value for available bone height, referring to the bone between the nasal cavity and the alveolar crest that had a width of 4 mm in the buccolingual direction, was 4.3 mm (range 1–10 mm). The mean dimension of the zygomatic bone was 9.5 mm (range 3–17 mm) in the frontal plane and 14.1 mm (range 8–15 mm) in the sagittal plane. Preoperatively, eight patients had mucosal thickening in either one or both maxillary sinuses. In one patient, the maxillary sinus on one side was completely opaque. This patient had previously been treated by a one-stage operation with intra-sinus bone graft and fixtures.

Grafting procedures
Bone grafting was deemed necessary in 17 patients (61%) to allow for the installation of supporting conventional fixtures. Only autogenous bone was used. Grafting requirements were judged individually and minimised in all patients. All grafting procedures were done at the same time as the zygoma fixture was inserted. Thirteen of the 17 patients were treated with an onlay graft, in eight in combination with a nasal inlay. The remaining four were given only cancellous bone and marrow as a subperiosteal nasal inlay. The grafts were taken from the iliac crest, except for one in whom a tibial graft was used. The method of bone grafting is thoroughly described elsewhere (1).

Installed fixtures
The zygoma fixtures were of custom design (BOC and Exopro, Göteborg, Sweden) with a thicker coronal portion (Ø 4.5 mm) to increase primary stability in the thin palatal region. The apical part was thinner (Ø 4 mm) to preserve the dense zygomatic bone and reduce the risk of trauma in the sensitive orbital region.
Fig. 1. (a) Placement of modified fixtures in the dense zygomatic bone as an alternative to grafting. (b) Diagram of the position of the anchoring elements for the zygomatic option with an indication of the load distribution. (c) Dimensional proportions of the bone-anchored apex of the zygomatic fixture and transfer of the load at penetration of the maxillary base that relies on rigid connection by a rigid bar (see Fig. 1b). (d, e) Topographical anatomy of the zygomatic region with vascular relations. By kind permission of Dr José Sans Casado, Madrid, Spain.
The design also enabled treatment of patients with expansion of the sinus in an anterior direction within the jawbone.

In total, 52 zygoma fixtures (range 30–50 mm long) and 106 conventional fixtures (range 10–20 mm long) were installed. In 24 of the patients (86%) zygoma fixtures were placed bilaterally; in the remainder they were unilateral. In these patients a sufficient number of conventional fixtures could be placed or were already present in the opposite side. Of the 52 zygoma fixtures installed, 28 (15 patients) had a design with an angled head (Fig. 3).

All conventional fixtures were installed at the time at which the zygoma fixture was inserted, although additional fixtures installed during the follow-up period are also accounted for in the Results section. In general, the intention was to install 2–4 fixtures in the anterior region to obtain adequate mechanical stability for the prosthesis. The conventional fixtures were installed according to standard principles and hence, only the

Fig. 2. Two typical patients included in the study. (a) Panoramic view showing an alveolar crest with moderate resorption, but the maxillary sinuses are bilaterally expanding to the alveolar crest and close to the midline (arrows). (b) Panoramic and (c) profile radiograph showing extreme resorption.
zygoma surgery is described under “Operative technique”.

Preparation of the patient
Cloxacillin 1 g × 3 was given starting one hour before the operation. At that time, patients were given flunitrazepam 1 mg after the mouth had been rinsed with chlorhexidine. The operation was done under general anaesthesia (isoflurane) with nasal intubation. A throat pack and a gastric tube were used in each case. Local anaesthesia (lignocaine and 2% adrenaline 15 ml) with 1:100 000 adrenaline was injected into the maxillary and palate regions. Sterile drapes, including the nasal area, were applied according to standard osseointegration procedures. However, the lateral part of the orbit was left uncovered so that it was possible to inspect and palpate it during the operation.

Operative technique
A vestibular incision, similar to a Le Fort I incision, was made between the first molar regions (Fig. 4). If simultaneous grafting was planned, the incision was extended in a more vestibular direction towards the lip to get a thick mucoperiosteal flap to cover the bone graft. A palatal flap was raised to expose the alveolar crest and the hard palate (Fig. 5). The nasal mucosa was dissected to increase visibility and to provide the required, detailed comprehension of the local anatomy. The dissection subsequently continued along the

Table I. Baseline characteristics
Data are number (%) except where otherwise stated.

| Age (years): | 7 (25) |
|            | 13 (46) |
|            | 8 (29)  |
| Mean (range) | 58.3 (39–79) |
| Sex:        |        |
| Male        | 12 (43) |
| Female      | 16 (57) |
| Opposing dentition: |        |
| Natural teeth | 14 (50) |
| Partial fixed prosthesis | 4 (14) |
| Fixed prosthesis | 10 (36) |
| Time (months) between fixture placement and delivery of fixed prosthesis (n = 26): |        |
| < 9        | 18 (69) |
| 9–12       | 4 (16)  |
| >12        | 4 (15)  |
| Time (days) between connection of the abutment and delivery of fixed prosthesis (n = 26): |        |
| <30        | 4 (15)  |
| 30–60      | 15 (58) |
| >60        | 7 (27)  |
infrazygomatic crest towards the zygomatic bone. The infraorbital nerve was localised and the zygomatic region exposed (Fig. 6). Usually, a few fibres of the masseteric muscle had to be cut to expose the anterior part of the zygomatic arch. The dissection then aimed at localising the incisura of the posterior zygomatic bone. When an adequate view was obtained, the periosteum of the medial part of the zygomatic body and the zygomatic arch was raised (Fig. 7).

A window about $5 \times 10$ mm wide was opened in the uppermost lateral aspect of the sinus wall in the extension of the infrazygomatic crest, using a round bur (Fig. 8a, b). The sinus mucosa was then reflected and no special effort was made to keep it intact. The window provided direct visibility of the roof of the sinus and enabled localisation of the optimal point for entrance of the drill into the zygomatic bone. Gauze soaked in adrenaline was placed inside the sinus for a few minutes to prevent bleeding and deter mucosal tissue from blocking the view.

A custom-designed zygoma retractor (Exopro, Göteborg, Sweden) was placed in the incisura above the zygomatic arch (Fig. 9). The retractor enlarged the view of the site and also served to protect the soft tissue during drilling. The direction of the zygoma fixture was selected to provide optimal stability over prosthetic requirements. The ambition was to optimise stability by angling the fixture so that the zygomatic bone was used fully to anchor the apical part of the fixture. From a prosthetic point of view, the optimal entrance was as far posterior and close to the crestal midline as possible. These combined considerations usually meant that the fixture originated from the second premolar region.

After removal of the gauze inside the sinus, the entrance on the palatal side of the crest was marked and a round bur, $\varnothing 2.9$ mm, (Fig. 10) was used to penetrate the crest and mark the entrance in the roof of the sinus.
The entire site in the zygoma was then prepared with a twist drill, Ø 2.9 mm, and a protecting sleeve was used to prevent damage to surrounding tissues (Fig. 11). The zygoma retractor served as protection against soft tissue damage where the drill exited the zygomatic bone.

A 3.5 mm pilot drill was then used to enlarge the site. To ensure that the wider drill did not deviate from the planned direction, it was equipped with a non-cutting tip (pilot piece) 2.8 mm in diameter. The guiding pilot piece led the 3.5 mm pilot drill through the path previously drilled with the 2.9 mm twist drill. The site was prepared until the tip of the pilot drill penetrated and hit the zygoma retractor (Fig. 12).

The preparation continued with a 3.5 mm twist drill with a cutting apex until the drill tip hit the retractor (Fig. 13). A depth indicator was inserted into the site to decide the correct length of the zygoma fixture (Fig. 14).

Because of the risk of excessive widening of the palatal entrance, the 4 mm countersink/twist drill was used only when the palatal bone was thick or dense (Fig. 15). All preparation of the site was made under generous external irrigation with saline.

The zygoma fixture was inserted slowly until its apical portion reached through the zygomatic bone and its wider portion was anchored in the alveolar crest. After the connection to the hand-piece had been disengaged, the fixture was manually inserted to adequate depth and positioned in an optimal way from the prosthetic point of view (Fig. 16). After the fixture mount had been removed, a cover screw was attached. Finally, 2–4 conventional fixtures were installed in the anterior region of the jawbone (Fig. 17). If anatomically possible 1–2 fixtures should be installed in the septum between the maxillary sinus and nasal cavity.

When closing the incision that exposed the zygoma region, it is important to minimise postoperative oedema and haematoma. The muscles that were

Fig. 8. (a, b) Different positions of the bony window depending on the extension of the maxillary sinus.
Fig. 9. Custom-designed zygoma retractor (arrow) placed to enlarge the view of the site and to protect soft tissue during drilling.

Fig. 10. Palatal mark for fixture entrance with a round bur. Penetration to and passage through the sinus. Entrance mark in the lateral-superior roof of sinus.

Fig. 11. Preparation of the entire site with a twist drill, Ø 2.9 mm.
released from the lower anterior aspect of the zygoma should be carefully repositioned to avoid the formation of a retrozygoma space (Fig. 18a). The submucous tissue should be reattached with individual absorbable sutures that connect to the lateral horizontal incision over the distal aspect of the maxilla, so that soft tissue with periosteum provides a cover over the window in the upper anterior maxillary body. Finally, the incision in the mucosa was closed with individual mattress non-absorbable sutures (Fig. 18b). Any sign of insufficient closure with exposure should be dealt with immediately.

Postoperative care
As soon as possible ice packs with compression bandages were applied to the cheeks and left for the first 12 postoperative hours. A gauze roll soaked in saline was placed into the vault of the palate to compress the mucoperiosteum and diminish the risk of developing a palatal haematoma. Prophylactic antibiotics (flucloxacillin $3 \times 500$ mg) were given for 14 days postoperatively. In grafted cases, amoxycillin ($3 \times 500$ mg) was added for the same time period. The sutures were removed after 10–14 days. No maxillary denture was used for the first two weeks. In case of onlay bone grafting, no maxillary denture was used for at least six weeks postoperatively. The denture was then relined and carefully adapted to avoid pressure on the tissues above the cover screws.

Connection of the abutment
Abutments were connected after a healing period of roughly six months (mean 204 days, range 145–295). All regular platform abutments in the standard Brånemark system were used. Fig. 12. Widening the bony site using a 3.5 mm (Ø) pilot drill.

Fig. 13. Preparation continues with a twist drill, Ø 3.5 mm, with a cutting apex until the drill tip hits the retractor.
mark System could be used together with the zygoma fixtures. The incision was made under local anaesthesia on the crest extending to the first molar regions. Because of the slightly palatal position of the zygoma fixtures, a fenestration was made slightly palatal to the incision and a flap was slipped over the abutment after it had been connected. The palatal flap was usually trimmed and thinned to secure soft tissue stability around the zygoma fixture abutments.

**Prosthetic procedures**

If the patient had had a bone graft, it was considered necessary to avoid extensive load on individual fixtures during healing after connection of the abutment. To this end, the fixtures were splinted together with a rigid

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**Fig. 14.** Angled depth indicator to measure the correct length of the fixture.

**Fig. 15.** Widening of the palatal entrance when palatal bone is thick or dense.

**Fig. 16.** Rotation of the zygoma fixture to ensure that the angled hexagonal part is directed towards an ideal occlusal plane.

**Fig. 17.** Intraoral view showing the distribution of fixtures.
gold-alloy bar (Fig. 19). An impression of the abutment’s positions and surrounding mucosa was taken immediately after connection using a rigid impression material, and a gold bar was custom-made in the laboratory. An impression of the lower jaw was also taken, together with a preliminary record of the relation of the jaws. The rigid bar was then attached to the abutments and secured in place with connecting screws. The patient’s denture was carefully adjusted and relined using a soft material. The bar was then used until the permanent bridge was finished. In some cases with a limited amount of alveolar crestal bone a splint was used to reduce further load on the individual fixtures.

Fabrication of the permanent fixed prosthesis followed standard procedures. Extension of the fixed prosthesis was normally from first molar to first molar (4–7 mm cantilevers) and special attention was paid to eliminating primary occlusal contacts on the cantilevers.

The patients were re-examined 1–2 weeks after delivery of the fixed prosthesis. The stability of the restoration was checked, the gold screws were retightened and function, phonetics, and aesthetics were evaluated.

**Postoperative radiographic examination**

The radiographic examination after installation of the fixture required special projections. Perfect projection geometry was often difficult to achieve in intraoral radiography as the conventional fixtures in the frontal region of the maxillae were installed in a jawbone with extensive resorption, dental scanograms (Scanora technique, Soredex, Finland) (2) were obtained in most cases. For the evaluation of the zygoma fixtures, frontal sinus scanograms as well as a mid-face panorama (frontal view) were taken (Fig. 20). The Scanora unit was also used for these two projections.

**Postoperative rhinoscopy and sinoscopy**

To evaluate the condition of the antral and nasal mucosa, nine patients were examined by rhinoscopy and sinoscopy under local anaesthesia. The findings were recorded on video-tape. This examination was made 3–5 years after installation of the zygoma fixture.
in seven of the patients, while the remaining two patients were examined 1–2 years postoperatively.

**Treatment of recurrent sinusitis**

During development of the zygoma procedure a new approach was evaluated (Björn Petruson, personal communication) to improve the ventilation and drainage from the sinuses through the lateral nasal wall through a new ostium inside the inferior turbinate. This procedure was used in four cases.

**RESULTS**

The study ended in December 2000, at which time all 28 patients had been followed up for at least five years after zygoma surgery. During the follow-up period three patients had died, one patient with two zygoma fixtures after five years and two after six years with one and two zygoma fixtures, respectively.

During the whole follow-up period three of the 52 zygoma fixtures were diagnosed as failures and

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*Fig. 20.* Postoperative radiographs obtained at 6-year follow-up examination using a Scanora® multimodal unit (same patient as in Fig. 2b).
removed but not replaced. Two of them were mobile when the abutment was connected, while the third was lost at the 6-year check-up. One of the patients, who had been given a unilateral fixture, could still get a fixed prosthesis supported by the conventional fixtures installed in the maxilla. The other two patients were wearing the original prosthetic reconstructions at the end of the study. The overall survival rate of zygoma fixtures was 94% (Table II).

Of the 106 originally installed conventional fixtures placed during insertion of the zygoma fixture, 29 were lost. The failures occurred in 13 patients. Five patients lost one fixture each, four patients two fixtures, one patient three fixtures, two patients four fixtures, and finally one patient lost five. The fixture survival rate was therefore 73%.

During the follow-up period another 10 additional conventional fixtures were installed, of which two had to be removed because of loss of osseointegration. An additional 17 fixtures were put in as replacements during the follow-up period, of which five were diagnosed as failures and removed. The overall survival rate of fixtures, excluding the zygoma fixtures, was 73% (Table III).

Fifteen (54%) of the total 28 treated patients did not loose any of the conventional fixtures installed at the same time as the zygoma fixture. Among the 13 patients with failures, six had had previous fixtures inserted.

Continuous fixed prosthesis function throughout the study period was achieved by 23 of the 28 patients (82%). Two patients were provided with an overdenture during an initial phase converted to a fixed prosthesis, while one patient carried an overdenture during the whole study period. One patient, initially provided with a fixed prosthesis, was forced to revert to wearing a complete denture because all fixtures placed in the frontal jawbone failed. Consequently, 27 of the 28 patients (96%) had a prosthetic reconstruction supported by fixtures at the end of the study. Figure 20 shows one of the patients in the study.

The palatal position of the heads of the zygoma fixture created no discomfort; most patients did not even notice the position until the question was raised directly. Speech problems did not differ from patients treated in a conventional manner.

Of the grafted patients, a few had sensory nerve disturbances in the upper lip caused by the labial incision. However, this resolved spontaneously. There were no other nerve disturbances related to the procedure. The patients reported moderate pain during the first eight postoperative hours, which was treated with opiates. After one day the pain could be handled with ordinary type 1 analgesics, such as paracetamol. During the first postoperative day minor oozing occurred from the nose and sinus, which was handled with anterior tamponades. Most patients experienced fairly extensive swelling and bruising postoperatively but this normalised during the first 10-14 days. No orbital injury was observed. The patients stayed in hospital for 1–6 days depending on the procedure. Patients who did not have grafts left hospital the day after operation.

In two patients, one of the two installed zygoma fixtures was unloaded because of suppuration at the palatal entrance of the zygoma fixture combined with a sinus infection. The zygoma fixtures were clinically stable. The complications occurred after six and nine years of follow-up, respectively. Both patients later had an inferior meatal antrostomy with successful results.

No signs of inflammatory reactions in the surrounding antral mucosa were found in the nine patients examined by sinoscopy (Fig. 21). The zygoma fixtures were completely or partly covered with normal mucosa. No inflammatory reactions were noted when the nasal cavity was inspected.
Four patients had recurrent sinusitis during the follow-up time, one of whom had a history of sinusitis, although when the zygoma fixture was inserted the maxillary sinuses were diagnosed as normal. Another of these patients also had normal sinuses preoperatively. Mucosal swelling was noted bilaterally in the remaining two patients. In these four cases, it was decided to improve the drainage from the sinuses through the lateral wall of the nasal cavity through a new ostium to optimise the nasal passage from the sinus. There has been no recurrence of the sinusitis. Radiographically-diagnosed sinusitis with clinically symptom-free maxillary sinuses was found in another four patients. In those cases no treatment was regarded to be necessary.

DISCUSSION

The aim of the present study was to evaluate whether zygoma fixtures combined with conventional fixtures placed in the frontal jawbone could be an alternative to bone grafting in the rehabilitation of the advanced resorbed edentulous maxilla.

The zygoma fixture was originally used in the rehabilitation of discontinuous maxillae to anchor an obturator prosthesis to the zygomatic bone. Despite unfavourable functional load direction and limited anatomy, clinical follow up indicated that the zygoma fixtures provided excellent anchorage for various prostheses. Based on these encouraging results the zygoma fixture was later used as a treatment option when onlay bone grafting procedures had failed (1).

With an overall prosthetic rehabilitation rate of 96% after at least five years in function, zygoma fixtures with simultaneous placement of endosseous fixtures in the frontal jawbone are a valuable approach to manage the resorbed edentulous maxillae. These results are comparable with the long-term results presented in the onlay bone grafting study published by Brånemark et al. (1). In that study, the prosthesis survival rate was 95% after five years and 93% after 10 years. As the number of patients in the present study was less (28 compared with 165 patients in the onlay bone graft study) we have chosen not to present any annual survival rates. After at least five years (range 5 to 10 years) the overall fixture survival rate, including originally installed fixtures, replacing conventional fixtures at zygoma surgery and additional conventional fixtures post-zygoma surgery, but excluding zygoma fixtures themselves, was 73%. This result is lower than that of the onlay graft study, where the survival rate was 80% for the originally installed fixtures and 77% for additional fixtures. The overall survival rate of the zygoma procedure, however, was 80% (158 fixtures installed compared with 32 fixtures removed).

The potential advantages of the zygoma procedure have been described recently by Higuchi (3). One of the factors listed is that donor site morbidity can be reduced or eliminated. In the present study bone grafts were deemed necessary in 17 patients (61%). It has to be kept in mind, however, that as many as 13 patients (46%) had a history of previous operations, of which 11 were combined with bone grafting procedures. Reduction in treatment time was also mentioned. In general, zygoma patients stayed in hospital between one to six days depending on the procedure. Patients for whom bone grafting was considered not necessary stayed in hospital for just one night. In the study with autogenous onlay bone grafting and simultaneous endosseous fixture placement, Brånemark et al. (1) found that the period of hospital stay in general lasted five to seven days, so this study has shown that time in hospital could be reduced. A further advantage mentioned by Higuchi was that the number of implants required to support a fixed prosthesis could be reduced. The mean number of conventional fixtures in the maxillae was 3.8 in this study (range 3–6). Sometimes a flange fixture in the anterior palate can improve the stability of the bar system connecting the fixtures.

In extreme resorption of the maxilla, when the wall between the sinus and the nasal cavity is thin and vertical and bone grafting is contraindicated, one further option is to place two zygoma fixtures on either side. The anterior of these fixtures can sometimes involve the anterior rim of the lateral wall of the orbit (Fig. 22). This procedure requires careful radiographic analysis of bony topography, and special attention to
protect the orbital contents. A fixed prosthesis is an advantage to avoid the relative motion of the anchoring elements.

Potential disadvantages to consider with zygoma fixtures (3) are risks of orbital injury or postoperative sinusitis. In none of the cases did any kind of orbital injury or complications occur. Four of the 28 patients experienced recurrent sinusitis, which was treated with a special surgical procedure (Björn Petruson, personal communication) and problems were solved without affecting the survival of zygoma fixtures. In the present study only three zygoma fixtures were lost (94% survival). None of the failing fixtures was lost because of a fracture. One fixture site was contaminated by muscle tissue at operation and the fixture was removed when the abutment was connected. The second zygoma fixture removed when the abutment was connected had not been correctly seated in the zygomatic body, and had insufficient bony support as judged from radiographs obtained postoperatively. The third zygoma fixture was lost after six years of function in a patient with loosely textured, low density bone as a result of Paget’s disease. Higuchi further stressed the need for well-trained surgeons with experience in maxillofacial procedures. He also pointed out that the surgical access may be difficult, a fact that might limit optimal placement and positioning of fixtures.

In conclusion, the Bråemark zygoma fixture is a valuable addition to the repertoire for the management of the compromised maxilla. Applied properly it may reduce surgical morbidity and reduce treatment costs. It is, however, essential that the surgical and restorative team is experienced, a fact that is also true for other such procedures.

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REFERENCES


