Clinical outcome of 103 consecutive zygomatic implants: a 6–48 months follow-up study

Chantal Malevez
Marcelo Abarca
Françoise Durdu
Philippe Daelemans

Authors’ affiliation:
Chantal Malevez, Marcelo Abarca, Françoise Durdu, Philippe Daelemans, Department of Maxillofacial Surgery and Dentistry, Erasme Hospital, Université Libre de Bruxelles, Brussels Belgium

Correspondence to:
Dr Chantal Malevez
Department of Maxillofacial Surgery and Dentistry
Erasme Hospital Université Libre de Bruxelles
808 Route de Lennik 1070 Brussels Belgium
Tel.: +32 2 555 44 74
Fax: +32 2 555 45 99
e-mail: cmalevez@ulb.ac.be

Key words: zygomatic implants, zygoma bone, atrophic maxilla, oral implants, edentulism

Abstract: The purpose of this study was to evaluate retrospectively, after a period of 6–48 months follow-up of prosthetic loading, the survival rate of 103 zygomatic implants inserted in 55 totally edentulous severely resorbed upper jaws. Fifty-five consecutive patients, 41 females and 14 males, with severe maxillary bone resorption were rehabilitated by means of a fixed prosthesis supported by either 1 or 2 zygomatic implants, and 2–6 maxillary implants. This retrospective study calculated success and survival rates at both the prosthetic and implant levels. Out of 55 prostheses, 52 were screwed on top of the implants, while 3 were modified due to the loss of standard additional implants and transformed in semimovable prosthesis. Although osseointegration in the zygomatic region is difficult to evaluate, no zygomatic implant was considered fibrously encapsulated and they are all still in function. This study confirms that the zygoma bone can offer a predictable anchorage and support function for a fixed prosthesis in severely resorbed maxillae.

Long-term results of fixed prosthesis on 2-stage c.p. titanium screw-shaped oral implants indicate a predictable treatment outcome [Adell et al. 1990; van Steenbergh et al. 1990].

However, implant insertion and prosthetic rehabilitation of patients with an extremely atrophied maxilla are especially difficult issues. Bone resorption in the posterior region, widening of the sinuses, and anterior alveolar bone resorption can dramatically reduce the possibility of implant insertion and prosthetic rehabilitation. Ideally, these patients would have to be treated with bone augmentation techniques or onlay or veneer bone grafting, combined with sinus grafts or possibly nasal floor augmentation [Triplett et al. 2000; Kahnberg et al. 2001].

Localised ridge augmentations by means of a membrane, the so-called guided bone regeneration (GBR) technique, is a documented procedure, but data are limited for the totally edentulous patient [Buser et al. 1993; Simion et al. 2001].

Autologous bone grafting has given satisfactory success rates. This well-documented technique implies heavy surgery, and sometimes considerable morbidity also at the donor site [Breine & Branemark 1980; Isaksson 1994; Hürlézer et al. 1996; Lekholm et al. 1999].

The new zygomatic implantation technique proposes an alternative to this bone grafting by using the zygoma as a strong anchorage. Indications for the placement of zygomatic implants are:

- Sufficient bone volume in the anterior region of the maxilla: the length of the maxillary arch with a minimum height of 10 mm and width of 4 mm allows the placement of 2–4 implants, but the resorption of the posterior maxilla reduces the possibility of placement of standard implants.
• Insufficient bone volume in the anterior region of the maxilla: this situation necessitates onlay graft or GBR for implant placement. Sinus grafting for the posterior region could be contra-indicated for clinical reasons or avoided by the use of the zygomatic implants.

The aim of this retrospective study in consecutive patients was to evaluate the clinical outcome of the zygomatic implants and the prostheses they carry.

Material and methods

Patients

The study was based on 55 patients treated at the Department of Maxillofacial Surgery and Dentistry of the Erasme Hospital [Université Libre de Bruxelles], between December 1997 and November 2001.

All 55 patients were provided with Brånemark System® Zygomaticus fixtures (Nobel Biocare AB, Göteborg, Sweden), 41 women and 14 men. The average age for the men was 62 [range 40–76] years and for the women 57 [range 22–79] years.

All patients were totally edentulous in the upper jaw: 21 patients were full edentulous, while 34 patients were partially edentulous. Thirty-seven patients were nonsmokers, 11 patients smoked more than 10 cigarettes a day, and 7 patients reported that they smoked occasionally, but less than 10 cigarettes a day.

The medical history of the patients is shown in Table 1.

Material and methods

Patients

The study was based on 55 patients treated at the Department of Maxillofacial Surgery and Dentistry of the Erasme Hospital [Université Libre de Bruxelles], between December 1997 and November 2001.

All 55 patients were provided with Brånemark System® Zygomaticus fixtures (Nobel Biocare AB, Göteborg, Sweden), 41 women and 14 men. The average age for the men was 62 [range 40–76] years and for the women 57 [range 22–79] years.

All patients were totally edentulous in the upper jaw: 21 patients were full edentulous, while 34 patients were partially edentulous. Thirty-seven patients were nonsmokers, 11 patients smoked more than 10 cigarettes a day, and 7 patients reported that they smoked occasionally, but less than 10 cigarettes a day.

The medical history of the patients is shown in Table 1.

The selection criteria for the zygomatic implantation were: no possibility to insert 5–6 standard implants in the anterior region of the maxilla, a posterior bone height of less than 5 mm. If the anterior maxillary height was less than 13 mm and the width less than 4 mm, an additional bone grafting was performed in the anterior region.

Table 1. Summary of patients’ medical histories

<table>
<thead>
<tr>
<th>Medical history</th>
<th>Study group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes (type 2)</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>6</td>
</tr>
<tr>
<td>Allergy</td>
<td>5</td>
</tr>
<tr>
<td>Antidepressive drugs</td>
<td>1</td>
</tr>
<tr>
<td>Parkinson</td>
<td>1</td>
</tr>
<tr>
<td>Hepatitis</td>
<td>2</td>
</tr>
</tbody>
</table>

Exclusion criteria were acute infections of the sinuses.

Implants

Zygomatic implants are available in 8 different lengths ranging from 30 to 52.5 mm. The portion that engages the residual maxillary alveolar process has a diameter of 4.5 mm, while the apical portion inserted in the zygoma has a diameter of 4.0 mm (Fig. 1).

The distribution lengths of implants are shown in Table 2.

A total of 103 zygomatic implants were placed, generally 2, in each patient. Indeed in 7 patients unilateral anatomical reasons prevented the placement of 2 implants. Bone density and bone quantity were evaluated by eye inspection on the basis of orthopantomographs and CT scans.

A number of 194 standard Brånemark System® implants (Nobel Biocare AB, Göteborg, Sweden) were placed in the anterior maxilla following the protocol defined by Brånemark [Brånemark et al. 1985]. Patients had a combination of 1 or 2 zygoma implants with 2, 3, 4, 5 or 6 Brånemark System® implants of type Regular Platform diameter 3.75 mm (54 patients) and Wide Platform diameter 5.0 mm (1 patient) in the anterior maxilla. In patients where 6 implants were placed, 2 were inserted in the maxillary tuberosity.

Table 2. Distribution of the different zygomatic implants according to their length

<table>
<thead>
<tr>
<th>Length of zygomatic implants in mm</th>
<th>Number of zygoma implants placed</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>6</td>
</tr>
<tr>
<td>40</td>
<td>43</td>
</tr>
<tr>
<td>42.5</td>
<td>3</td>
</tr>
<tr>
<td>45</td>
<td>42</td>
</tr>
<tr>
<td>47.5</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>9</td>
</tr>
<tr>
<td>52.5</td>
<td>0</td>
</tr>
<tr>
<td>Total of fixtures</td>
<td>103</td>
</tr>
</tbody>
</table>

Exclusion criteria were acute infections of the sinuses.

Implants

Zygomatic implants are available in 8 different lengths ranging from 30 to 52.5 mm. The portion that engages the residual maxillary alveolar process has a diameter of 4.5 mm, while the apical portion inserted in the zygoma has a diameter of 4.0 mm (Fig. 1).

The distribution lengths of implants are shown in Table 2.

A total of 103 zygomatic implants were placed, generally 2, in each patient. Indeed in 7 patients unilateral anatomical reasons prevented the placement of 2 implants. Bone density and bone quantity were evaluated by eye inspection on the basis of orthopantomographs and CT scans.

A number of 194 standard Brånemark System® implants (Nobel Biocare AB, Göteborg, Sweden) were placed in the anterior maxilla following the protocol defined by Brånemark [Brånemark et al. 1985]. Patients had a combination of 1 or 2 zygoma implants with 2, 3, 4, 5 or 6 Brånemark System® implants of type Regular Platform diameter 3.75 mm (54 patients) and Wide Platform diameter 5.0 mm (1 patient) in the anterior maxilla. In patients where 6 implants were placed, 2 were inserted in the maxillary tuberosity.

Table 3. Relation between number of implants in the anterior sector of the maxilla and the number of zygomatic implants in the posterior sector in the group of patients

<table>
<thead>
<tr>
<th>Number of implants in the anterior sector of the maxilla</th>
<th>Number of implants</th>
<th>1 zygoma implant</th>
<th>2 zygoma implants</th>
<th>Total of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 zygoma implant</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2 zygoma implants</td>
<td>15</td>
<td>7</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>Total of patients</td>
<td>15</td>
<td>7</td>
<td>24</td>
<td>5</td>
</tr>
</tbody>
</table>

The distribution of zygomatic and anterior implants is shown in Table 3.

Surgical procedures

All the zygomatic implants were placed under general anesthesia. A Le Fort I osteotomy incision was used in 2 patients. For the others, this incision was modified for technical reasons to a palatal incision, which exposes the entire maxillary alveolar process from zygomatic buttress to zygomatic buttress. The drilled hole ends at the junction of the zygomatic arch and the lateral orbital rim. The zygomatic implant ultimately engages the bone in both the zygoma and the maxillary alveolus [Brånemark 1998].

Antibiotic prophylaxis, mostly amoxicillin 2 g/day for 5 days, was used in all patients. Except for the first 2 patients, all received corticoids to avoid the important swelling of the lips and face.

Normally, the placement of additional standard implants in the anterior sector of the maxilla is done at the time of the placement of the zygomatic implants, but in 7 patients, due to the extreme bone resorption they presented, an autologous onlay or veneer bone graft was placed at the time of the first surgery (Fig. 2). The placement of the standard implants was then delayed to a second surgery a few months later (4–6 months).

All anterior implants were placed routinely according to a 2-stage procedure.
Prosthetic procedures

On the day of the abutment connection, standard abutments were installed on all implants and all the implants were immediately connected by a rigid bar or a provisional acrylic prosthesis screwed on top of them. The final prosthetic procedure started about 10 days after abutment connection according to the standard prosthetic protocol [Brånemark et al. 1985].

The final prosthesis consisted of a conventional gold framework with acrylic teeth. In 2 patients, the teeth were made of porcelain [Figs. 3, 4].

Results

None of the 103 zygomatic implants failed. A life table of zygomatic implants is shown in Table 4.

Out of all the 194 placed in the anterior maxilla, 16 were lost, which means the success rate was 91.75%.

These losses clustered in 7 patients but all, except 3, still wear a fixed prosthesis. These 3 patients went back to a removable prosthesis, of whom 1, who lost all the standard implants (3), got 2 magnets on the zygomatic implants.

One complication was observed prior to the placement of the prosthesis, 1 patient presented a severe infection of the sinus, which was successfully treated with antibiotics.

After prosthesis placement, patients were controlled after 1 week, 1 month, 3 months, 6, 12, 24, 36 up to 42 months.

Stability of the zygomatic implants, control of plaque and inflammation, bleeding on probing were performed at all the implants sites and for the anterior standard implant retroalveolar radiographies were also realised at 3 and 6 months and once a year.

Orthopantomograms were realised on all the patients after surgery at the time of the insertion of the prosthesis, but this examination could not give relevant information.

In 3 patients, facial X-rays gave a better information concerning the localisation of the zygomatic implant.

In cases where bone grafting was performed, CT scans were realised but could not contribute to any conclusions concerning osseointegration of the zygomatic implants.

After prosthesis placement, 5 patients had sinusitis that, however, could not be associated with the zygoma implants. One patient had a variety of several complaints due to psychological problems, 1 patient had problems with oral hygiene control, and 1 patient had aesthetic problems.

Discussion

Few reports have been published about zygomatic implants [Higuchi 2000; Schramm et al. 2000; Stevenson & Austin 2000; Bedrossian & Stumpel 2001; Parel et al. 2001; Uchida et al. 2001]. None offers a follow-up as long as the present study. The use of zygomatic implants represents an interesting alternative in the rehabilitation of the fully edentulous patient. It offers a solid and an extended anchorage in a region situated at an important distance from the occlusal level. Indeed, histological analysis of the zygoma shows regular trabeculae and compact bone with an osseous density of 98% [Gosain et al. 1998].
The zygoma bone can be compared to a pyramid, offering an interesting anatomy for the insertion of implants (Karlan & Cassisi 1979). The proven strength of this anchorage contrasts with the poor bone quality (mostly type IV) of the posterior maxilla. Owing to this bone density, it has also been used in the treatment of maxillofacial fractures, for the insertion of miniplates (Champy et al. 1986). It has also been used during orthodontic treatment, offering a fixed anchorage to allow tooth movements (Melsen et al. 1998). In the protraction of the maxilla, one animal study uses the zygoma bone as an anchorage place (Smalley et al. 1988). In maxillofacial prosthesis, the zygoma bone was utilized as an anchorage for the placement of implants for a facial prosthesis (Sabin et al. 1995). Finally after maxillectomy, zygomatic implants were connected with other standard implants in a conventional screwed prosthesis (Izzo et al. 1994).

For all these reasons, zygoma bone should be considered as a steady anchorage for rehabilitation of the very resorbed maxilla.

In the present study, only survival was reported since the application of success criteria is technically impossible.

Only clinical appreciation about the stability of the implants was performed: no pain, no swelling, no infection, and no mobility.

A relevant radiographic analysis of bone apposition is also impossible around the implant in the zygoma.

All zygomatic implants in this series are still in function, without complications, and with no signs of pain, infection or any pathology.

**Conclusions**

The zygomatic implants have been developed for compromised maxillary situations. The zygomatic implant offers a predictable therapeutic solution as has been shown in this up-to-4-year observation on more than 100 consecutive implants without a single implant loss.

There is a need to develop clinical and/or radiological criteria to assess whether zygoma implants have achieved an intimate bone-to-implant contact.

**Résumé**

Le but de cette étude a été d’évaluer rétrospectivement, après une période de six à 48 mois après la mise en charge prothétique, le taux de survie de 103 implants zygomatics insérés chez 55 dents complets avec mâchoires supérieures extrêmement résorbées. Cinquante-cinq patients (41 femmes et quatorze hommes) avec une résorption osseuse maxillaire très sévère ont été soignés à l’aide d’une prothèse fixée supportée par un ou deux implants zygomatic et deux à six implants maxillaires. Cette étude rétrospective a calculé le taux de survie et le taux de succès tant au niveau prothétique que l’implantaire. Des 55 prothèses, 52 ont été visées sur les implants tandis que trois ont été modifiées vu la perte d’implants standards supplémentaires et transformées en prothèses semi-amovibles. Bien que l’ostéointégration dans la région zygomatic soit difficile à évaluer, aucun implant zygomatic n’a été considéré comme encapsulé fibreusement et ils sont encore tous en fonction. Cette étude confirme que l’os zygomatic peut offrir un ancrage prévisible et un support de support pour une prothèse fixée dans les cas de maxillaires fortement résorbés.

**Zusammenfassung**

Die klinischen Ergebnisse von 103 Implantaten im Jochbein. Eine Langzeitstudie über 6–48 Monate. Das Ziel dieser Studie war es, bei 55 vollständig zahnlosen und massiv resorbierten Oberkiefern die...
Maleve et al. Clinical outcome of 103 consecutive zygomatic implants


Obwohl die Osseointegration in der Region des Jochbeins schwierig zu beurteilen ist, musste keines dieser Implantate als hindigewegig eingeht bezeichnet werden und alle sind immer noch in Funktion.

Diese Arbeit belegt, dass der Knochen des Jochbeins eine für eine festsitzende Brücke bei massiv resorbierten Oberkiefern liefern kann.

Resumen

La intención de este estudio fue evaluar retrospectivamente, tras un periodo de 6–48 meses de seguimiento de carga prostética, el índice de supervivencia de 103 implantes zigomáticos insertados en 55 maxilares superiores edentulos severamente reabsorbidos.

Se rehabilitaron 55 pacientes consecutivos, 41 mujeres y 14 hombres, con reabsorción ósea severa del maxilar, por medio de una prótesis fija soportada por 102 implantes zigomáticos, y de 2 a 6 implantes maxilares.

Este estudio retrospectivo calculó los índices de éxito y supervivencia tanto a nivel de la prótesis como del implante. De las 53 prótesis, 32 se atomillaron sobre los implantes mientras que 3 se modificaron debido a la perdida de implantes estándar adicionales y se transformaron en prótesis semimóviles.

Aunque la osteointegración en la región zigomática es difícil de evaluar, no se consideró a ningún implante zigomático como fibrosamente encapsulado y están aún en función.

Este estudio confirma que el hueso zigomático puede ofrecer un anclaje predecible y función de soporte para una prótesis fija en el maxilar severamente reabsorbido.

Referencias


Chicago: Quintessence Publishing Co.


