

Zygomatic Implants for the Management of the Severely Atrophied Maxilla: A Retrospective Analysis of 244 Implants

Humberto Fernández, DDS,* Andrés Gómez-Delgado, DDS,†
Sergio Trujillo-Saldarriaga, DDS,‡ Daniel Varón-Cardona, DDS,§
and Jaime Castro-Núñez, DMD||

Purpose: The aim of this investigation was to describe the surgical techniques, success rate, prosthetic rehabilitation, complications, and demographics of patients undergoing zygomatic implant surgery.

Patients and Methods: A retrospective case series study design was implemented that included patients who received zygomatic implants identified in the database of the Department of Oral and Maxillofacial Surgery, Universidad El Bosque from 2009 to 2013. Contact information was retrieved from the charts and patients were asked to attend the department for a follow-up appointment. The population consisted of all patients found in the database and the sample included otherwise healthy patients living in Bogotá, Colombia. Predictor variables were categorized into patient's medical history, demographics, surgical technique, and prosthetic rehabilitation. The outcome variable was the presence or absence of postoperative complications. Smokers, diabetics, and patients living outside Bogotá were excluded. Patients also were excluded if their medical status had changed since zygomatic implant surgery. Descriptive statistics were computed for each study variable.

Results: Data of 95 patients were retrieved. The sample consisted of 80 patients in whom 244 implants were inserted. The sample's mean age was 55.5 years. One hundred eleven zygomatic implants were placed in women and 133 were placed in men, with an overall complication rate of 9.9%, with sinusitis the most frequent complication (7.5%). Other complications included paresthesia (0.4%) and oroantral fistula (0.4%). The follow-up period was 6 to 48 months.

Conclusions: This investigation reviewed the authors' 4-year experience placing zygomatic implants and proved a reliable method for the treatment of the resorbed maxilla.

© 2014 American Association of Oral and Maxillofacial Surgeons
J Oral Maxillofac Surg 72:887-891, 2014

A moderately to severely resorbed maxilla represents a challenge to functional occlusal rehabilitation because of the lack of alveolar bone, which impedes the retention of a conventional prosthesis. To resolve this impasse, dentists have developed several techniques, such as bone grafting, dental implants, sinus lifting, Le Fort I osteotomy with interpositional bone grafting, pterygoid implants, and zygomatic implants (ZIs).¹

In 1998 Brånemark et al² presented their experience with ZIs. This method was originally developed for patients who had undergone maxillary resection owing to malignant conditions and needed retention for an obturator. Since then, the zygomatic fixture has been used in patients with advanced maxillary bone loss and, although the edentulous population has decreased in recent years, mainly owing to public

Received from the Universidad El Bosque, Bogotá, Colombia.

*Director, Oral and Maxillofacial Surgery Residency Program; Head, Department of Oral and Maxillofacial Surgery, Clínica El Bosque; Head, Department of Craniomaxillofacial Surgery, Hospital Simón Bolívar, Bogotá, Colombia.

†Resident, Department of Oral and Maxillofacial Surgery.

‡Resident, Department of Oral and Maxillofacial Surgery.

§Resident, Department of Oral and Maxillofacial Surgery.

||Chief Resident, Department of Oral and Maxillofacial Surgery.

Conflict of Interest Disclosures: None of the authors reported any disclosures.

Address correspondence and reprint requests to Dr Fernández: Departamento de Cirugía Oral y Maxilofacial, Universidad El Bosque, Carrera 7 B Bis No 132-11. Código Postal 110121, Bogotá, Colombia; e-mail: humfer_co@yahoo.com

Received October 14 2013

Accepted December 21 2013

© 2014 American Association of Oral and Maxillofacial Surgeons

0278-2391/14/00065-2\$36.00/0

<http://dx.doi.org/10.1016/j.joms.2013.12.029>

health politics, factors such as aging, premature loss of teeth, metabolic diseases, and large maxillary resections contribute to the atrophy of the maxillary bone seen in many current patients.

Notwithstanding the universal acceptance of ZI placement as a reliable technique for the rehabilitation of the severely resorbed upper jaw, there is a deficiency of scientific information regarding the population in which this fixture is placed, survival rate, prosthetic rehabilitation, and complications associated with this procedure. To the very best of the authors' knowledge, there is no a single investigation published in the English-language literature on this specific topic pertaining to the Hispanic American population.

With those elements in mind, the authors aimed at identifying the demographics, surgical techniques, success and survival rates, prosthetic rehabilitation, and complications associated with ZIs placed at the Department of Oral and Maxillofacial Surgery, Universidad El Bosque (Bogota, Colombia) from August 2009 through August 2013.

Patients and Methods

STUDY DESIGN AND SAMPLE

To fulfill the purpose of this research, the authors designed and implemented a retrospective case series study design that included patients who received ZIs identified in the database of the Department of Oral and Maxillofacial Surgery, Universidad El Bosque from August 2009 through August 2013. The population was composed of all patients found in the database. The study sample included all patients who presented for clinical and radiographic evaluations at a follow-up visit.

Otherwise healthy patients living in the Bogota area were included in this study. Patients were excluded as study subjects if they did not reside in the Bogota area and if their medical status had changed since ZI placement. Other exclusion criteria were diabetes, drug abuse, and systemic alterations affecting the gnathic system. Patients with controlled hypertension were not excluded. The senior author (H.F.) inserted all fixtures with the assistance of an oral and maxillofacial surgical resident. The surgeon performed the clinical and radiographic evaluations.

This retrospective case series investigation observed the Declaration of Helsinki on medical protocol and ethics and the ethical review committee guidelines of Universidad El Bosque.

STUDY VARIABLES

- *Medical history.* Patient health status was determined according to the American Society of Anesthesiology (ASA) classification system (ASA I to

ASA V). For anamnesis, the authors searched for immunosuppression, cardiovascular conditions, liver disease, and diabetes. In the habits section, the authors recorded smoking, drinking habits, and drug abuse.

- *Demographics.* Included were gender and age at the time of implant surgery. Colombian regional background also was recorded.
- *Type of surgical technique implemented.* Information regarding the surgical approach used was recorded.
- *Implant success and survival rates.* The following information was registered: date of ZI surgery; restoration placement; implant mobility, as documented by the clinician; pain lasting longer than 3 months (chronic); infection, defined as the presence of purulent exudate or a documented diagnosis of infection requiring the use of an antibiotic agent; radiolucency associated with the fixture; and impaired wound healing.
- *Prosthetic rehabilitation.* The type of prosthetic rehabilitation implemented (hybrid or overdenture) was recorded.
- *Complications.* Complications were classified into 2 main categories: intraoral and extraoral. The date of the complication (when present) was documented. Intraoral complications were defined as those occurring within the anatomic limits of the oral cavity.

OUTCOME VARIABLES

The principal outcome variable was the presence or absence of complications after the insertion of ZIs. After recording the complication date, complications were grouped into intraoral or extraoral categories.

DATA COLLECTION

Once the contact information of each patient was recovered, those patients living in the Bogota area were requested to make a follow-up appointment. Patients were asked to attend with an anteroposterior radiograph at a specific date and time. The surgeon (H.F.) assessed all patients.

ANALYSIS

Descriptive statistics (mean, frequency, range, and standard deviation) were computed for each study variable using Excel (Microsoft, Redmond, WA).

Results

Ninety-five patients with ZIs were seen at the Department of Oral and Maxillofacial Surgery, Universidad El Bosque from August 2009 through August

2013. Fifteen patients were excluded from the study owing to relocation, change of medical status since hardware insertion, drug abuse, presence of medical conditions affecting the gnathic system, and tobacco use. As presented in Table 1, the final sample consisted of 80 patients (40 women and 40 men) in whom a total of 244 ZIs were installed. One hundred eleven implants were placed in women (45.5%) and 133 were placed in men (54.5%), with an overall complication rate of 9.9%, with sinusitis showing highest prevalence (7.5%). The sample's average age was 55.5 years (range, 25 to 75 yr). The median duration of follow-up was 27 months (range, 6 to 48 months). All patients were partially or totally edentulous in the upper jaw with severe atrophy.

MEDICAL HISTORY AND DEMOGRAPHICS

The overall frequencies of patients according to their ASA classification at the time of surgery were 91.25% for ASA I and 8.75% for ASA II. Although all

Table 1. SUMMARY OF PATIENTS WITH ZYGOMATIC IMPLANTS IDENTIFIED AT THE DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY, UNIVERSIDAD EL BOSQUE FROM 2009 TO 2013

Variables	Result
Patients (n = 80)	
Men	40
Women	40
Zygomatic implants	
Total inserted	244
In men	133 (54.5%)
In women	111 (45.5%)
Follow-up (mo), median (range)	27 (6-48)
Surgical technique	
Brånemark approach	29 (36.25%)
Brånemark approach and lower antrostomy	51 (63.75%)
Prosthetic rehabilitation	
Hybrid	100%
Complications	
Overall	9.9%
Intraoral complications	1.2%
Orosinusual fistula	1 (0.4%)
Vestibular cortical fenestration	1 (0.4%)
Implant loss	1 (0.4%)
Extraoral complications	8.7%
Maxillary sinusitis	6 (7.5%)
Subcutaneous malar emphysema	2 (0.8%)
Infraorbital nerve paresthesia	1 (0.4%)

Fernández et al. Zygomatic Implants in Atrophied Maxilla. J Oral Maxillofac Surg 2014.

80 patients lived in Bogota or in its vicinity, they were born or raised in 1 of the 5 regions of Colombia: Caribbean zone, Pacific Coast, Orinoquia, Andean zone, or Amazonia.

TYPE OF SURGICAL TECHNIQUE IMPLEMENTED

All ZIs were inserted according to the classic approach described by Brånemark et al² in 1998. Of note, in cases 30 to 80, a lower antrostomy was performed as a prophylactic maneuver to prevent sinusitis after ZI placement. The most recent patient (case 80) was a 55-year-old man in whom a diagnosis of skeletal Class III anomaly and severe maxillary atrophy was made. This patient was treated by a Le Fort I osteotomy to correct the aforementioned skeletal anomaly and the maxillary advance was fixed with 4 ZIs (this case will be presented in a different article).

IMPLANT SUCCESS AND SURVIVAL RATES

Although osseointegration in the zygomatic bone is difficult to assess, in the present series no fixture was considered fibrously encapsulated. Of all 244 ZIs inserted, there was only 1 case of implant loss, which represents 0.4%. No patient developed chronic pain or infection as a consequence of ZIs surgery. All patients healed uneventfully and all fixtures met the prosthetic standards for rehabilitation.

PROSTHETIC REHABILITATION

The overall prosthetic rehabilitation rate was 100%. All patients achieved restoration with hybrid prostheses.

COMPLICATIONS

The overall frequency of complications was 9.9%. Intraoral complications accounted for 1.2% of all complications and included 1 case of orosinusual fistula (0.4%), 1 case of vestibular cortical fenestration (0.4%), and 1 case of implant loss (0.4%). Extraoral complications represented 8.7% and included 6 cases of sinusitis (7.5%), 2 cases of subcutaneous malar emphysema (0.8%), and 1 case of infraorbital nerve paresthesia (0.4%). The 2 cases of subcutaneous malar emphysema resolved spontaneously. The cases of vestibular cortical fenestration and orosinusual fistula were treated with rotational local flaps.

Discussion

The oral and maxillofacial surgical residency program at Universidad El Bosque is Colombia's leading institution for the placement of ZIs. At this department the principal author (H.F) has documented one of the largest series of ZIs in Hispanic America. With this vast experience in mind, the authors sought to identify the

demographics, surgical techniques, success and survival rates, prosthetic rehabilitation, and complications associated with ZIs.

This research included 80 patients from all areas of Colombia (40 women and 40 men) in whom a total of 244 zygomatic fixtures were installed. Men received 54.5% of all ZIs, and women received 45.5%. The sample's mean age was 55.5 years. Regarding the complication rate, intraoral complications accounted for 1.2% and those categorized as extraoral represented 8.7%, of which sinusitis was found most frequently. The follow-up period was 6 to 48 months. The success rate of patients with restoration was 100%.

ZI surgery offers an interesting alternative for the rehabilitation of the moderately to severely resorbed maxilla. According to many investigators,¹⁻¹⁴ this is possible not only because the zygomatic bone is a solid place in which to anchor hardware for the attachment of dental prostheses, but also because of its physical properties. The zygomatic bone is composed of regular trabeculae and compact bone with an osseous density of 98%, which is in juxtaposition to the usually insolvent quality of bone of the posterior maxilla.³

Rehabilitation of the edentulous maxillary bone by ZIs can be achieved using a 1-stage⁴ or 2-stage⁵ protocol. With the 1-stage technique, Balshi et al,⁴ reported a survival rate of 96% over a period of 9 months to 5 years. In contrast, Davó⁵ reported a survival rate of 89.9% after 5 years of follow-up. The present investigation yielded a survival rate of 99.5% (243 of 244) over a period of 6 to 48 months, which is comparable to the results published by Balshi et al,⁴ Davó,⁵ Bedrossian et al,⁶ Malevez et al,⁷ Brånemark et al,⁸ and Hirsch et al.⁹

Reported complications with ZIs are maxillary sinusitis,¹⁰ implant failure,¹¹ neurosensory disturbances,¹¹ and speech difficulties.¹² In the present series, complications were maxillary sinusitis (7.5%), subcutaneous malar emphysema (0.8%), orosinus fistula (0.4%), vestibular cortical fenestration (0.4%), infraorbital nerve paresthesia (0.4%), and hardware loss (0.4%). This rate of complications is in agreement with most clinical studies, in which maxillary sinusitis is the complication found most frequently.^{13,14}

Another aspect that must be addressed is the implementation of a lower antrotomy, which was used as a prophylactic intraoperative maneuver to lower the risk of developing maxillary sinusitis. The reported incidence of sinusitis after ZI placement ranges from 0%⁶ to 26.6%,¹⁵ and when it occurs, it is usually treated with antibiotics. To the best of the authors' knowledge, there is only 1 previous report of the use of an inferior meatal antrotomy to treat recurrent sinusitis after ZI placement. In fact, it was Brånemark et al⁸ who in their 2004 article reported this method in 4 patients with recurrent sinusitis. Patients were reported free of sinusitis after performing an inferior antrotomy.

Inflammation of the maxillary sinus interferes with its normal drainage, causing mucus retention, decreased mucociliary clearance, and predisposition to bacterial growth. Diagnosis is made through clinical and imaging evaluations. Clinical signs include congestion, cough, and purulent nasal discharge lasting longer than the usual 5 to 10 days of a viral upper respiratory tract infection. The aims of sinusitis treatment are to eliminate the infection, decrease inflammation, promote sinus drainage, and improve sinus ostial patency.¹⁶

The ZI, anatomic conditions of the patient, or variables related to the surgical technique, ie, perforation of the sinus membrane, may act as local factors that contribute to the development of maxillary sinusitis.^{10,11,15} Although there is no scientific evidence supporting a cause-and-effect relation between ZIs and the development of maxillary sinusitis, during recent years some techniques have been introduced to avoid this tedious complication.¹⁷⁻¹⁹

This report presented the results of a retrospective analysis of 244 ZIs inserted in 80 Colombian patients, which makes this research one of the largest series published in the English language about ZIs in a Hispanic American population. Many researchers, clinicians, oral and maxillofacial surgical residents, and even patients around the world may find this information useful when considering ZIs as a rehabilitation option.

In conclusion, this investigation confirms that the zygomatic bone offers a predictable anchorage for fixed prostheses in patients in whom the maxilla is severely resorbed. Therefore, ZI surgery seems a reliable and predictable method for the treatment of these types of patients. By publishing this material, the authors wanted to present their clinical outcomes with this relatively new method. Patients from all regions of Colombia in need of ZIs will keep coming to the authors' institution because it is a national center of reference. This status allows the authors the opportunity to design other clinical and experimental studies in which they can search for answers for the many unsolved questions in this field.

Acknowledgments

The authors are greatly indebted to the Department of Oral and Maxillofacial Surgery, Universidad El Bosque in Bogota, Colombia. Many thanks to Dr Mauricio Montero-Aguilar for his methodologic assistance; Dr Paula Ramírez-Arce, resident, Department of Oral and Maxillofacial Surgery, Universidad El Bosque for sharing her printed material related to ZIs; and Glenna Castro-Núñez for her amazing job with the artwork. They also thank their patients for their cooperation.

Press Release

This article's Press Release can be found, in the online version, at <http://dx.doi.org/10.1016/j.joms.2013.12.029>.

References

1. Chrcanovic BR, Abreu MH: Survival and complications of zygomatic implants: A systematic review. *J Oral Maxillofac Surg* 17:81, 2013
2. Brånemark PI: Surgery and fixture installation. *Zygomaticus fixture clinical procedures* (ed 1). Göteborg, Sweden, Nobel Biocare AB, 1998
3. Gosain AK, Song L, Capel CC, et al: Biomechanical and histologic alteration of facial recipient bone after reconstruction with autogenous bone grafts and alloplastic implants: A 1-year study. *Plast Reconstr Surg* 101:1561, 1998
4. Balshi SF, Wolfinger GJ, Balshi TJ: A retrospective analysis of 110 zygomatic implants in a single-stage immediate loading protocol. *Int J Oral Maxillofac Implants* 24:335, 2009
5. Davó R: Zygomatic implants placed with a two-stage procedure: A 5-year retrospective study. *Eur J Oral Implantol* 2:115, 2009
6. Bedrossian E, Stumpel L, Beckely ML: The zygomatic implant: preliminary data on treatment of severely resorbed maxillae. A clinical report. *Int J Oral Maxillofac Implants* 17:861, 2002
7. Malevez C, Abarca M, Durdu F, et al: Clinical outcome of 103 consecutive zygomatic implants: A 6-48 months follow-up study. *Clin Oral Implants Res* 15:18, 2004
8. Brånemark PI, Gröndahl K, Öhrnell LO, et al: Zygoma fixture in the management of advanced of advanced atrophy of the maxilla: Technique and long-term results. *Scand J Plast Reconstr Surg Hand Surg* 38:70, 2004
9. Hirsch JM, Öhrnell LO, Henry PJ, et al: A clinical evaluation of the zygoma fixture: One year of follow-up at 16 clinics. *J Oral Maxillofac Surg* 62:22, 2004
10. Aparicio C, Ouazzani W, Garcia R, et al: Prospective clinical study on titanium implants in the zygomatic arch for prosthetic rehabilitation of the atrophic maxilla with a follow-up of 6 months to 5 years. *Clin Implant Dent Relat Res* 8:114, 2006
11. Bedrossian E: Rehabilitation of the edentulous maxilla with the zygoma concept: A 7-year prospective study. *Int J Oral Maxillofac Implants* 25:1213, 2010
12. Bothur S, Garsten M: Initial speech problems in patients treated with multiple zygomatic implants. *Int J Oral Maxillofac Implants* 25:379, 2010
13. Maló P, Rangert B, Nobre M: "All-on-four" immediate-function concept with Brånemark System® implants for completely edentulous mandibles: A retrospective clinical study. *Clin Implant Dent Relat Res* 5:2, 2003
14. Chrcanovic BR, Nogueira MH: Survival and complications of zygomatic implants: A systematic review. *J Oral Maxillofac Surg* 17:81, 2013
15. Becktor JP, Isaksson S, Abrahamsson P, et al: Evaluation of 31 zygomatic implants and 74 regular dental implants used in 16 patients for prosthetic reconstruction of the atrophic maxilla with cross-arch fixed bridges. *Clin Implant Dent Relat Res* 7:159, 2005
16. Meltzer EO, Charous BL, Busse WW, et al: Added relief in the treatment of acute recurrent sinusitis with adjunctive mometasone furoate nasal spray. *J Allergy Clin Immunol* 106:630, 2000
17. Stella JP, Warner M: Sinus slot technique for simplification and improved orientation of zygomaticus dental implants: A technical note. *Int J Oral Maxillofac Implants* 15:889, 2000
18. Malo P, de Araujo Nobre M, Lopez IA: A new approach to rehabilitate the severely atrophic maxilla using extramaxillary anchored implants in immediate function: A pilot study. *J Prosthet Dent* 100:354, 2008
19. Aparicio C, Ouazzani W, Hatano N: The use of zygomatic implants for prosthetic rehabilitation of the severely resorbed maxilla. *Periodontology* 2000 47:162, 2008