The Challenge of Endosseous Implants Placed in the Posterior Partially Edentulous Maxilla: A Clinical Report

Devorah Schwartz-Arad, DMD, PhD[1]/Eran Dolev, DMD[2]

The survival rate of implants placed in the maxillary molar area in a 2-stage procedure was evaluated. Between 1990 and 1997, 60 consecutive patients (32 females and 28 males, mean age 51 years) received 87 implants to replace missing maxillary molar teeth. Radiographs were evaluated preoperatively for bone quantity (mesiodistal width, potential implant length not compromising the integrity of adjacent vital structures). Second-stage surgery was performed in a mean of 7.9 months postimplantation. The 5-year cumulative implant survival rate and the influence of implant characteristics (type, length, diameter, and coating) on implant failure and complication rates (between the 2 stages of surgery) were evaluated. The total 5-year cumulative survival rate was 95.4% (4 implants were lost). There were a total of 17 "complications" (premature spontaneous implant exposure) in non-failing implants, 11 with high and 6 with flat cover screws, respectively. Implantation in the edentulous maxillary molar area is a predictable procedure with a considerably high survival rate. The type of implant cover screw used can affect the complication rate. (Int J Oral Maxillofac Implants 2000;15:261–264)

Key words: *implants, posterior maxilla, survival rate*

The long-term success rate of endosseous implants placed in the maxillary posterior region is inferior to that in other areas.[1–3] The disadvantages of this region include poor bone quality, close proximity of the maxillary sinus (thus making long implants impossible to place), higher occlusal loads, and the frequency of the occlusal table being wider than the implant diameter, resulting in mesiodistal and buccolingual cantilever and off-axis forces.[4]

The purpose of this study was to evaluate the 5-year cumulative survival rate (CSR) and complications of late implants placed in the posterior maxillary molar area to support fixed ceramometal prostheses.

MATERIALS AND METHODS

From 1990 to 1997, 60 patients (28 males and 32 females), aged between 25 to 77 years (mean age 51 years), presented for implant placement in the posterior maxilla. A total of 87 implants was placed to replace 87 missing maxillary molar teeth, and the surgery was performed in one clinic by the senior surgeon (DSA). Oral examination included evaluation of the intra- and interarch relationships to determine the restorative possibilities. Radiographs were evaluated for bone quantity (sufficient mesiodistal width and potential implant length not compromising the integrity of adjacent vital structures). Patients with inadequate vertical bone height inferior to the maxillary sinus were excluded (referred for sinus augmentation), and only patients with a minimum of 10 mm vertical bone height and at least 5 mm width were selected. Implants used were from 4 different manufacturers (67 Paragon, Encino, CA; 10 Steri-Oss, Nobel Biocare, Yorba Linda, CA; 7 Calcitek, Carlsbad, CA; and 3 Brånemark, Nobel Biocare). Sixty-two were commercially pure titanium screws, 18 were hydroxyapatite-coated (HA) screws, 5 were titanium plasma spray-coated screws, and 2 were HA

[1]Lecturer, Department of Oral and Maxillofacial Surgery, The Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel.
[2]Instructor, Department of Prosthetic Dentistry, The Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel.

Reprint requests: Dr Devorah Schwartz-Arad, Department of Oral and Maxillofacial Surgery, Tel Aviv University, Tel Aviv, Israel. Fax: 972-3-5497368. E-mail: dubish@post.tau.ac.il

Copyright © 2000 by Quintessence Publishing Co, Inc. Printing of this document is restricted to personal use only. No part of this article may be reproduced or transmitted in any form without written permission from the publisher.

Table 1 Enrollment Rate

Year	No. of implants	Percentage of total
1990	2	2.3
1991	2	2.3
1992	14	16.1
1993	4	4.6
1994	7	8.0
1995	8	9.2
1996	13	14.9
1997	37	42.5

Table 2 Distribution of Implants by Length and Diameter

	No. of implants
Implant length (mean, 12.46 mm)	
10 mm	30
12 mm	5
13 mm	34
14 mm	1
15 mm	4
16 mm	12
18 mm	1
Total	87
Implant diameter (mean, 3.9 mm)	
3.25 mm	1
3.75 mm	47
3.8 mm	5
4.25 mm	8
4.5 mm	3
4.7 mm	19
5 mm	4
Total	87

cylinders. There were 19 external hex and 68 internal hex-type implants.

One hour prior to surgery, amoxicillin (1 g) and dexamethasone (8 mg) were administered. For patients who were allergic to penicillin, erythromycin (0.5 mg) was the drug of choice. Amoxicillin or erythromycin was continued for 5 to 7 days postsurgery, and dexamethasone (4 mg per day) was administered for 2 additional days.

Drilling for site preparation was accomplished with standard drills (620 RPM with internal and external irrigation) in the center of the ridge. Implants were determined at the end of the surgical procedure to be clinically stable. Resorbable membranes were used together with autogenous bone grafting for 2 implant sites with buccal bone defects and implant thread exposure. Augmentation with autogenous bone without a membrane was performed for 4 implant sites that demonstrated buccal implant neck exposure.

Patients were seen at least once a month prior to second-stage surgery. Radiographs of the implant sites were taken prior to second-stage surgery, and healing caps were placed (a mean of 7.9 months after implantation, range 4 to 12 months). After varying intervals, implants were restored with a fixed prosthesis. The mean follow-up period was 31.9 months (range 3 to 100 months). The influence of gender and implant characteristics (type, length, and diameter) on complications and the failure rate was evaluated.

RESULTS

The enrollment rate of the implants is shown in Table 1. Follow-up lasted from the time of implant placement until January 1999. There were 71 first molar replacements and 16 second molar replacements. The mean implant length was 12.46 mm (range 10 to 18 mm) and the mean implant diameter was 3.9 mm (range 3.25 to 5 mm) (Table 2).

Premature spontaneous implant exposures that required the use of chlorhexidine rinses and oral antibiotics without surgical intervention were defined as minor complications. Those requiring surgical intervention for curettage and primary closure were defined as major complications.[5–8] There were 19 complications, 18 minor (20.7%) and 1 major (1.2%); 4 implants were lost (4.6%). There was no implant loss after loading (3 to 100 months follow-up). Complications were evident in 17 (20.5%) of 83 non-failing implants. Two of the 4 failing implants demonstrated minor complications (Table 3). Table 4 shows the relationship between complications and implant characteristics. For coated implants, there were 9 complications (36%) of all coated implants, versus 8 of 62 (12.9%) noncoated implants. Two types of cover screws were used: high (external hex) and flat (internal hex). Complications were evident in 11 (58%) of 19 high cover screws and 6 (8.8%) of 68 flat cover screws.

The 5-year implant CSR was 95.4% (there was no change in the CSR after the first year). The 5-year CSR among males was 92.9%, versus 93.8% among females.

DISCUSSION

The posterior maxilla is a challenging area for implant dentistry. Absolute bone loss is generally high in this region because it is affected by progressive maxillary sinus pneumatization, although knife-edged ridges are rarely found and ridge contours are

COPYRIGHT © 2000 BY QUINTESSENCE PUBLISHING CO, INC. PRINTING OF THIS DOCUMENT IS RESTRICTED TO PERSONAL USE ONLY. NO PART OF THIS ARTICLE MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM WITHOUT WRITTEN PERMISSION FROM THE PUBLISHER.

Table 3 Characteristics of Failing Implants

Subject	Time of failure (mo. post-placement)	Location	Length (mm)	Diameter (mm)	Implant type	Complications
1	13	Second molar	16	3.75	Commercially pure titanium screw	No
2	6	First molar	10	3.75	Commercially pure titanium screw	No
3	9	First molar	13	3.75	Commercially pure titanium screw	Yes
4	12	First molar	13	4.7	Commercially pure titanium screw	Yes

Table 4 Complications (Spontaneous Premature Implant Exposure) with Respect to Implant Characteristics

Implant type	Mean diameter (mm)	Mean length (mm)	High cover screw	Flat cover screw	Total
Total	4.01	12.37	11	6	17
HA-coated	4.13	12.57	7	0	7
Titanium plasma spray-coated	4.47	11.50	2	0	2
Commercially pure titanium	3.83	12.37	2	6	8

High cover screw: external hex or Spline implant cover screw; Flat cover screw: internal hex implant cover screw.

generally well rounded.[9] Poor bone mineral density in the posterior maxilla can also adversely affect initial implant stabilization because of insufficient contact between implant and bone. This could influence force transmission to the bone.[4,10,11]

An overall failure rate of 35% in Type IV quality bone has been reported.[1] The failure rate increased to 44% in Type IV bone in the maxilla, with most of the failures at second-stage surgery. Presurgical determination of Type IV bone for decreasing implant failure has been recommended. In another study[12] that examined osseointegration of dental implants with respect to their anatomic location, there was a 71.4% success rate in the posterior maxilla, compared to better results in other areas of the mouth. However, in a 5-year follow-up report on 259 implants placed in posterior partially edentulous arches, the overall cumulative survival rate was 97.2%.[13] For 732 implants placed in the posterior maxilla, the overall failure rate was 4.8% at 5 to 70 months after loading.[14] The failure rate in Type IV bone was only slightly higher than that in Types II and III bone (5.5% versus 4.6%). The failure rate in the entire molar area was 5.3%, compared with 4.5% in the premolar area (statistically insignificant).

The longitudinal clinical effectiveness of osseointegrated dental implants in posterior partially edentulous patients has been studied.[15] The overall implant survival rate was 94.3%. In a survey of 1,203 implants conducted by Nevins and Langer,[16] the use of osseointegrated implants to replace posterior teeth in partially edentulous patients was evaluated. Of 652 implants placed in the maxilla, 31 failed, for a success rate of 95.2%. In another study conducted on 1,170 endosseous implants placed in partially edentulous arches, it was concluded that implant survival was independent of anatomic location.[17] Engquist et al[2] reported a 20% failure rate of maxillary implants placed to support overdentures; 78% of the failures were in Type IV bone. Both reports suggested bone quality as a major prognostic factor for implant success.

In a multicenter prospective study,[18] a survival rate of 92.4% was reported in the maxilla over 3 years. A survival rate of 93.6% after 1 year was shown in 78 implants placed in the molar area for single-tooth replacement.[19] It was concluded that replacement of a single molar by a single implant can be a valid and successful surgical treatment modality with a high survival rate.

The present study provides further information on the outcome of implantation in the posterior maxillary region. Although the bone quality in the posterior maxilla is usually inferior to other areas of the maxilla, predictability of implant therapy for fixed prostheses seems evident by the high 5-year CSR of 95.4%.

The influence of implant surface characteristics on the survival rate of dental implants has been studied.[20] The survival rates of HA-coated and pure titanium root-form implants (a total of 390 implants) were compared during a 6-year period. Similar survival rates for both types were reported, although most of the HA-coated implants were

COPYRIGHT © 2000 BY QUINTESSENCE PUBLISHING CO, INC. PRINTING OF THIS DOCUMENT IS RESTRICTED TO PERSONAL USE ONLY. NO PART OF THIS ARTICLE MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM WITHOUT WRITTEN PERMISSION FROM THE PUBLISHER.

generally placed in Type III and IV bone. This conclusion is compatible with that of Saadoun and LeGall,[21] who recommended the use of titanium screw-type implants where bone quality is Type I. For all other situations in which bone density decreases and approaches Type IV, the use of cylindric HA-coated implants is recommended, especially in the posterior maxilla.

The results of the present study support the use of HA-coated implants in the posterior maxilla. Of 62 commercially pure titanium-screw type implants, 4 failed (survival rate of 93.5%), compared to a 100% 5-year CSR for the HA-coated and titanium plasma-sprayed implants. Two of the failed implants had previous minor complications.

Complications, or premature spontaneous exposure of submerged implants, were first classified by Schwartz-Arad and Chaushu.[5–8] Recently, a new classification was described,[22] showing that early perforation and partial exposure of the implant's covering device are a focus for plaque accumulation, which may result in inflammation and possible periimplant bone loss. In the present study, premature exposure was associated with implants having high cover screws (11 of 17 complications), compared to internal-hex implants with "flat" cover screws at the crestal level (6 of 17 complications).

CONCLUSION

Implantation in the edentulous maxillary posterior region is a predictable surgical procedure with a high 5-year survival rate of 95.4%. The type of implant used influences the likelihood of minor complications between the 2 surgical stages.

REFERENCES

1. Jaffin RA, Berman CL. The excessive loss of Brånemark fixtures in type IV bone: A 5-year analysis. J Periodontol 1991; 62:2–4.
2. Engquist B, Bergendal T, Kallus T, Lindén U. A retrospective multicenter evaluation of osseointegrated implants supporting overdentures. Int J Oral Maxillofac Implants 1988;3: 129–134.
3. Scurria MS, Morgan ZV IV, Guckes AD, Li S, Koch G. Prognostic variables associated with implant failure: A retrospective effectiveness study. Int J Oral Maxillofac Implants 1998;13:400–406.
4. Misch CE. Contemporary Implant Dentistry, ed 2. St. Louis: CV Mosby, 1999:109–118,193–204.
5. Schwartz-Arad D, Chaushu G. Placement of implants into fresh extraction sites: 4 to 7 years retrospective evaluation of 95 immediate implants. J Periodontol 1997;68:1110–1116.
6. Schwartz-Arad D, Chaushu G. Full-arch restoration of the jaw with fixed ceramometal prosthesis. Int J Oral Maxillofac Implants 1998;13:819–825.
7. Chaushu G, Schwartz-Arad D. Full-arch restoration of the jaw with fixed ceramo-metal prosthesis: Late implant placement. J Periodontol 1999;70:90–94.
8. Schwartz-Arad D, Chaushu G. Immediate implant placement: A procedure without incisions. J Periodontol 1998;69: 743–750.
9. Ulm CW, Solar P, Gsellmann B, Matejka M, Watzek G. The edentulous maxillary alveolar process in the region of the maxillary sinus—A study of physical dimension. Int J Oral Maxillofac Surg 1995;24:279–282.
10. Devlin H, Horner K, Ledgerton D. A comparison of maxillary and mandibular bone mineral densities. J Prosthet Dent 1998;79:323–327.
11. Truhlar RS, Orenstein IH, Morris HF, Ochi S. Distribution of bone quality in patients receiving endosseous dental implants. J Oral Maxillofac Surg 1997;55:38–45.
12. Drago CJ. Rates of osseointegration of dental implants with regard to anatomical location. J Prosthodont 1992;1:29–31.
13. Jemt T, Lekholm U. Oral implant treatment in posterior partially edentulous jaws: A 5-year follow-up report. Int J Oral Maxillofac Implants 1993;8:635–640.
14. Bahat O. Treatment planning and placement of implants in the posterior maxillae: Report of 732 consecutive Nobelpharma implants. Int J Oral Maxillofac Implants 1993;8: 151–161.
15. Zarb GA, Schmitt A. the longitudinal clinical effectiveness of osseointegrated dental implants in posterior partially edentulous patients. Int J Prosthodont 1993;6:189–196.
16. Nevins M, Langer B. The successful application of osseointegrated implants to the posterior jaw: A long-term retrospective study. Int J Oral Maxillofac Implants 1993;8:428–432.
17. Eckert SE, Wollan PC. Retrospective review of 1170 endosseous implants placed in partially edentulous jaws. J Prosthet Dent 1998;79:415–421.
18. Grunder U, Polizzi G, Goené R, Hatano N, Henry P, Jackson WJ, et al. A 3-year prospective multicenter follow-up report on the immediate and delayed-immediate placement of implants. Int J Oral Maxillofac Implants 1999;14: 210–216.
19. Schwartz-Arad D, Samet N, Samet N. Single tooth replacement of missing molars: A retrospective study of 78 implants. J Periodontol 1999;70:449–454.
20. Evian CL. A comparison of hydroxyapatite-coated Micro-Vent and pure titanium Swede-Vent implants. Int J Oral Maxillofac Implants 1996;11:639–644.
21. Saadoun AP, LeGall ML. Clinical results and guidelines on Steri-Oss endosseous implants. Int J Periodontics Restorative Dent 1992;12:486–495.
22. Tal H. Spontaneous early exposure of submerged implants: I. Classification and clinical observations. J Periodontol 1999;70:213–219.

COPYRIGHT © 2000 BY QUINTESSENCE PUBLISHING CO, INC. PRINTING OF THIS DOCUMENT IS RESTRICTED TO PERSONAL USE ONLY. NO PART OF THIS ARTICLE MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM WITHOUT WRITTEN PERMISSION FROM THE PUBLISHER.