Immediate/Early Loading of Zygomatic Implants: Clinical Experiences after 2 to 5 Years of Follow-up

Carlos Aparicio, MD, DDS, MSc;* Wafaa Ouazzani, DDS;† Arnau Aparicio, DDS candidate;‡ Vanessa Fortes, DDS, MSc;† Rosa Muela, DDS, MSc;† Andres Pascual, DDS, MSc;† Maria Codesal, DDS, MSc;† Natalia Barluenga, DDS, MSc;† Monica Franch, MD, DDS, MSc†

ABSTRACT

Background: Conventional prosthetic treatment of the edentulous and resorbed maxilla with zygomatic implants is a lengthy procedure. Today, immediate/early loading is a clinical reality and it is possible that such protocols could be used also for zygomatic implants.

Purpose: The aim of the present study is to report on the clinical outcomes of immediate/early loading of zygomatic implants for prosthetic rehabilitation of edentulous and severely resorbed maxillary cases.

Materials and Methods: A total of 47 zygomatic and 129 regular implants were placed in 25 consecutive patients with total ($N = 23$) or partial ($N = 2$) edentulism in the maxilla. The patients had less than 4 mm of available bone height and width distal to the canine pillars. Straight and angulated abutments and impression copings were attached to the implants during surgery. Impressions and bite registrations were made and 19 patients received a bridge within 24 hours and six patients were rehabilitated within 5 days. Screw-retained full arch restorations were used in 23 patients and cemented in 2 patients. The patients were instructed for a soft diet during 4 months. Follow-up controls were performed at 1, 4, and 12 months and thereafter annually. All patients were followed for at least 2 years and up to 5 years in function.

Results: All zygomatic implants were stable during the follow-up (cumulative survival rate 100%). One regular implant placed in the pterygoid plate failed after 52 months of loading (cumulative survival rate 99.2%). Apart from fracture of one abutment screw and of anterior teeth in five patients, no other complications were noted.

Conclusions: Within the limitations of the present study, it is concluded that immediate/early loading is a viable treatment modality for prosthetic rehabilitation of the severely resorbed maxilla using zygomatic and conventional implants.

KEY WORDS: clinical study, edentulous maxilla, immediate loading, resorption, zygomatic implants

INTRODUCTION

Severe resorption of the maxilla may preclude routine treatment with dental implants for support of a fixed bridge because of the lack of bone for implant integration. There are several treatment options for these cases, including bone grafting and the use of zygomatic implants. The Brånemark zygomatic fixture was originally developed for prosthetic rehabilitation of cases with extensive defects of the maxilla caused by tumor resections, trauma, and congenital defects.[1] The bone of the zygomatic arch was used for anchorage of a long fixture that together with ordinary fixtures could be used as anchorage for epistheses, prostheses, and obturators.[2,3] Since then the technique has been widely used in cases with severe atrophy of the maxilla.[4–10] A typical totally edentulous case is treated with one zygomatic implant on each side, going from the palatal aspect of the first to the second premolar region, through the

*Private practice, Clinica Aparicio, Barcelona, Spain, and Department of Biomaterials, Institute for Clinical Sciences, Sahlgrenska Academy, Gothenburg University, Gothenburg, Sweden; †private practice, Clinica Aparicio, Barcelona, Spain; ‡Universidad Europea Madrid, Spain

Reprint requests: Dr. Carlos Aparicio, Clínica Aparicio, Mitre 72-74 b, 08017 Barcelona, Spain; e-mail: carlos@clinicaaparicio.com

DOI 10.1111/j.1708-8208.2008.00134.x

maxillary sinus and into the body of the zygomatic bone, and with additional regular implants in the premaxilla. Today, the technique is well documented and a recent review of studies including 1,143 zygomatic implants showed a survival rate of 98.4% after a follow-up from 6 months to 10 years.[11] Implant treatment of the maxilla was often a lengthy procedure with healing periods of 6 to 8 months prior to loading, and the trend now is to reduce or even to eliminate healing periods. Immediate/early loading is a clinical reality and good clinical outcomes have been reported on all indications and especially on totally edentulous arches.[12] The advantageous for the patient are obvious since only one surgical procedure is needed and the patient will get an instant esthetic appearance as well as immediate function is possible. The reasons for the good results reported may be because of careful patient selection and concern about primary stability. It can also be because that the implants can be placed in an arch form that counteracts bending forces. According to the present authors' experiences,[10] high primary stability can also be achieved with zygomatic implants and it is possible that an early loading protocol could be used also for this implant.

The aim of this study is to report on the 2 to 5 years experiences of using an immediate/early loading protocol for regular and zygomatic implants to rehabilitate the severely atrophic maxilla.

MATERIALS AND METHODS

Patients

The study group consisted of 25 consecutive patients (12 females/13 males, mean age 48 years, range 34–78 years) with need of prosthetic rehabilitation because of missing teeth in the maxilla. All patients were healthy. Thirteen patients were smokers; all smoked more than 10 cigarettes/day. Twelve patients were diagnosed as bruxers.

Inclusion criteria:

- The presence of residual alveolar crest with less than 4 mm in width and height, immediately distal to the canine pillar that precluded the use of regular implants.
- The possibility to place regular implants in the anterior regions in order to get an arch form distribution of zygomatic and regular implants.

Exclusion criteria:

- General and local health conditions that prevented the use of general anesthesia and/or intraoral surgery.

Surgical and Prosthetic Procedures

The presurgical radiographic examinations included computed tomography scans and orthopantomograms.

The patients were treated under general anesthesia and with local injections of lidocain/epinephrine. Patients were given antibiotics prior to surgery. Crestal and posterior vestibular releasing incisions were made and mucoperiosteal flaps were raised to expose the alveolar crest, the lateral wall of the maxillary sinus, and the inferior rim of the zygomatic arch. A retractor was used to ensure good visibility of the zygomatic bone. The zygomatic implant site was planned by striving for placing the implant head at or near the top of the crest, usually in the second premolar/first molar regions using either a classical intra-sinus path (seven patients) or a novel extra-sinus path (18 patients).[13] For the latter technique, the implant body should preferably engage the lateral bone wall of the maxillary sinus while entering the zygomatic bone. The implant site was prepared without making an opening to the maxillary sinus and followed the standard drilling steps for zygomatic implants as described elsewhere.[1, 10] Additional conventional implants were placed in the anterior regions and in some cases also posterior to the zygomatic implants. A total of 47 zygomatic implants (Nobel Biocare AB, Gothenburg, Sweden), in lengths from 35 to 52.5 mm, were placed (Table 1). A total of 129 conventional implants, with lengths from 7 to 18 mm and in diameters of 3.75 and 4.0 mm (Nobel Biocare AB, Gothenburg, Sweden), were used (Table 2). The zygomatic implants had a turned surface whereas the regular implants had an

TABLE 1 Number and Length of Zygomatic Implants

Length (mm)	Number
35	3
40	4
42.5	10
45	16
47.5	6
50	4
52.5	4
Total	47

TABLE 2 Number and Position of All Implants

Position of Implants	Number
Zygomatic arch (Z)	47
Canine regions (R)	42
Pterygoid plate (R)	10 (1)
Incisive regions (R)	56
Premolar and molar regions (R)	21
Total	176

Failed implant in parenthesis.
R = regular implants; Z = zygomatic implants.

oxidized surface (TiUnite™, Nobel Biocare AB). Abutments, straight or angulated (Multiunit Abutment®, Nobel Biocare AB) in different lengths, were connected to the implants together with sterile impression copings. The wound was closed by suturing. Impressions of both jaws and bite registration were made immediately following surgery in order to manufacture a provisional fixed bridge. The patients were prescribed postoperative antibiotics and analgesics.

Nineteen patients received a temporary bridge within 24 hours, and six patients received the definitive metal-resin bridge within 5 days. For the former group, the definitive metal-resin bridge was delivered 4 to 6 months after surgery. A screw retained full arch restoration was used in 23 patients and two patients received partial cemented bridges. The patients were instructed for a soft diet during 4 months.

Removal of sutures and check-up of occlusion were made 10 days after surgery.

Follow-Up

Follow-up controls were performed at 1, 4, and 12 months, thereafter annually. The check-up examinations also included assessments of oral hygiene, soft tissue health, prosthesis stability, and signs of mechanical complications. All bridges were removed for individual checking of the implants after 1 year in function. Standardized intraoral radiographs of the zygomatic implants could not be made and consequently these implants could not be evaluated with regard to marginal bone resorption.

An implant removed for any reason was counted as a failure and the implants still in function were counted as survivals.

RESULTS

The period after implant surgery was regarded as normal in all patients with some postoperative pain and swelling that could be controlled with analgesics.

All patients were followed for at least 2 and up to 5 years of loading and attended the follow-up appointments. All zygomatic implants were judged to be stable during the follow-up, giving a cumulative survival rate (CSR) of 100% (Table 3). One regular implant placed in the pterygoid plate failed after 52 months of loading, resulting in a CSR of 99.2% for the regular implants (Table 4).

There were no signs of soft-tissue infections or fistulae to the maxillary sinus. Some mechanical complications were experiences since anterior teeth fractured in five patients with metal-resin ($N = 4$) and metal-porcelain ($N = 1$) bridges. Moreover, one abutment screw of a zygomatic implant supporting a metal-resin bridge fractured in another patient after 3 years of loading.

DISCUSSION

The present clinical follow-up study demonstrated good results with immediate/early loading of 47 zygomatic and 129 conventional implants in 25 patients as no

TABLE 3 Life Table of Zygomatic Implants

Interval	Implants	Failures	Not Yet Due	Cumulative Survival Rate (%)
Placement – prosthesis	47	0	0	100
Prosthesis to 1 year	47	0	0	100
1 to 2 years	47	0	23	100
2 to 3 years	24	0	9	100
3 to 4 years	15	0	7	100
4 to 5 years	8	0	0	100
>5 years	8			

TABLE 4 Life Table of Regular Implants

Interval	Implants	Failures	Not Yet Due	Cumulative Survival Rate (%)
Placement – prosthesis	129	0	0	100
Prosthesis to 1 year	129	0	0	100
1 to 2 years	129	0	63	100
2 to 3 years	66	0	25	100
3 to 4 years	41	0	19	100
4 to 5 years	22	1	0	99.2
>5 years	21			

zygomatic, and only one regular implant was lost during a follow-up from 2 to 5 years. The results from the present study are in line with the experiences from other authors. Bedrossian and colleagues reported no loss for 28 zygomatic and 55 routine implants in 14 patients after more than 12 months.[14] In another study, Davo and colleagues lost none of 36 zygomatic but three of 68 conventional implants after a follow-up from 6 to 29 months.[15] Although the available studies are short-term investigations, the findings show that immediate/early loading is a viable treatment modality also when zygomatic implants are included in the treatment. Moreover, it is reasonable to believe that any negative effects from immediate/early loading per se should be seen soon after commencing loading and not after a long period of time. A recent review of over 1,143 zygomatic implants demonstrated a survival rate of 98.2 % after 6 months to 10 years, which is encouraging.[11] Immediate/early loading has many advantages and apart from the fact that the treatment time is reduced to a minimum and only one surgical intervention is needed, the patients do not need to wear a removable denture.

Several clinical reports have reported good outcomes with immediate/early loading of conventional implants in the totally edentulous maxilla.[16–19] For instance, Östman and colleagues reported the loss of one (0.8%) of 123 implants in 20 patients after 1 year of loading. The reasons for the good results reported may be because of careful patient selection and concern about primary stability having in mind that bone density often is low in the posterior maxilla. In fact, Östman and colleagues did use inclusion criteria based on primary stability as assessed with insertion torque and resonance frequency analysis measurements, and also took measures to improve primary stability.[16] However, in a randomized clinical study, Fischer and colleagues compared early and delayed loading during 5 years of loading using no such inclusion criteria. After 5 years of follow-up, they concluded that there were no differences between the groups.[19] It can be speculated that bending is counteracted by the arch-formed placement of the implants and that the rapid splinting of the implants diminish rotational forces to act on the implants. In the present study, the zygomatic implants had in 18 patients been placed using an extrasinus path as described elsewhere.[13] With this technique the implants were probably engaged in more bone because of a more crestal starting point and engagement of cortical bone at the lateral aspect of the maxilla. In fact, Periotest measurements revealed a high degree of primary stability for these implants.[13] Another crucial factor is probably occlusion that was carefully controlled in the present patients who also were recommended a soft diet for 4 months.

Placement of zygomatic implants should be considered a major surgical procedure and proper training is needed. Surgery is usually made in general anesthesia although recent experiences show the possibility of performing zygomatic implant placement also under local anesthesia.[11] Compared with major bone grafting it is still a less invasive technique and can be used in cases where bone grafts cannot be harvested for any reason. In situations where bone grafting of the anterior maxilla is needed, intraorally harvested grafts can be used prior to installation of zygomatic and regular implants.

Exposure of threads to the maxillary sinus membrane and cavity and in cases of extrasinus placement exposure towards the overlying buccal mucosa may pose a potential risk for development of soft tissue problems. No such complications were registered in the present study. According to the literature, sinusitis seems to

develop in 2.3 to 13.6% of cases treated with zygomatic implants.[5,9,10,20,21] Intraoral infections have been reported at a similar rate, ie, from 3.8 to 6.5%,[9,10,21,22] and in some studies from 29 to 32%.[9,20] Al-Nawas and colleagues reported that 9 of 20 zygomatic implants showed bleeding and increased probing depths that may be because of difficulties for proper hygiene caused by the positioning of the zygomatic implant head and abutment and the design of the prosthesis.[22] Other authors have described problems with recurrent sinusitis that led to removal of zygomatic implants.[9] The authors speculated that deficient osseointegration of the coronal part of the zygomatic implant had resulted in the formation of an oroantral fistulae and infection. In the present study, caution was taken to avoid extensive countersink preparation, and to avoid fracture of the thin alveolar crest during insertion. Moreover, the use, from the beginning, of the definitive abutment probably benefits the desmosomal adhesion of the soft tissue to the titanium abutment surface. Those factors may explain the absence of sinus problems.

Within the limitations of the present study, it is concluded that immediate/early loading is a viable treatment modality for prosthetic rehabilitation of the severely resorbed maxilla using zygomatic and conventional implants.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare. [Correction added after online publication 24 May 2010: Conflict of Interest Statement added.]

REFERENCES

1. Branemark PI, Grondahl K, Ohrnell LO, et al. Zygoma fixture in the management of advanced atrophy of the maxilla: technique and long-term results. Scand J Plast Reconstr Surg Hand Surg 2004; 38:70–85.
2. Parel SM, Branemark PI, Ohrnell LO, Svensson B. Remote implant anchorage for the rehabilitation of maxillary defects. J Prosthet Dent 2001; 86:377–381.
3. Weischer T, Schettler D, Mohr CH. Titanium implants in the zygoma as retaining elements after hemimaxillectomy. Int J Oral Maxillofac Implants 1997; 12:211–221.
4. Aparicio C, Branemark P-I, Keller E, Olive J. Reconstruction of the premaxilla with autogenous iliac bone in combination with osseointegrated implants. Int J Oral Maxillofac Implants 1993; 8:61–67.
5. Malevez C, Daelemans P, Adrianssens P, Durdu F. Use of zygomatic implants to deal with resorbed posterior maxillae. Periodontol 2000; 2003; 33:82–88.
6. Higuchi KW. The zygomaticus fixture: an alternative approach for implant anchorage in the posterior maxilla. Ann R Australas Coll Dent Surg 2000; 15:23–33.
7. Bedrossian E, Stumpel LJ. The Zygomatic implant; Preliminary Data on Treatment of Severely Resorbed Maxillae. A Clinical Report. Int J Oral Maxillofac implants 2002; 17:861–865.
8. Malevez C, Abarca M, Durdu F, Daelemans P. Clinical outcome of 103 consecutive zygomatic implants: a 6–48 months follow-up study. Clin Oral Impl. Res 2004; 15:18–22.
9. Becktor JP, Isaksson S, Abrahamsson P, Sennerby L. 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 2005; 7:159–165.
10. Aparicio C, Ouazzani W, Garcia R, Arevalo X, Muela R, Fortes V. A prospective clinical study on titanium implants in the zygomatic arch for prosthetic rehabilitation of the atrophic edentulous maxilla with a follow-up of 6 months to 5 years. Clin Implant Dent Relat Res 2006; 8:114–122.
11. Aparicio C, Hatano N. The use of zygomatic implants for prosthetic rehabilitation of the severely resorbed maxilla. Periodontol 2000; 2008; 47:162–171.
12. Östman PO. Immediate/early loading of dental implants. Clinical documentation and presentation of a treatment concept. Periodontol 2000; 2008; 47:90–112.
13. Aparicio C, Ouazzani W, Aparicio A, et al. Extrasinus zygomatic implants: a new surgical approach for patients with pronounced buccal concavities in the edentulous maxilla. Clin Implant Dent Relat Res 2008 (in press).
14. Bedrossian E, Rangert B, Stumpel L, Indresano T. Immediate function with the zygomatic implant: a graftless solution for the patient with mild to advanced atrophy of the maxilla. Int J Oral Maxillofac Implants 2006; 21:937–942.
15. Davo C, Malvez C, Rojas J. Immediate function in the atrophic maxilla using zygoma implants: a preliminary study. J Prosthetic Dent 2007; 97:S44–51.
16. Östman PO, Hellman M, Sennerby L.Direct implant loading in the edentulous maxilla using a bone density-adapted surgical protocol and primary implant stability criteria for inclusion. Clin Implant Dent Relat Res 2005; 7(Suppl 1):60S–69S.
17. Olsson M, Urde G, Andersen JB, Sennerby L. Early loading of maxillary fixed cross-arch dental prostheses supported by six or eight oxidized titanium implants: results after 1 year of loading, case series. Clin Implant Dent Relat Res 2003; 5(Suppl 1):81–87.
18. Fischer K, Stenberg T, Hedin M, Sennerby L. Five-year results from a randomized, controlled trial on early and

delayed loading of implants supporting full-arch prosthesis in the edentulous maxilla. Clin Oral Implants Res 2008; 19:433–441.

19. van Steenberghe D, Glauser R, Blombäck U, et al. A computed tomographic scan-derived customized surgical template and fixed prosthesis for flapless surgery and immediate loading of implants in fully edentulous maxillae: a prospective multicenter study. Clin Implant Dent Relat Res 2005; 7(Suppl 1):111S–120S.
20. Farzad P, Andersson L, Gunnarsson S, Johansson B. Rehabilitation of severely resorbed maxillae with zygomatic implants: an evaluation of implant stability, tissue conditions, and patients' opinion before and after treatment. Int J Oral Maxillofac Implants 2006; 21:399–404.
21. Hirsch JM, Ohrnell LO, Henry PJ, et al. A clinical evaluation of the Zygoma fixture: one year of follow-up at 16 clinics. J Oral Maxillofac Surg 2004; 62(9 Suppl 2):22–29.
22. Al-Nawas B, Wegener J, Bender C, Wagner W. Critical soft tissue parameters of the zygomatic implant. J Clin Periodontol 2004; 31:497–500.