Immediate Loading of Maxillary Fixed Prostheses Retained by Zygomatic and Conventional Implants: 24-month Preliminary Data for a Series of Clinical Case Reports

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Purpose: *To evaluate the success rate of immediately loaded conventional implants placed in the premaxilla in association with 2 zygomatic implants.* ***Materials and Methods:*** *All patients included had worn complete maxillary dentures for at least 2 years. They were required to have no severe systemic pathologies and could not be on any drugs. They could not have any oral infection, uncontrolled periodontal disease, sinusitis, parafunctional signs, alteration of the occlusal plane, or smoking habits. They had to be good candidates for the insertion of 4 or 5 traditional implants in the premaxilla and 2 zygomatic implants without guided bone regeneration. Primary stability had to be achieved. Impressions for prosthetic rehabilitation were made during first-stage surgery. Temporary fixed cross-arch prostheses were inserted 12 to 24 hours after surgery. Permanent cross-arch screw-retained prostheses were placed after 6 months.* ***Results:*** *Seven patients met all the inclusion criteria and were enrolled in the study (Caucasian, 4 males and 3 females, mean age 56.8 years). In total, 14 zygomatic and 34 conventional implants were placed. The survival rate for zygomatic and conventional implants and fixed prostheses was 100% after 24 months of functional loading.* ***Conclusion:*** *The preliminary results are encouraging, but the long-term clinical prognosis remains to be determined.* (Case Series)
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Key words: *edentulous maxilla, immediate loading, resorbed maxilla, single-stage surgery, zygomatic implants*

The number of edentulous patients is rising as the elderly population increases,[1] and consequently, implant-retained prostheses are increasingly in demand. Because of bone quality and anatomic conditions, the edentulous maxilla may at times need posterior implant anchorage for fixed rehabilitation. To attain sufficient bone for implant anchorage, the maxilla can be reconstructed using sinus lifts or onlay or inlay ridge augmentation procedures with autologous bone grafts from the iliac ridge or calvaria.[2–5] Zygomatic implants may provide an effective alternative for the rehabilitation of a severely resorbed maxilla. Even when an anterior bone graft is required, the extension of the graft in the posterior region can be avoided.[6] Moreover, when the premaxilla has sufficient bone for positioning at least 2 implants, zygomatic implants may make it possible to avoid bone grafting and the days of hospitalization necessary for the traditional maxillary ridge augmentation procedure.[7–9]

The classification of the atrophic maxilla proposed by Misch and Judy in 1987 can be used to judge whether there is sufficient bone for use of a zygo-

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matic implant.[10] Class A (bone thickness > 5 mm and height > 13 mm) or B (thickness between 2.5 and 5 mm and height between 10 and 13 mm) in the premaxilla, associated with class C (thickness < 2.5 mm and height < 10 mm) or D (severe atrophy) in the posterior regions, are the ideal conditions for the use of zygomatic implants. Esposito et al underlined the need to assess the performance of zygomatic implants when loaded immediately or early in order to evaluate another possible advantage of this type of implants: the shortening of the treatment time for patients.[11]

The guidelines proposed in previous studies exclude many patients from immediate loading of the maxilla.[12–14] Only 1 paper (a 10-month preliminary report) on immediate loading of zygomatic implants has been published.[15]

Therefore, the purpose of this study was to answer the question: Is the immediate loading of fixed cross-arch prostheses retained by 4 or 5 conventional implants in the premaxilla in association with 2 zygomatic implants a predictable therapeutic option?

MATERIALS AND METHODS

Fifteen patients were initially selected for the study. They were informed in detail of the benefits and hypothetical risks of the immediate loading procedure and were told that they would be included in the protocol only if they met rigid predetermined inclusion criteria. All gave informed consent to the treatment. The inclusion criteria consisted of the following:

- The wearing of traditional complete maxillary dentures for at least 2 years prior to this intervention
- The absence of severe systemic pathologies; no treatment with drugs
- The absence of any kind of infection in the oral cavity or uncontrolled periodontal disease (in the case of presence of teeth in the mandible)
- No previous treated or untreated episodes of sinusitis, signs or symptoms of ongoing sinus inflammation or infection, or radiographically evident alterations of the sinus mucosa
- The possibility of inserting 4 or 5 traditional implants in a premaxilla with class A or B bone quantity according to the classification of Misch and Judy[10]
- The possibility of inserting 2 zygomatic implants in a posterior maxilla with class C or D bone quantity[10]
- No signs of enamel cracks, occlusal abrasions, masseter hypertrophy, bruxism, or alteration of the mandibular occlusal plane
- The absence of a smoking habit

In addition, 3 inclusion criteria were evaluated during surgery:

- A minimum implant insertion torque of 40 Ncm
- Primary implant stability
- No guided bone regeneration necessary around any implant

No specific criterion regarding bone quality was applied. The type of mandibular dentition was not a limiting criterion.

Before surgery, type III stone casts (Dental Hydrocal; Kerr Italia, Scafati, Salerno, Italy) obtained from impressions of the edentulous maxillary ridges in irreversible hydrocolloid (Xantalgin; Heraeus Kulzer, Dormagen, Germany) and of the mandibular dentition of the patients were transferred to an articulator (Gerber Condylator, Zürich, Switzerland) using extra- and intraoral registration. It was then possible to prepare clinical acrylic resin setups using Malò et al's technique.[16]

Antibiotic prophylaxis with amoxicillin (Zimox 1 g; Pfizer, Milan, Italy) was administered by mouth the day before surgery and for 4 days thereafter (2 g/d). Surgery was performed under general anesthesia. A full-thickness mucoperiosteal flap was raised and the traditional implants were positioned in the premaxilla. The torque controller device was limited to 35 Ncm, and the torque was increased until the implants were lodged completely. The zygomatic implants were inserted following the Brånemark protocol.[8] A bony window osteotomy and sinus membrane elevation were performed using the piezoelectric technique.[17] Bone preparation and implant placement were performed under abundant saline irrigation. Angled multiunit abutments (Nobel Biocare, Göteborg, Sweden) were mounted on the zygomatic implants. Impression copings were mounted, and nonabsorbable monofilament sutures (Gore-Tex; W.L. Gore and Associates, Flagstaff, AZ) were used for flap closure (Fig 1). The impressions were taken with an open tray and a polyether material (Permadyne; ESPE, Seefeld, Germany; Fig 2). After removing the copings, healing abutments were inserted. The patients were given ice applications, 0.12% chlorhexidine digluconate mouthrinses (Plak Out; Byk Gulden, Milan, Italy), and naproxen as an anti-inflammatory and analgesic twice daily for 4 days (Synflex Forte 550 mg; Recordati, Milan, Italy). The previously prepared acrylic resin setups were adapted to provisional abutments on the stone casts (Dental Hydrocal; Kerr Italia, Scafati, Salerno, Italy) obtained from the impressions taken during surgery to construct temporary fixed cross-arch screw-retained prostheses (Figs 3 and 4).

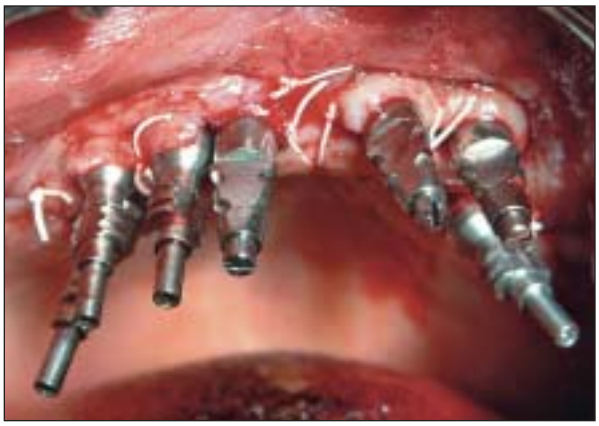


Fig 1 Sutured flap around the impression copings.

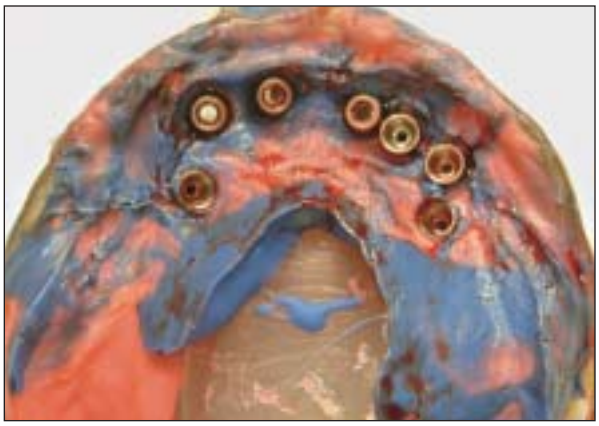


Fig 2 Impression taken at the first-stage surgery.

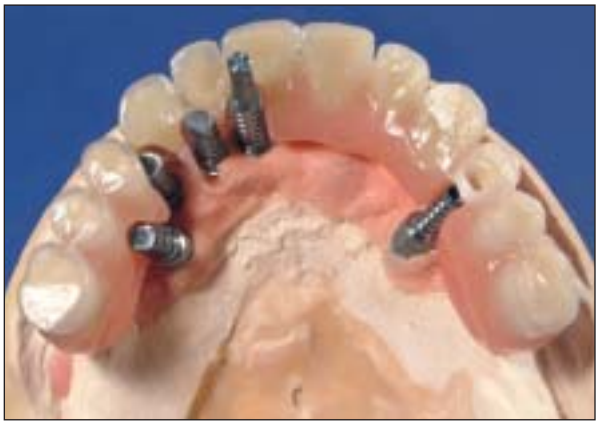


Fig 3 Setup adapted to the stone cast with provisional cylinders obtained from the impression taken during surgery.

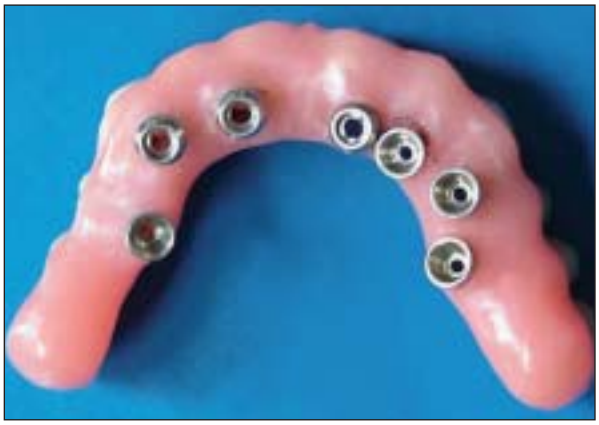


Fig 4 Temporary prosthesis: superior view.

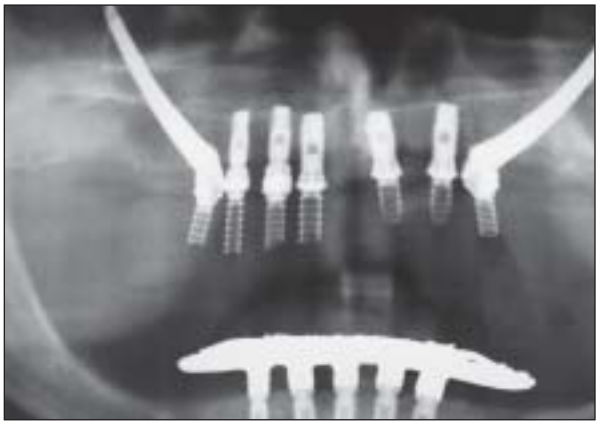
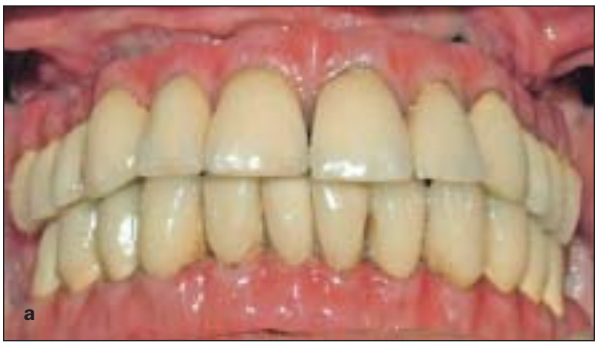


Fig 5 Panoramic radiograph taken immediately after delivery of the provisional fixed prosthesis.

Beginning 12 to 24 hours after surgery, the implants were loaded functionally. Care was taken to ensure a flat occlusal plane, group function, and well-balanced occlusal contacts.[18] The patients were asked to eat only soft food for the first month and were given instructions for correct oral hygiene. Patients were examined after 7 days to check the wounds and prostheses and to remove the sutures. Panoramic radiographs were obtained as soon as possible (Fig 5). The patients were recalled monthly to evaluate their hygiene maintenance and clinical parameters, such as pain and signs of inflammation or infection.



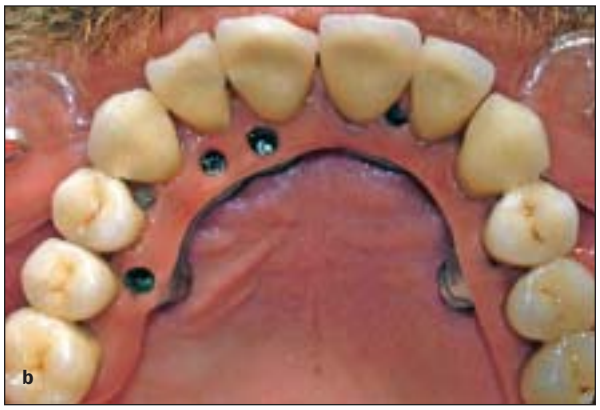


Fig 6 Complete prosthesis: *(a)* intraoral view and *(b)* occlusal view.

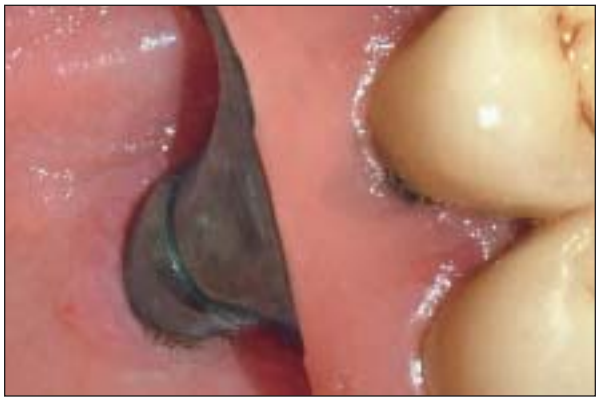


Fig 7 Gingival reaction around the abutments mounted on the zygomatic implants at 24 months. The aspect of the gingiva shows no clinical signs of inflammation. The keratinized palatal mucosa permits good, painless oral hygiene.

Permanent cross-arch screw-retained prostheses were fabricated and delivered after 6 months in accordance with the aforementioned occlusal characteristics. The patients were then recalled every 3 months (Figs 6 and 7). New panoramic radiographs were obtained 1 and 2 years after loading (Fig 8).

RESULTS

Only 7 of the 15 enrolled patients (Caucasian, 4 males and 3 females; mean age 56.8 years) met all of the study requirements. The patients were treated between December 2003 and April 2004. They received 4 or 5 conventional implants (MK III or MK IV; Nobel Biocare) in the premaxilla (n = 34) and 2 zygomatic implants (Nobel Biocare) in the posterior maxilla (n = 14; Table 1).

The survival rate of the implants and prostheses after 24 months of functional loading was 100%. No clinical problems arose around the implants; the implants remained stable, and the peri-implant tissue remained free of inflammation, suppuration, or pain. No symptoms of sinusitis were reported. No prosthetic complications occurred during the observation period, and all patients had functioning prostheses throughout the study. The patients were satisfied with the treatment. One patient initially had slight difficulty in pronouncing the letter "S" with the provisional prosthesis and later complained that maintaining good oral hygiene was difficult. No radiographic translucency around the implants was detected after 2 years of loading (Fig 6).

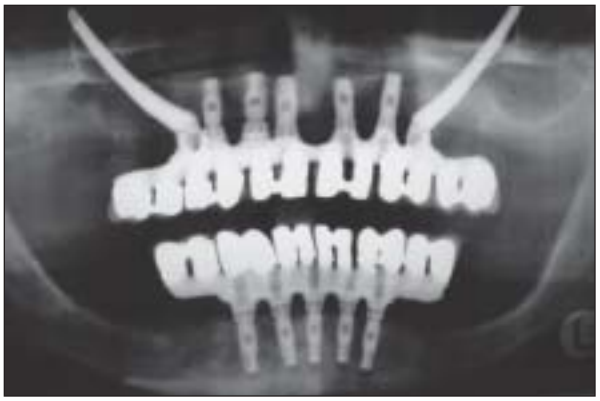


Fig 8 Panoramic radiograph obtained after 24 months of loading.

Table 1 Patient Data, Zygomatic Implant Length, and Mandibular Dentition

Patient	Age	Length of zygomatic implants in mm	No. of implants in premaxilla	Mandibular dentition
1	60	50 50	5	Removable partial denture*
2	53	50 47.5	5	Implant-retained full arch
3	48	50 47.5	5	Implant-retained full arch
4	52	35 35	5	Natural dentition
5	64	40 35	4	Implant-retained overdenture
6	59	40 40	5	Implant-retained full arch
7	62	45 45	5	Implant-retained full arch

*Class I according to Kennedy.

Table 2a Follow-up Period and Success Rate of Delayed Loading of Zygomatic Implants Associated with Traditional Implants in the Premaxilla

Author	Year	Follow-up period	% Success		No. of implants	
			Zyg	Trad	Zyg	Trad
Bedrossian[19]	2002	34 mo	100	91.2	44	80
Nakai[6]	2003	6 mo	100	–	15	–
Brånemark[8]	2004	5 to 10 y	94	73	52	106
Malevez[20]	2004	48 mo	100	91	103	194
Hirsch[9]	2004	12 mo	97.9	–	124	–
Becktor[21]	2005	9 to 69 mo	90.3	95.9	31	74

Trad = traditional; zyg = zygomatic. – indicates "not mentioned."

Table 2b Follow-up Period and Success Rate of Immediate or Early Loading of Traditional and Zygomatic Implants Supporting Maxillary Fixed Cross-arch Dental Prostheses

Author	Year	Follow-up period	% Success	No. of implants	
				Zyg	Trad
Chow[15]	2006	10 mo	100	20	10
van Steenberghe[22]	2002	12 mo	100	Not specified	Not used
Olsson[14]	2003	10 mo	93.4	61	Not used
Fischer[23]	2004	10 mo	100	95	Not used
Malò[16]	2005	6 to 12 mo	97.6	128	Not used

DISCUSSION

The preliminary data obtained from this study seem to suggest that the immediate loading of fixed cross-arch prostheses retained by 4 or 5 conventional implants in the premaxilla in association with 2 zygomatic implants is a predictable therapeutic option.

High success rates of zygomatic implants[6,8,19–21] and good, predictable results of the early and immediate loading of conventional full-arch implant-retained fixed maxillary prosthesis have been reported[14,16,22,23] (Tables 2a and 2b).

The success rate in this study can be explained by the meticulous attention paid to every phase of the surgery and prosthetic rehabilitation, the short interval between follow-up visits, and, above all, the careful patient selection. The latter requires great attention in the evaluation of general and oral risk factors, intraoral conditions, and radiographic images.[24] Nevertheless, it is difficult to determine the extent to

which each of the aforementioned factors actually contributed to the positive outcome reported here.

The large number of traditional implants placed in the premaxilla (5 in 6 patients and 4 in the seventh, for a total of 34) may have been more than necessary. Chow et al[15] placed 4 implants per patient in their protocol. However, in the present study sample, more implants were deemed essential to lessen the likelihood of prosthetic failure. The surgical interventions the patients had to undergo to obtain fixed teeth, the risks of the technique,[8,9,21] the fact that immediate loading of zygomatic implants still lacks a sound scientific background,[11] and the fact that the main complication that seems to occur with zygomatic implants is sinusitis,[9,11,20] which may develop several years after placement,[8] suggest that caution be exercised. In some cases, fixed prostheses have had to be converted into removable ones.[8,9,20] Such a large number of implants in the premaxilla probably reduces the load applied to the zygomatic implants. When the behavior of the bone around immediately loaded zygomatic implants is known in detail, it will probably be feasible to reduce the number of implants in the premaxilla. In addition, the reduction in the cantilever derived by inserting the zygomatic implants may have positive long-term effects on the distribution of the load on the implants in the premaxilla.

Radiographic evaluation criteria proposed to establish success rates[25] were recently deemed inapplicable for the case of immediate loading.[26] Nevertheless, no abnormal images or translucencies were seen around the implants in radiographs obtained 2 years after loading (Fig 6).

One of the prerequisites for immediate or early loading is high initial implant stability.[27] Studies have shown that modified implant surfaces maintain primary stability better than the machined ones.[28–31] The use of treated-surface implants (TiUnite, Nobel Biocare) may have contributed to the favorable results in this study.[32]

Another critical factor for successful immediate or early loading is control of the occlusal forces and other functional load forces. The type of dentition in the mandibular arch was not a limiting factor in patient selection for this study. As mandibular dentition, 4 of the 7 treated patients had an implant-retained full-arch prosthesis; of the remaining 3, one had an implant-retained overdenture, one had natural dentition, and one had a removable partial denture (Kennedy Class I). It was important to prosthetic success to obtain well-balanced occlusal contacts and group function. Correct occlusion helps the patient to discriminate different thicknesses and to modulate the dynamics of the mandible so as to maintain the functional load within physiologic limits.[18,33]

The guidelines proposed in previous studies exclude many patients from immediate loading of the maxilla.[12,13] Other studies have suggested that immediate or early loading be considered for patients treated with at least 6 implants in the maxilla.[14,22] A new protocol for immediate loading using 4 implants in the edentulous maxilla has been described.[16] Recently, a protocol for the immediate loading of 4 conventional and 2 zygomatic implants using template navigation was presented with a 10-month follow-up without complications or failures.[15]

From the preliminary results obtained in this study, it appears that successful immediate loading of fixed maxillary prostheses retained using conventional implants in the premaxilla in association with 2 zygomatic implants inserted to reduce the cantilever is a promising solution and a predictable therapeutic option for edentulous maxillae if a strict protocol is followed. However, given the small number (n = 7) of patients treated and the short follow-up time, caution must be used in interpreting the results. Further studies are necessary to confirm these results.

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