

Rehabilitation of Atrophic Posterior Maxilla With Zygomatic Implants: Review

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The objective of this study was to review the published literature to evaluate treatment success with zygomatic implants in patients with atrophic posterior maxilla. Studies from 1987 to 2010 were reviewed. In each study, the following were assessed: indications for treatment, number of patients, number of implants, length and diameter of the implants, surgical technique, prosthetic rehabilitation, success rate, complications, and patient satisfaction. Sixteen studies were included, with a total of 941 zygomatic implants placed in 486 patients. The follow-up periods ranged from 12 to 120 months. Three different surgical techniques were used to place zygomatic implants: intrasinus implants with the classic sinus window technique, the sinus slot technique, and extrasinus zygomatic implants. The most common restoration used was fixed prosthesis, with either delayed loading after 3–6 months (89%–100% success) or immediate loading (96.37%–100% success). The weighted average success rate was 97.05%, and the most frequent complication was maxillary sinusitis. The general level of patient satisfaction was high. Zygomatic implants have a high success rate and constitute a suitable alternative to treat severe posterior maxillary atrophy.

Key Words: zygomatic implants, anatomic buttress, maxillary atrophy

INTRODUCTION

Severe resorption of the maxilla may prevent conventional treatment with dental implants.¹ Many alternative treatments are available, some of which use bone grafts, such as the iliac crest block bone graft, Le Fort I osteotomy, onlay-type bone grafting techniques, or maxillary sinus lift procedures in the posterior sectors of the maxilla. These techniques have a number of disadvantages: the need for multiple surgeries; the use of extraoral donor areas (eg, iliac crest or skull), which involve extra morbidity; and the length of time the patient has to spend without oral rehabilitation waiting for graft consolidation and healing.^{1–3,10} An alternative solution is to place implants in the zygomatic bone.

These implants, introduced by Branemark in 1988, permit the amount of bone grafting to be reduced in patients seeking a permanent solution with a minimum number of surgeries and the shortest possible treatment, without reducing expectation for success.^{1–16}

Rehabilitation with zygomatic implants requires sufficient bone volume in the anterior maxilla, with a minimum height of 10 mm and width of 4 mm, to allow placement of 2–4 conventional implants.^{2–4,6} If the volume of bone in the anterior region is insufficient, then the ideal conditions must be provided for bone grafting and guided bone regeneration.²

The objective was to review the literature published in the past 6 years reporting clinical series of at least 15 patients treated with zygomatic implants. Indications for treatment, surgical technique, prosthetic rehabilitation, success, complications, and patient satisfaction levels were assessed.

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DOI: 10.1563/AAID-JOI-D-10-00126

MATERIALS AND METHODS

A data search was performed of the PubMed electronic database for clinical series published between 1987 and 2009, having at least 15 patients with atrophic posterior maxilla (class IV and V Cadwood and Howell), and treated with zygomatic implants, in which success was assessed at a minimum of 12 months of follow-up. The search terms used were *zygomatic implants and implants in zygomatic bone*.

The selected keywords appeared in 225 articles. Abstracts were read by selecting only 102 clinical case articles and excluding the articles with fewer than 15 patients and a follow-up period less than 12 months, leading to a final 18 articles.

For each study, the following criteria were assessed: indications for treatment, number of patients, number of implants, length and diameter of the implants, surgical technique, prosthetic rehabilitation, success rate, complications, and patient satisfaction.

RESULTS AND DISCUSSION

Sixteen studies were included, providing a total of 941 zygomatic implants placed in 486 patients. The implant lengths ranged from 30 to 52.5 mm, and the diameters ranged from 3.75 mm to 4.5 mm. The follow-up period ranged between 12 and 120 months.

Indications

Zygomatic implants are indicated for the treatment of severe maxillary atrophy, in combination with conventional implants in the anterior area.¹⁻¹⁵ They are also an adequate solution for patients with maxillary resections^{10,11} and with systemic pathology causing severe maxillary atrophy such as cleft palate¹⁰ or epidermolysis bullosa.¹⁵

Some studies excluded patients with prior sinus pathology,^{2,6} metabolic disorders, or uncontrolled disease.¹⁰ The only exception was the study by Kahnberg et al,¹³ which included patients with previous sinus pathology (14%), obtaining a 96% success rate after placing 145 zygomatic implants in 76 patients and observing the greatest number of complications of all the studies reviewed.

Some authors included smokers,^{1-3,5-7,13,15} with some specifying the number of cigarettes smoked per day.^{2,3,5,7,15} Davo et al⁵ and Peñarrocha et al¹⁵

included patients who smoked fewer than 10 cigarettes a day, obtaining a 100% success rate. Aparicio et al^{3,7} and Pi et al² included patients smoking more than 10 cigarettes a day, obtaining success rates of 100% and 96.04%, respectively.

Surgical procedure

General anesthesia with local anesthesia was used in most studies,^{1-7,9,10,12,13} but Peñarrocha et al^{8,15} used local anesthesia and conscious intravenous sedation for this type of procedure.

The studies reviewed reported 3 different surgical techniques for placement of zygomatic implants: intrasinus implants with the classic sinus window technique,^{2,4-6,9,11-14,17,18} intrasinus implants with the sinus slot technique,^{8,10,15} and extrasinus implants.^{1,3,7}

The classic sinus window technique consists of exposing the frontolateral face of the zygomatic bone and creating a 10- × 5-mm window in the sinus to visualize the implant trajectory.^{2,6,13} The weighted average success was 96.6%.

Subsequently, in 2000, Stella and Warner¹⁹ developed the sinus slot technique. This technique improves visualization of the implant positioning, reduces sinus complications and postoperative symptoms, and allows a more buccal positioning of the implant head, thus facilitating prosthetic restoration. The weighted average success was 97.8%.

A new technique is currently being developed that involves placing extrasinus zygomatic implants by fixing them to the lateral sinus wall and the zygomatic bone. Aparicio et al^{3,7} observed higher primary stability than with the classic technique since the implant is fixed to a larger amount of cortical bone. Maló et al¹ used this technique to place 67 implants in 29 patients, obtaining 98.5% success. The weighted average success was 99.2%.

Prosthetic rehabilitation

The most widely used prosthetic restoration by all authors was the cemented or screwed fixed prosthesis.^{1-3,5-10,12-15} Success rates between 90.03% and 100% were obtained after 12 to 120 months of follow-up. Landes et al⁴ rehabilitated 15 patients using overdentures, with a success rate of 89% after 13-102 months of follow-up.

Implants are most frequently loaded 3-6 months after placement. Ten of the studies used delayed

TABLE 1
Clinical case series of zygomatic implants

Authors	Patients	Number of Implants	Technique	Follow-up	Success Rate, %
Branemark et al ¹⁴	28	52	Sinus window	60–120	94.3
Hirsch et al ¹⁶	66	124	Sinus window	12	97.9
Ferrara and Stella ¹⁰	16	25	Sinus slot	—	96
Becktor et al ¹²	16	31	Sinus window	69	90.3
Davo et al ⁵	18	36	Sinus window	29	100
Aparicio et al ⁹	69	131	Sinus window	60	100
Kahnberg et al ¹³	76	145	Sinus window	36	96.3
Peñarrocha et al ⁸	23	44	Sinus slot	12	97.7
Boyes-Varley et al ¹¹	20	40	Sinus window	69	100
Peñarrocha et al ¹⁵	21	40	Sinus slot	12–45	100
Aparicio et al ⁷	25	47	Extrasinus	24–60	100
Aparicio et al ³	20	36	Extrasinus	36–48	100
Pi et al ²	54	101	Sinus window	72	96.1
Maló et al ¹	29	67	Extrasinus	18	98.5
Balshi et al ⁶	56	110	Sinus window	60	96.4
Landes et al ⁴	15	36	Sinus window	13–102	89
Johansson et al ¹⁷	44	61	Sinus window	12–60	98.8
Stiévenart et al ¹⁸	20	80	—	40	96
	552 patients	1082 implants			Weighted averaged success 96.7%

loading, with high success rates (89% to 100%). More recently, some authors^{1,3,5} have recommended immediate loading, obtaining success rates of 96.4% to 100%. Immediate loading is a clinical reality, and good clinical outcomes have been reported for all indications, especially in totally edentulous arches. The advantages for the patient are obvious since only 1 surgical procedure is needed and immediate esthetics and function are possible. The reason for the good results reported may be because of careful patient selection and concern about primary stability.^{5,7}

Success rates

There are no specific criteria for assessing the success of zygomatic implants, but most authors^{2,3,5–14} considered mobility, pain, or infection in the implants after prosthetic loading, the absence of peri-implant radiolucency, and favorable prosthetic positioning.^{1–16} The weighted average success for these criteria in the 15 studies was 97.05% (Table 1).

Landes et al⁴ placed 36 implants in 15 patients and obtained an 89% success rate after an average follow-up of 8.5 years, whereas Peñarrocha et al¹⁵ obtained 100% success placing 40 zygomatic implants in 21 patients after a follow-up of 12 to

45 months. Aparicio et al^{3,7,9} achieved a 100% success rate in 3 clinical series with 36, 46, and 131 implants and a follow-up period of 24 to 60 months.

Complications and Level of Satisfaction

The most common complication was maxillary sinusitis, appearing in 8 of the 15 studies with a frequency of 1.85% to 18.42%.^{1,2,5,9,10,12,13,15} In all cases, antibiotic treatment was used, and the sinusitis resolved without further complications. The highest percentage of sinusitis was presented by Kahnberg et al,¹³ whose series included 14% of patients with prior sinus disease.

Other less frequent complications were minor sinus membrane perforation,¹⁷ gingival infections,^{8,12,13,16} fistula,⁷ lip laceration,⁹ paresthesia,^{9,13,16} implant loss,^{1,2,4,6,8,12–14,16} and fractures of prosthesis^{2,7,9,13,16} (Table 2). Pi et al² had 1 fracture of a prosthesis with 2 distal zygomatic implants and 3 anterior implants. The other authors did not specify the number of implants in the anterior sector.

Patient satisfaction levels were evaluated in 6 studies, showing a high level of overall satisfaction, with minimal problems regarding hygiene and function. Becktor et al¹² found problems with prosthetic hygiene and gingivitis in 10 patients.

TABLE 2
Complications of zygomatic implants

Authors	Complications
Branemark et al ¹⁴ Hirsch et al ¹⁶	— 1.5% sinus pain 7.5% fistula 12.2% gingivitis 9.1% nerve abnormalities 13.6% fracture prosthesis
Ferrara and Stella ¹⁰ Becktor et al ¹²	— 9.7% sinusitis 56.3% local infection
Davo et al ⁵ Aparicio et al ⁹	5.5% sinusitis 4.3% sinusitis 8.7% facial hematoma 7.2% lip laceration 8.7% paresthesia 11.6% gingival inflammation 9.2% fracture prosthesis
Kahnberg et al ¹³	3.3% infection, redness, and swelling around the implants 18.4% sinusitis 3.9% fistula 1.3% paresthesia 13% fracture prosthesis
Peñarrocha et al ⁸ Boyes-Varley et al ¹¹ Peñarrocha et al ¹⁵ Aparicio et al ⁷ Aparicio et al ³ Pi et al ²	— Complications for tumor removal 9.5% sinusitis 20% fracture prosthesis — 1.8% sinusitis 1.8% fracture prosthesis
Maló et al ¹ Balshi et al ⁶ Landes et al ⁴ Johansson et al ¹⁷ Stiévenart et al ¹⁸	13.7 % sinusitis — — 6.8% sinus membrane perforation —

These authors did not specify the number of patients with gingivitis and peri-impact on, so we cannot obtain any specific percentage of this problem. Peñarrocha et al⁸ obtained an overall average satisfaction level of 90% in a study on satisfaction of patients rehabilitated with zygomatic implants (parameters evaluated were esthetics, function, ease of hygiene, comfort, and stability).

CONCLUSIONS

Zygomatic implants are a suitable alternative for the treatment of severe posterior maxillary atrophy. Three different surgical techniques exist for placing zygomatic implants: the sinus window technique (classic), the sinus slot technique, and the procedure for extrasinus zygomatic implants. The fixed prosthesis was the most common rehabilitation type.

The weighted average success is 97.05%, and maxillary sinusitis was the most common complication, ranging from 1.5% to 18.42%.

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