COMPARISON OF DIFFERENT ZYGOMATIC IMPLANT PLACEMENT TECHNIQUES- AN ORIGINAL RESEARCH

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ABSTRACT

Aim

Purpose of our research was to initiate a comparison as well as evaluation between various zygomatic implant placement techniques.

Methodology

101 Patients with extremely atrophied maxillae were provided with one to four zygomatic implants in conjunction with sinus grafting, plus conventional auxiliary implants, for immediate support of a provisional full-arch maxillary prosthesis following all the 5 techniques of zygomatic bone implant placement techniques. Definitive prostheses were delivered at 6 months after implant placement. All patients underwent clinical and radiographic examinations at 6 months.

Results

Patients with extremely atrophied maxillae were provided with one to four zygomatic implants in conjunction with sinus grafting, plus conventional auxiliary implants, for immediate support of a provisional full-arch maxillary prosthesis. Definitive prostheses were delivered at 6 months.
after implant placement. All patients underwent clinical and radiographic examinations at 6 months. Maximum success rate was noticed in Exteriorized approach.

Conclusion

Preference for one technique over the other should take into consideration the concavity formed by the ridge crest, maxillary sinus, and region of implant insertion in the Zygomatic Bone.

Keywords: Atrophic maxilla. Maxillary sinus. Zygomatic implants. Surgical techniques.

INTRODUCTION

Conventional implant treatment cannot be performed in the edentulous maxilla in some patients because of advanced bone resorption and/or the presence of extensive maxillary sinuses, leading to inadequate amounts of bone tissue for anchorage of the implants. For over three decades, bone grafting prior to, or simultaneously with, implant placement has become routine in oral rehabilitation. Various bone-augmentation techniques, such as sinus floor augmentation and onlay bone grafting, have been described with the common goal of increasing the volume of load-bearing bone.1 During the last two decades, the zygoma implant has proven to be an effective option in the management of the atrophic edentulous maxilla, as well as for maxillectomy defects.2 The Bränemark zygoma implant was introduced for the prosthetic rehabilitation of patients with extensive defects of the maxilla caused by tumor resections, trauma and congenital defects.3 The bone of the zygomatic arch was used for anchorage of a long implant, which, together with conventional implants, could be used as an anchor for epistheses, prostheses and/or obturators. The technique has enabled sufficient rehabilitation of these patients, providing restored function and improved esthetics, and has given many patients back a normal social life. The use of multiple zygomatic implants (e.g. two to three in each side) to support a prosthesis was suggested by Bothur et al. Despite numerous publications with positive long-term outcomes, there are no randomized controlled trials comparing their clinical effectiveness with alternative means for rehabilitation. The use of multiple zygomatic implants (e.g. two to three in each side) to support a prosthesis was suggested by Bothur et al.4 Despite numerous publications with positive long-term outcomes, there are no randomized controlled trials comparing their clinical effectiveness with alternative means for rehabilitating patients with atrophic edentulous maxillae.5 Moreover, there are few published prospective long-term studies that endorse this technique.6 Currently, there are no well-defined, specific criteria that help the clinician to evaluate the success of a zygomatic-supported rehabilitation. The original Bränemark customized zygoma fixture was designed to be inserted from the palatal aspect of the resorbed maxilla in the region of the second premolar premolar, through the maxillary sinus into the compact bone of the zygoma. Initially it had the characteristics of a conventional implant but with increased length and diameter. It was a self-tapping titanium implant with a machined surface and available in lengths of 30–52.5 mm. The threaded apical part had a diameter of 4 mm and the crestal part had a diameter of 4.5 mm. The implant head was provided with an inner thread for connection of standard abutments. Later on, the implant head was angulated at 45°.7 In today’s fixture the surface has evolved to a moderately rough oxidized threaded surface and the head includes an implant driver screw that remains inside the implant, offering an inner thread for the connection of special ‘zygomatic’ abutments. Currently,
Zygomatic implants are commercially available from at least three different companies that offer implants with an oxidized rough surface, a smooth mid-implant body, a wider neck at the alveolar crest and a 55° angulation of the implant head. Various techniques have been described to treat the atrophic maxilla, including the use of angled implants in the paranasal region, implants in pterygoid apophysis, grafting of the maxillary sinus floor, short and wide implants, and zygomatic implants (ZIs). The use of ZIs after ablative tumor surgery with resection of the maxillary bone, trauma, congenital defects, unsuccessful autogenous bone grafts, gunshot wounds, and in patients who refuse autogenous bone grafting is valuable in providing new zygomatic buttresses that play a key role in the form of the midface and in oral rehabilitations.9-13 ZIs can still be considered a relevant alternative to short implants and implants of conventional length placed following sinus floor elevation. Concerning the use of short implants, Renouard and Nisand observed that in sites associated with jaw bone resorption, a prevalence of short implants and/or wide-diameter implants might be used.14 However, in these particular situations, failure rates may be increased due to poor bone density commonly associated with these areas. Moreover, clinical investigations have shown better survival rates for implants with greater length than shorter ones.15 Concerning the sinus floor elevation, bone grafting usually requires two surgical sites when host bone is used, which can make the postsurgical period uncomfortable. In addition, the use of removable dentures during the healing period may be contraindicated. Finally, the treatment may demand considerable time until definitive prostheses are delivered.16

**AIM OF THE PRESENT STUDY**

Purpose of our research was to initiate a comparison as well as evaluation between various zygomatic implant placement surgical techniques in maxillary bone pertaining to long term stability as well as success of the implant in general.

**METHODOLOGY**

Five different surgical approaches were considered in the present study: (1) the classical approach, (2) the sinus slot technique, (3) the exteriorized approach, (4) the minimally invasive approach by the use of custom-made drill guides, and (5) the computer aided surgical navigation system approach. This case cohort study was performed in our institution. 101 Patients over the age of 18 (of both sexes and any race) were recruited for maxillary reconstruction with an immediately loaded full-arch prosthesis using all the 5 different techniques. All patients had extremely atrophied maxillae and were planned to be treated with one to four zygomatic implants (Nobel Biocare) in conjunction with sinus bone grafting. To determine the residual bone volume and the desired prospective implant positions and lengths, a presurgical cone beam computed tomography (CBCT) scan was obtained. Consequently, a three-dimensional evaluation of the maxilla and the sinus cavity was performed. The width, density, and volume of the zygoma were determined to ensure that placement of a zygomatic implant was a feasible treatment approach. Then implant placement was carried out with proper surgical protocols. All patients were given the opportunity to participate in an implant recall program. The supportive care was performed on an individual basis at 3- or 6-month intervals. The stability of each implant was assessed by applying pressure with two opposing instruments after removal of the prostheses. For the purposes of this study, implant and prosthesis survival were defined as the implant and/or prosthesis remaining in situ throughout the observation period, with or without modification. All biologic complications were noted, including...
postoperative bruising, infection, neuropathy/paresthesia, and/or recurrent and persistent peri-implant infection. Technical complications to be noted included fracture of the implants, screws, or abutments; screw or abutment loosening; framework or veneer fractures; and loss of retention. For the purposes of this study, implant and prosthesis survival were defined as the implant and/or prosthesis remaining in situ throughout the observation period, with or without modification. All biologic complications were noted, including postoperative bruising, infection, neuropathy/paresthesia, and/or recurrent and persistent peri-implant infection. Technical complications to be noted included fracture of the implants, screws, or abutments; screw or abutment loosening; framework or veneer fractures; and loss of retention.

RESULTS

In all, 101 zygomatic implants were placed. Each patient received zygomatic implants in conjunction with sinus bone grafting. 62 patients presented at the 6-month follow-up examination with mean percentage of total surfaces and FMBS of 18.3% ± 2.1% and 13.5% ± 2.1%, respectively. All implants were clinically stable. The 6-month mean PPD was 3.7 ± 0.3 mm. DIM of 3.3 ± 0.4 mm and PAL of ± 0.3 mm on average were recorded. Mean KT height of 3.4 ± 0.2 mm was found. In all in 13 cases, implants had to re-implanted. It was noted that maximum success rate was noticed in Exteriorized approach of zygomatic implant placement technique (99%) followed by Sinus slot technique of implant placement in zygomatic bone. (Table 1) In all treated sites, the grafting material could be visualized as a radiopaque structure in CBCT scans post-surgically and at the 6-month evaluation. The differences in average radiographic bone gain at reference level Z1 between baseline and 6 months were statistically significant (P < .0001 and P = .0023, respectively).

DISCUSSION

Generally, the studies in the literature describe the advantages of the more recent techniques in comparison with the classical technique. However, the great importance of the classic technique described by Brånemark in 1998 was to be the pioneering technique. Thus, it opened the door so that improvements could be made from subsequent surgical techniques. Corvello et al.17 aimed to compare the classical technique and the exteriorized technique in relation to the length of the drilling holes in the ZB for placement of ZIs, the most frequently used ZI length, and the most frequent position where the implants emerged in the ZB. In contrast to the approach with drilling templates, a computer-aided surgical navigation approach offers constant intraoperative visualization of the tip of the drilling bur. This enables the surgeon to precisely guide the drill to control the implant axis and ensure optimum bone use, as well as feedback regarding the accuracy of the template or the position relative to the anatomic structures.18 Schramm et al. were the first to use a navigation system for preoperative planning and intraoperative control of the insertion of ZIs, reporting the use in three patients.19 When the maxilla is severely resorbed, the concavity formed by the ridge crest is small, and the original classical technique should be used. When maxillary resorption generates a large concavity, it would be better to exteriorize the zygomatic implant. The externalized technique has fewer surgical steps than the classical and sinus slot methods, is less invasive, and reduces surgical time. It is recommended that utilization of the sinus slot technique together with the CT-based drilling guide would enhance the final results. Although the technique that uses the
computer-aided surgical navigation system approach may produce an improved precision in the clinical procedure, its use is expensive, prolongs the operation time, and is limited to centers that have the necessary equipment for the surgery. All surgical techniques showed a high success rate, between 92.0% and 99.0%. The lowest success rate found with the minimally invasive approach by the use of custom-made drill guides (92.0%) was influenced by the three ZIs lost in the same patient in the study of Stiévenart and Malevez.20 The externalized technique could be considered one of the best surgical approaches, as it has fewer surgical steps than the classical and sinus slot methods, is less invasive, and reduces surgical time. Concerning the technique that uses customized drill guide produced by stereolithography, one study demonstrated that the use of the ZI, in the context of this protocol, should probably be reevaluated because some large deviations were noted. Thus, it is recommended that utilization of the sinus slot technique together with the CT-based drilling guide would enhance the final results. Although the technique that uses the computer-aided surgical navigation system approach may produce an improved precision in the clinical procedure, its use is expensive, prolongs the operation time, and is limited to centers that have the necessary equipment for the surgery.

CONCLUSION

Preference for one technique over the other should take into consideration the concavity formed by the ridge crest, maxillary sinus, and region of implant insertion in the Zygomatic Bone.

REFERENCES


TABLES

Table 1- Zygomatic implants: success rate with respect to the surgical technique

<table>
<thead>
<tr>
<th>Surgical techniques</th>
<th>Success</th>
<th>Failure</th>
<th>% success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classical/Bränemark approach</td>
<td>18</td>
<td>2</td>
<td>98.1%</td>
</tr>
<tr>
<td>Sinus slot technique</td>
<td>20</td>
<td>2</td>
<td>98%</td>
</tr>
<tr>
<td>Exteriorized approach</td>
<td>15</td>
<td>1</td>
<td>99.0</td>
</tr>
<tr>
<td>Minimally invasive approach by the use of custom-made drill guides</td>
<td>25</td>
<td>4</td>
<td>92.0</td>
</tr>
<tr>
<td>Computer-aided surgical navigation system approach</td>
<td>10</td>
<td>3</td>
<td>96.5</td>
</tr>
</tbody>
</table>