Zygomatic Implants Using the Sinus Slot Technique: Clinical Report of a Patient Series

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Purpose: *The management of 5 patients with extreme maxillary atrophy and treatment consisting of maxillary fixed prostheses supported by conventional implants and zygomatic fixations positioned according to the sinus slot technique is reported.* ***Materials and Methods:*** *A total of 16 conventional implants were placed, together with 2 pterygoid implants and 10 zygomatic fixations. In 2 cases zygomatic fixation could not be performed on the alveolar ridge, thus requiring palatal displacement. One patient presented nasogenian ecchymosis. The fixed rehabilitations were either screwed or cemented after 5 to 6 months.* ***Results:*** *Follow-up from implantation lasted 12 to 18 months, during which the prostheses and implants remained stable and in function.* ***Discussion:*** *The placement of zygomatic fixations based on the sinus slot technique offers advantages over the conventional technique, though extreme atrophy of the alveolar processes does not allow fixation at the supracrestal level, and complications may develop.* ***Conclusion:*** *While zygomatic fixation is a valid alternative for treating the atrophic jaw, long-term studies are required to confirm its efficacy.* Int J Oral Maxillofac Implants 2005;20:788–792

Key words: *atrophic maxilla, dental implants, sinus slot technique, zygomatic implants*

In 1998, Brånemark and colleagues[1] introduced zygomatic implants for the rehabilitation of atrophic maxillae. Their prospective study of 62 patients with a follow-up of 1 to 10 years involved a new implant design ranging from 30 to 50 mm in length. As early as 1993, Aparicio and associates[2] mentioned zygomatic bone as a location for the definitive anchoring of dental implants. Years later these same authors published their work with transzygomatic implants in 29 patients.[3]

Since the description of zygomatic fixation by Brånemark,[1] a number of researchers have endeavored to improve the technique. Uchida and colleagues[4] carried out morphometric measurements in corpses and described the implant lengths and angulations required to avoid perforation of the maxillary sinus and temporal fossa. Bedrossian and Stumpel[5] in turn developed a technique to simplify the clinical procedures and shorten the duration of treatment. In 2000, Stella and Warner[6] presented zygomatic implantation based on the sinus slot technique, which improves upon a number of aspects of the original technique, such as implant orientation, elimination of the sinus window, and the reduction of postoperative symptoms. Recently, Boyes-Varley and associates[7] described surgical modifications to the Brånemark zygomaticus protocol. They placed 77 implants with a modified head angulation of 55 degrees in 45 patients as close to the crest of the edentulous ridge as possible, thereby improving access and ensuring ideal positioning of the restorative head.

This report presents 5 patients with extreme maxillary atrophy subjected to rehabilitation using zygomatic implants placed according to the sinus slot technique described by Stella and Warner.[6]

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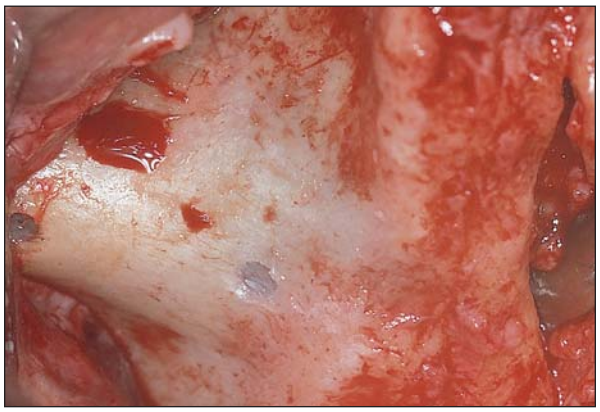
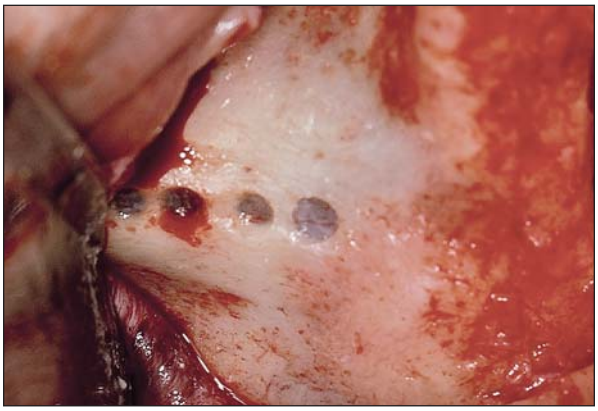
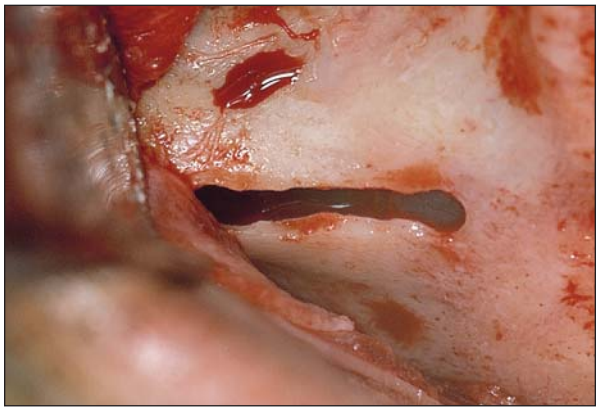


Fig 1a *(Right)* Case 3. A full-thickness flap is raised to visualize the zygomatic arch. A rounded tungsten carbide drill was used to prepare a hole in the lateral wall of sinus at the upper extreme of the contour of the zygomatic buttress. The zygomaticus implant depth gauge was placed in the hole and positioned to simulate the angle of approach of the implant twist drill. Several holes were made on this line above the crest of the ridge.

Figs 1b and 1c *(Below)* Case 3. A slot is made connecting the 2 holes.





MATERIALS AND METHODS

Presurgical Evaluation

All adult, fully grown patients who were scheduled for treatment with zygomatic implants to be placed using the slot technique were consecutively enrolled in the study. Patients who presented with severe maxillary jaw atrophy were treated with zygomatic implants instead of bone grafts. No further inclusion and exclusion criteria were applied. After the prosthetic restoration, all patients were subjected to a minimum of 12 months of follow-up.

Five patients were treated; 1 smoked a pack of cigarettes a day, and 1 patient presented a history of prior serious illness (hypohidrotic ectodermal dysplasia). The required radiographic studies included panoramic radiographs and computerized tomographic scans in the preoperative evaluation of these patients to identify the anatomic structures and detect the presence of pathology.

Surgical Protocol

Surgery was performed under sedation and involved blood pressure, pulse, and oximetric monitoring by an anesthetist. A crestal incision was made from third molar to third molar, with releasing incisions in the second molar area. Under extraoral bimanual control, the periosteal elevator was guided over the lateral aspect of the zygomatic body in a superior and lateral direction toward the zygomatic arch. The palatal mucosa was reflected so that only the crest of the ridge was exposed. A rounded tungsten carbide drill was used to prepare a hole in the lateral wall of the maxillary sinus at the upper extreme contour of the zygomatic buttress (Fig 1a). The zygomaticus implant depth gauge was placed in the hole and positioned to simulate the angle of approach of the implant twist drill. A second hole was made on this line 5 mm above the crest of the ridge. A slot was then made connecting the 2 holes (Figs 1b and 1c). A rounded drill was used to mark the implant anchoring zone on the maxillary crest at the first molar level. Through this perforation the first 2.9-mm drill was introduced and directly visualized through the prepared sinus slot (Figs 2a to 2c). The drill was advanced superiorly toward the junction of the lateral orbital rim and zygomatic arch. In the same way, the 3.5-mm pilot drill and 3.5-mm twist drill were also directed through the center of the sinus slot. The depth of the preparation was again confirmed with the zygomaticus implant depth gauge, and the appropriate length implant was chosen.

In each patient, 2 Brånemark System zygomatic implants (Nobel Biocare, Göteborg, Sweden) were

Fig 2a Case 2. View of the vestibular slot in the maxilla.

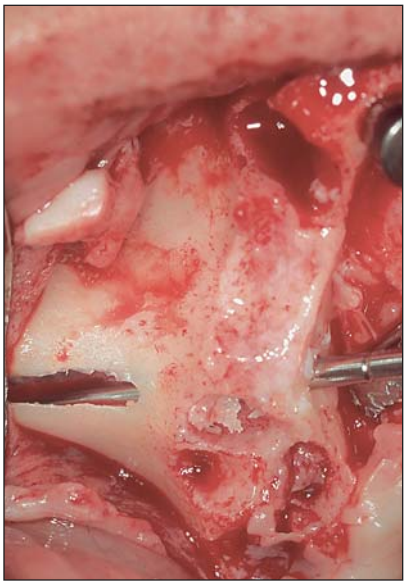


Fig 2b Case 2. Perforation over the alveolar crest and drill trajectory over the previously created slot in the direction of the base of the zygomatic process of the jaw.

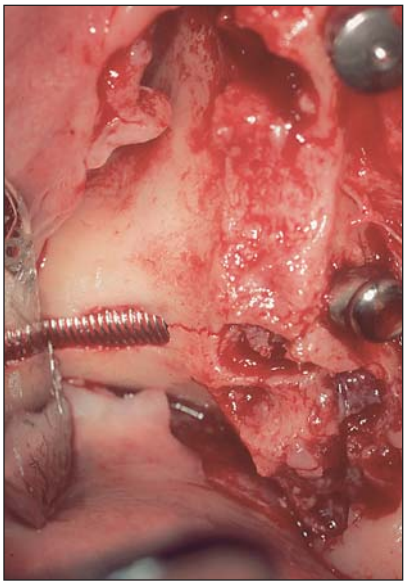


Fig 2c Case 2. Zygomatic implant placement.

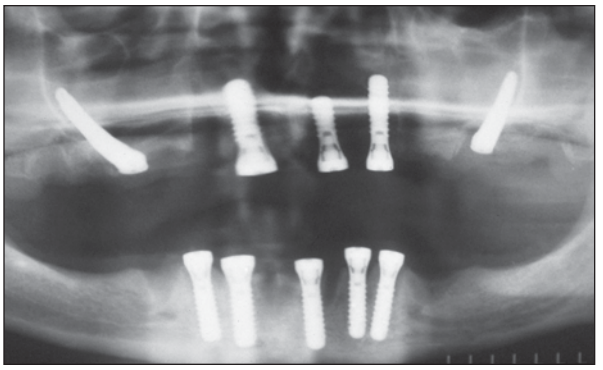


Fig 3a Case 2. Radiographic view of the implants. The pterygoid and zygomatic implants and the 3 anterior implants can be seen.

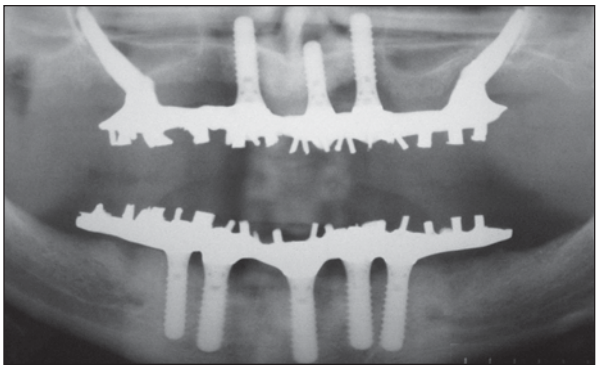


Fig 3b Case 2. Panoramic radiograph showing the maxillary bar on the zygomatic implants and the 3 anterior implants. In the mandible the bar is supported by 5 interforaminal implants.

positioned, based on the sinus slot technique, and complemented with Straumann threaded anterior maxillary implants (Straumann, Waldenburg, Switzerland) measuring 10 to 16 mm in length (Figs 3a and 3b). All implants were left submerged. Moreover, in case 5, 2 16-mm Straumann implants located in the pterygoid region were used. All patients received 750 mg amoxicillin every 8 hours for 7 days; 600 mg ibuprofen every 8 hours for 4 days; and 0.12% chlorhexidine rinses 3 times a day for 7 days. Examinations were made after 7, 14, 30, and 90 days.

The patients' removable dentures were used as temporary prostheses during the 5 to 6 months prior to preparation of the definitive prosthesis. Transzygomatic implant palatal zone deloading was carried out. Second-stage surgery was performed 3 months after implant placement, followed 1 month later by impression making. The definitive prosthesis was positioned 5 to 6 months after implant placement. This surgical protocol was applicable in the treatment of the following 5 patients.

RESULTS

Case 1 involved a 29-year-old male patient with hypohidrotic ectodermal dysplasia who presented with extreme atrophy of the maxilla. The patient had worn complete dentures since he was 17 years old. The restorations supported by implants with a screw-retained fixed prosthesis were still successful at the 18-month follow-up.

Table 1 Summarized Characteristics of the Patients Treated with Trans-Zygomatic Implants Based on the Sinus Slot Technique

Case	Age	Sex	Length of maxillary zygomatic implant (mm)		No. of anterior implants (lengths)	Antagonist occlusion	Follow-up (mo)	Observations
			Right	Left				
1	29	M	35	40	3 (14, 12, 12)	Overdenture	18	Hypohydrotic ectodermal dysplasia
2	52	F	30	30	3 (14, 12, 14)	Cemented fully fixed prosthesis	16	Moderate periodontal disease
3	48	M	40	35	4 (12, 14, 14, 12)	Cemented fully fixed prosthesis	15	Smoker (1 pack/dy); advanced periodontal disease
4	48	F	30	35	4 (14, 14, 14, 16)	Overdenture	14	Hysterectomy, appendectomy, hormone supplements
5	75	F	30	35	2 (12, 12)	Overdenture	12	Arterial hypertension, hypothyroidism, hypercholesterolemia; on multiple medications; presented with nasogenian ecchymosis; two 16-mm-long pterygoid implants also placed

Case 2 concerned a 52-year-old woman subjected to removal of all her remaining maxillary teeth because of periodontal disease. She wore a cemented fixed mandibular prosthesis. The postoperative course following implant placement was uneventful. Five months after the first surgery, a screw-retained fully fixed prosthesis was fabricated.

Case 3 was the case of a 48-year-old man who smoked of 1 pack of cigarettes a day and had advanced periodontal disease. Four anterior Straumann implants and 2 transzygomatic implants were positioned. The implants were loaded with a screwed fully fixed prosthesis 6 months after implant placement.

Case 4 involved a 48-year-old woman with a history of hysterectomy, appendectomy, and hormone replacement therapy. A screw-retained fixed prosthesis was fabricated 5 months after implant placement.

Case 5 concerned a 75-year-old woman with arterial hypertension, hypothyroidism, and hypercholesterolemia; she was on multiple medications. Following implant surgery, she presented with bilateral nasogenian ecchymosis that subsequently descended to the submandibular and anterior cervical region and resolved 14 days after the operation. Definitive prosthetic rehabilitation was carried out 6 months after surgery.

During surgery, the sinus membrane was perforated in all cases; however, there were no important postoperative complications. Follow-up of the patients for 12 to 18 months revealed a lack of clinical symptoms. Table 1 shows the main characteristics of each case. In all cases substantial benefit in terms of oral function was obtained, and all patients reported improvement in self-esteem and social relations.

DISCUSSION

In patients with severe maxillary bone atrophy, a treatment option is represented by implant placement in anatomical buttresses instead of grafting.[8] For severe atrophy of the maxilla, zygomatic implants have been used to treat patients with ectodermal dysplasia,[9] maxillary defects[10] and maxillectomies,[11] and reconstruction of nasomaxillary defects.[12]

The sinus slot technique[6] incorporates a supracrestal flap from 1 tuberosity to another. This approach is less invasive than that employed in the Brånemark technique,[1] thereby reducing postoperative edema and ecchymosis.

According to Stella and Warner,[6] the sinus slot technique allows a more vertical orientation of fixation with respect to the occlusal plane. This approach is more convenient from the prosthetic point of view than the original technique,[1] in which emergence is located palatally in the first or second premolar zone. In 2 of the presented patients marginal atrophy was extreme, with a narrow alveolar crest, thus requiring the zygomatic implants to be placed slightly palatally in the region of the maxillary first molars. Boyes-Varley and associates[7] also placed implants as close to the crest of the edentulous ridge as possible, which reduced the buccal cantilever and improved tongue space and access for maintenance. Without a window in the maxillary sinus, bone loss is reduced and surgery is shortened, though perforation of the sinus membrane is not avoided.

Because of the bone atrophy of the treated patients, the residual bone was found particularly in

the anatomical buttresses, at the canine prominence level as recommended by Mattsson and coworkers,[13] in the pterygomaxillary region,[8] and in the zygomatic arch.[1]

An 80% success rate for a series of 52 pterygoid implants has been reported by Tulasne,[14] while Balshi and Wolfinger[8] reported a success rate of 88.2% from a sample of 356 implants. In 1998, Pi[15] reported a 97.2% success rate for 177 implants, and Raspall and Rodriguez[16] reported success for 99% of 238 implants.

A high success rate for zygomatic implants has also been reported. Brånemark and colleagues[1] reported a 97% survival rate in 164 implants that had been followed for 1 to 10 years. Aparicio and Malevez[3] reported the successful placement of 58 implants and provided a review of the technique and preparation of prostheses. Bedrossian and associates[17] placed a total of 44 zygomatic implants and 80 premaxillary implants in 22 patients and found success rates of 100% for the zygomatic implants and 91.25% success rate for the premaxillary implants after 34 months of follow-up.

CONCLUSION

Zygomatic implants, when placed in conjunction with premaxillary implants, can facilitate the surgical rehabilitation of patients presenting with severe maxillary resorption. Zygomatic fixation via the sinus slot technique offers a valid alternative for maxillary rehabilitation in patients presenting with limited bone availability and provides advantages over the original Brånemark technique for zygomatic implants. The procedure is not without complications, and further studies are required to evaluate the long-term outcomes.

REFERENCES

1. The Zygomaticus Fixture: Clinical Procedures. Göteborg, Sweden: Nobel Biocare, 1998.
2. Aparicio C, Brånemark P-I, Keller EE, Olive J. Reconstruction of the premaxilla with autogenous iliac bone in combination with osseointegrated implants. Int J Oral Maxillofac Implants 1993;8:61–67.
3. Aparicio C, Malevez C. El implante trans-zigomático. Revista del Ilustre Consejo General de Colegios de Odontólogos y Estomatologos de España 1999;4:171–184.
4. Uchida Y, Goto M, Katsuki T, Akiyoshi T. Measurement of the maxilla and zygoma as an aid in installing zygomatic implants. J Oral Maxillofac Surg 2001;59:1193–1198.
5. Bedrossian E, Stumpel LJ III. Immediate stabilization at stage II of zygomatic implants: Rationale and technique. J Prosthet Dent 2001;86:10–14.
6. Stella JP, Warner M. Sinus slot technique for simplification and improved orientation of zygomaticus dental implants: A technical note. Int J Oral Maxillofac Implants 2000;15:889–893.
7. Boyes-Varley JG, Howes DG, Lownie JF, Blackbeard GA. Surgical modifications to the Brånemark Zygomaticus protocol in the treatment of the severely resorbed maxilla: A clinical report. Int J Oral Maxillofac Implants 2003;18:232–237.
8. Balshi TJ, Wolfinger GJ. Analysis of 356 pterygomaxillary implants in edentulous arches for fixed prothesis anchorage. Int J Oral Maxillofac Implants 1999;14:398–406.
9. Balshi TJ, Wolfinger GJ. Treatment of congenital ectodermal dysplasia with zygomatic implants: A case report. Int J Oral Maxillofac Implants 2002;17:277–281.
10. Parel SM, Brånemark P-I, Ohrnell LO, Svensson B. Remote implant anchorage for the rehabilitation of maxillary defects. J Prosthet Dent 2001;86:377–381.
11. Tamura H, Sasaki K, Watahiki R. Primary insertion of implants in the zygomatic bone following subtotal maxillectomy. Bull Tokyo Dent Coll 2000;41:21–24.
12. Block MS, Salinas T. Reconstruction of a nasomaxillary defect with traditional and infraorbital zygomaticus implants: Report of a case. J Oral Maxillofac Surg 2002;60:1362–1366.
13. Mattsson T, Köndell PA, Gynther GW, Fredholm U, Bolin A. Implant treatment without bone grafting in severely resorbed edentulous maxillae. Int J Oral Maxillofac Implants 2000;15:722–730.
14. Tulasne JF. Osseointegrated fixtures in the pterygoid region. In: Worthington P, Brånemark P-I (eds). Advanced Osseointegration Surgery: Applications in the Maxillofacial Region. Chicago: Quintessence, 1992:182–188.
15. Pi J. Implantes en la región pterigomaxilar: Estudio retrospectivo con seguimiento de 1 a 10 años. RCOE 1998;4:339348.
16. Raspall G, Rodriguez J. Implantes pterigoideos. RCOE 1998;5:461–467.
17. Bedrossian E, Stumpel L, Beckerly M, Indersano T. The zygomatic implant: Preliminary data on treatment of severely resorbed maxillae. A clinical report. Int J Oral Maxillofac Implants 2002;17:861–865.