

Long-term Results in Placement of Screw-Type Implants in the Pterygomaxillary-Pyramidal Region

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Purpose: To present the long-term results for screw-type implants consecutively placed in the pterygomaxillary-pyramidal region in the treatment of patients with posterior maxillary edentulism. **Materials and Methods:** One hundred fifty-two implants were inserted in 92 partially edentulous patients using cylindrical osteotomes as bone-site formers, thus minimizing the use of drills in the bone preparation. **Results:** The 152 implants placed were loaded for an average of 89.7 ± 30.7 months. There were a total of 8 failures; 6 took place between implant placement and prosthesis delivery (early failures), and 2 failed in following functional loading. The overall survival rate was 94.7%. **Discussion:** Cylindrical osteotomes allow the surgeon to accurately place implants. The use of surgical drilling was minimized, resulting in lowered surgical risk and diminished bone loss. **Conclusion:** Implant placement in the posterior pterygomaxillary region using cylindrical osteotomes for osteotomy preparation resulted in an implant survival rate of 94.7%. INT J ORAL MAXILLOFAC IMPLANTS 2007;22:195–200

Key words: low-risk surgical techniques, pterygomaxillary-pyramidal region, screw-type implants, sinus grafting

Implant dentistry has become a predictable and reliable scientific method for the rehabilitation of totally¹ or partially² edentulous patients. Although implant location appears to have no significant effect on implant survival, implant fracture rate, screw loosening, or screw fracture,³ it is well known that the placement of implants in the posterior area of the maxilla may be difficult. There are a number of factors linked with this difficulty, namely the small quantity of subsinusal bone, pneumatization of the maxillary sinus, and low bone density in the maxillary tuberosity.^{4,5} This is why the establishment of predictable methods to allow implant placement in the

posterior maxilla remains a critical challenge to the clinician placing implants. The therapeutic method can vary depending on the kind of patient. In a totally edentulous patient, the degree of oral disability may be serious enough to justify aggressive techniques using general anesthesia or bone grafts (onlay,^{6,7} inlay,⁸ or Le Fort I^{9,10}). However, these techniques involve adding surgical areas and stages, with higher morbidity and long treatment periods.^{6–10} For patients with partial edentulism in the posterior maxilla, oral disability is lower. Therefore, whenever possible, the solution should be less aggressive than in totally edentulous patients. Two techniques are often described to manage this anatomic area when there is insufficient bone to allow simple implant placement. These are sinus augmentation^{11,12} and the placement of implants in the pterygomaxillary-pyramidal junction.¹³

The present study provides long-term results following placement of screw-type implants in the pterygomaxillary-pyramidal region using osteotomes to prepare the bone for implant placement.^{13,14}

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Table 1 The Patient Sample

	Age (y)		Total no.
	Mean	Range	
All patients	50.7	32–74	92
Women	50.3	32–74	50
Men	51.1	38–69	42
Patients with unilateral edentulism	51.7	32–69	32
Patients with bilateral edentulism	50.15	35–74	60

MATERIALS AND METHODS

All patients in this study were treated in the author's private practice since the initiation of the placement of implants in the pterygomaxillary-pyramidal junction in November 1990. Inclusion in this study required that (1) all surgical and prosthetic treatment be completed at the author's private practice; (2) the patient strictly follow a fixed protocol; and (3) implant placement be completed before December 2000. Patient records were reviewed to determine gender, age at implant placement, date of implant, protocol follow-up, and number of implants.

Study Protocol

A comprehensive evaluation of each patient was carried out. In addition to the usual radiographic study (panoramic radiograph, tomographies, skull side view, etc) a computerized axial tomographic (CAT) scan was needed to establish the exact location, quality, and quantity of the bone available in the described anatomic region. This preoperative study also included an occlusion assessment, a study of prosthetic space, and the fabrication of templates for radiographic and surgical positioning. Surgical technique for implant placement consisted of the consecutive use of 6 cylindrical osteotomes of increasing diameter calibrated in millimeters to form the bone site.

All the patients underwent the same postsurgical protocol. This protocol included administration of an oral antibiotic (amoxicillin 500 mg every 8 hours) and an oral nonsteroidal anti-inflammatory analgesic (ibuprofen 400 mg every 8 h) for 3 days following surgery and an examination 24 hours after the operation to assess any immediate postsurgical complications (eg, dehiscence suture, infections). On the seventh day after surgery, the suture was removed. The patients were examined monthly for 6 months. Following a radiologic study, the second surgical phase was undertaken. The clinical criteria used for success were those described by Albrektsson et al.¹⁵ All implants

were used as posterior anchorage loci for implant-supported prostheses. After prosthesis delivery, the patients were clinically and radiologically examined. Clinical examinations took place 3 and 6 months after prosthesis delivery. Clinical and radiologic examinations were conducted annually thereafter.

For the purposes of this study, failures that occurred between the first surgical stage and prosthesis delivery were considered early failures (ie, before second-stage surgery). Failures that occurred after prosthesis delivery were considered late failures. To ensure a sufficient period of functional load, the present study was carried out at the end of January 2005. Therefore, the implants investigated were under function for a minimum of 4 years.

Statistical Analysis

For statistical analysis, all continuous variables were reported as means (SD). The survival rates of implants were estimated using the Kaplan-Meier method, and the differences between the 5-year and 10-year survival curves were calculated by the log-rank test (GraphPad Prism 4.0; GraphPad Software, San Diego, CA). The multivariate Cox hazard models (SPSS v.12 for Windows; SPSS, Chicago, IL) were performed to evaluate the independent contributions of variables such as age, gender, and edentulism on the patient outcome. In addition, the cumulative success rate was calculated using the life table analysis described by Cutler and Edeler.¹⁶

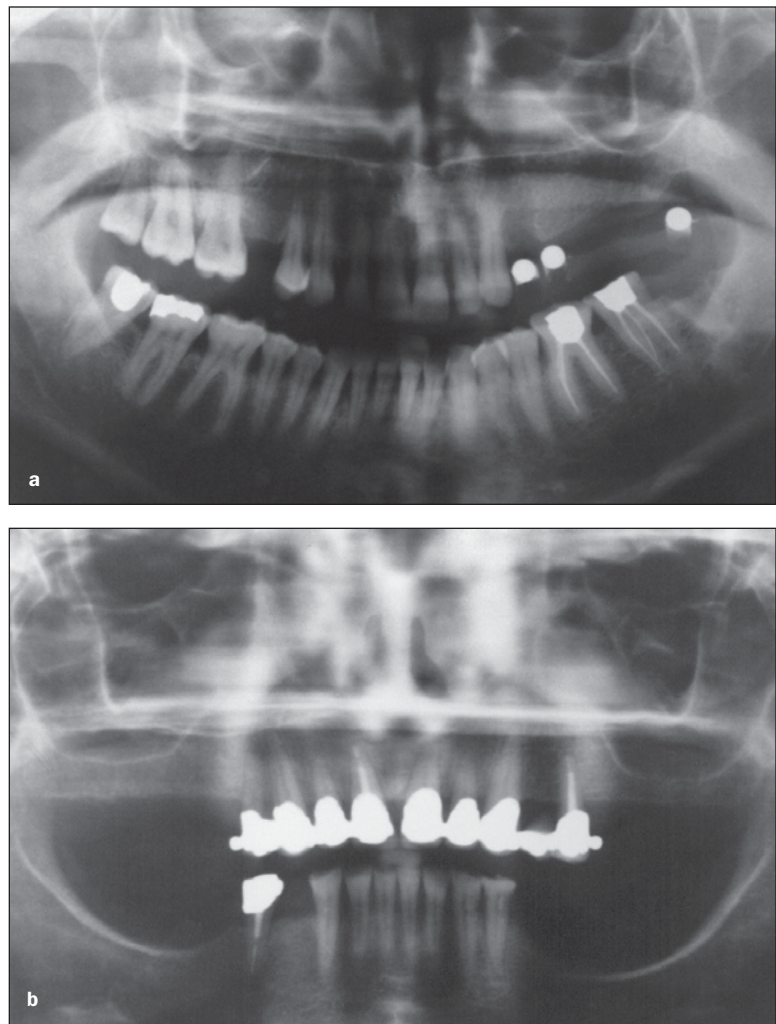
A 5-year analysis was carried out on 130 implants placed between November 1990 and December 1999, which had been loaded for 5 years at the time of this study. This analysis resulted in the evaluation of actual 5-year survival and allows its comparison with the estimated 10-year cumulative survival and success rates of the entire group of 152 implants.

RESULTS

From November 1990 to December 2000, 162 consecutive screw-type implants (Brånemark System; Nobel Biocare, Göteborg, Sweden) were placed in the pterygomaxillary-pyramidal region in 102 patients showing partial edentulism (uni- or bilateral) in the maxilla. The sample comprised 55 women and 47 men between 32 and 74 years old.

From the initial group, 10 patients have been withdrawn. Two patients died, 1 during the osseointegration period and the other 2 years after prosthesis placement; these deaths were not related to the treatment. A Muslim woman could not strictly follow the protocol because she refused to take medicines or to be examined after surgery during Ramadan.

Fig 1 Panoramic radiograph of (a) a unilaterally edentulous patient and (b) a bilaterally edentulous patient prior to implant placement.



Three patients did not attend any periodic clinical examinations after prosthesis placement. Four patients missed at least 1 periodic clinical examination after prosthesis placement. Therefore, the final number of patients considered for this study was 92 (50 women and 42 men). The age of the patients at the time of the implant placement ranged between 32 and 74 years, with a mean age of 50.7 ± 8.7 years (Table 1). A total of 152 implants were placed in these patients. Sixty presented with bilateral edentulism and 32 with unilateral edentulism (Fig 1). There was no statistical association between implant survival and patient age ($P = .14$), gender ($P = .55$), or edentulism type ($P = .39$).

The patient population was monitored for 89.7 ± 30.7 months (range, 0.1–169 months) after surgery. Of the 152 implants placed, 8 failed. Six of these failures were considered early failures. Of the 146 remaining implants, 2 failed after being subject to functional load (1 after 50 months of loading and 1 after 132 months of loading; Table 2).

The actual 5-year survival ($n = 130$) was $94.6\% \pm 1.9\%$ (Fig 2) according to the Kaplan-Meier method. The difference between the failure time curves at 5 years, 10 years or through the last follow-up examination (169 months) was not significant ($P = .79$). The 10-year cumulative success rate was similar, as shown in Table 3.

In a few cases, a more aggressive surgical technique was used to use the anteroposterior bone volume in the pterygomaxillary-pyramidal junction to best advantage to obtain optimal initial stability for the implant. In these cases, the pterygomaxillary-pyramidal region junction was completely perforated in the anteroposterior direction. Penetration extended a few millimeters in the retropterygoid area and caused slight venous bleeding, which subsided easily under local measures of hemostasis and/or implant placement. In these patients, moderate discomfort, as well as a slight limitation in mouth opening, appeared after surgery in some cases. Both easily remitted with physiotherapy and muscular relaxants.

Table 2 Distribution of Failures at the End of January 2005

	0.1 to 36 mo		36 to 64 mo		> 120 mo	
	F	M	F	M	F	M
Age (y)						
32 to 42	—	—	—	—	—	—
42 to 52	—	2	—	—	—	—
52 to 62	3	—	1	—	—	—
62 to 74	—	1	—	—	—	1
Edentulism						
Unilateral	1	—	—	—	—	—
Bilateral	2	3	1	—	—	1

M = male, F = female.

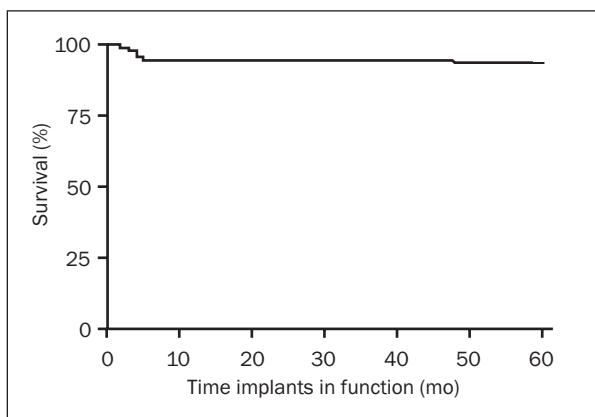


Fig 2 Kaplan-Meier analysis was performed to determine the implant survival curve for 130 implants placed between November 1990 and December 1999.

DISCUSSION

Although Eckert et al,³ in an extensive review, reported that the anatomic location of an implant has been shown to have no effect on implant survival, implant fracture rates, screw loosening, or screw fracture,³ this review stands in opposition to other reports.¹⁷⁻²⁰ There is no doubt that factors like the small quantity of subsinus bone, pneumatization of the maxillary sinus, and low bone density in the maxillary tuberosity^{4,5} may pose difficulty in the rehabilitation of patients with partial edentulism in the posterior maxilla. For such patients, where oral disability is lower, 2 therapeutic approaches are mainly carried out for the rehabilitation: either sinus augmentation^{11,12} or the placement of implants in the pterygomaxillary-pyramidal junction.¹³ The Sinus Consensus Conference of 1996²¹ concluded that the indications and contraindications of sinus augmentation should be assessed in greater depth and that the use of different combinations of graft materials in different proportions introduces variables that impede the establishment of global results that could be applied

Table 3 Cumulative Success Rate of Implants

Years	No. of implants in interval	No. failed	Success rate within interval (%)	Cumulative success rate (%)
0-1	152	6	96.05	96.05
1-2	145	0	100	96.05
2-3	140	0	100	96.05
3-4	133	0	100	96.05
4-5	123	1	99.2	95.3
5-6	112	0	100	95.3
6-7	93	0	100	95.3
7-8	72	0	100	95.3
8-9	44	0	100	95.3
9-10	10	0	100	95.3

in general terms to this kind of patient. Thus, the systematic review of survival rates for implants placed in the grafted maxillary sinus published by Del Fabbro et al²² is of great interest, since different success rates were shown in relation to the materials that were grafted.

The placement of implants in the pterygomaxillary-pyramidal junction precludes the use of graft material; the implants are anchored in the patient's pre-existing bone. Thus, numerous reports attribute to these implants success rates that are similar to or higher than those of other techniques.²³⁻²⁶

Of the 152 implants, 8 were lost in 169 months. Thus, the absolute survival rate of 94.7% shown in this group is similar to the overall survival rate reported in other studies in grafted maxillae.^{17,18}

The exhaustive statistical analysis of the data allows a deeper evaluation of clinical results in relation with the loading period. Both the 5-year and 10-year survival rates of the present study are in accordance with other reports where a similar statistical analysis was carried out.^{3,17} In this sense, the applied life table analysis reveals a high accumulative

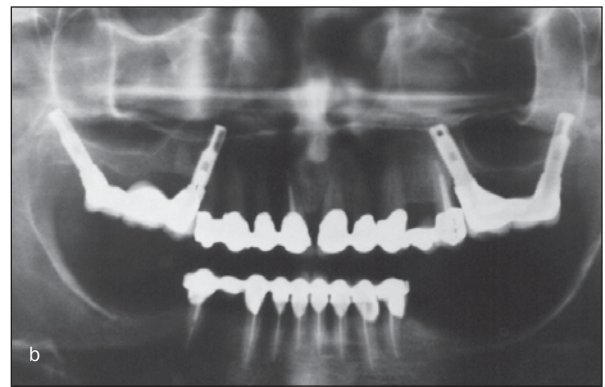
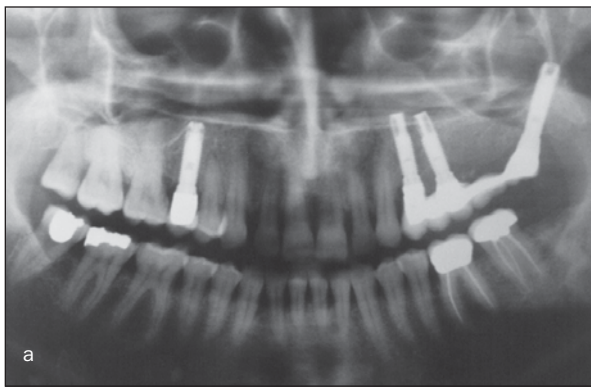


Fig 3 Images obtained after 3 years of functional loading. (a) Panoramic radiograph of a patient who was unilaterally edentulous. (b) Panoramic radiograph of a patient who was bilaterally edentulous. (c) Clinical appearance of the posterior anchorage of the prostheses.



success rate (95.3%) in this area of the maxilla¹⁹ for a 10-year period. Thus, the placement of implants in the pterygomaxillary-pyramidal region using the low-risk technique described in this study¹⁴ showed highly satisfactory clinical results. The osseointegration period (6 months) was not reduced or extended in any case, thus avoiding the introduction of uncontrolled variables in the study.

In addition, this technique can be used under local anesthesia. The use of drills was reduced to a minimum, thus saving bone and reducing surgical risks.¹⁴ Therefore, this option should be considered as the ideal therapeutic approach if one aims to use the pre-existing patient bone and avoiding grafting. Moreover, the differences between the survival time curves for 5 years, 10 years, or the entire follow-up period (169 months) were not significant ($P = .79$), because of the low incidence of late failure. Of the 152 implants placed, only 2 (1.3%) were lost after functional load, indicating that, despite the necessity for inclination, these implants perfectly supported functional load (Fig 3).

CONCLUSION

Analysis of the study presented led to the following conclusions:

1. Implant placement in the posterior pterygomaxillary region using cylindrical osteotomes for osteotomy preparation resulted in an implant survival rate of 94.7%.
2. The surgical technique presented can be carried out under local anesthesia and using the patient's pre-existing bone.
3. The low incidence of late failures (1.3%) reveals the predictability and durability of these implants as posterior anchorage loci in implant-supported prostheses in the posterior maxilla.

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