

## Single Tooth Replacement of Missing Molars: A Retrospective Study of 78 Implants\*

Devorah Schwartz-Arad, Naama Samet, and Nachum Samet

*As experience with osseointegrated implants has grown, greater use has been made of placement in the posterior jaw. The aim of this study is to present the survival rate of 78 osseointegrated single implants, inserted in the molar area and to evaluate the prosthetic rehabilitation on these teeth. This retrospective study presents findings of 55 consecutive patients with 78 restored single osseointegrated implants in the molar area. The patients went through a clinical and radiological evaluation. The same maxillofacial surgeon inserted all implants. Three of the implants were inserted into the maxilla and 75 into the mandible; 4 of the 78 implants were immediate implants. The cumulative survival rate after one year was 93.6%. Follow-up was up to 80 months, with an average of 27 months. Out of all the implants, 6 failed (7.7%): 5 failed in the surgical stage, and 1 after prosthetic loading. The main implant failures were among the titanium screw implants. Prosthetic complications occurred in 11 cases (14%), which included loosening of the abutment and/or the crown (9 cases), fracture of the abutment (1 case), and porcelain fracture (1 case). No incident of implant fracture occurred. Within the limits of this study, replacement of a single molar by a single implant is a valid and successful surgical treatment modality, with a high survival rate. J Periodontol 1999;70:449-454.*

### KEY WORDS

**Dental implants; mouth rehabilitation; follow-up studies; osseointegration.**

Since Bränemark introduced osseointegrated implants more than 25 years ago, there has been an increased interest in the use of implants in partially edentulous patients.<sup>1-4</sup> Replacement of a single tooth using a single osseointegrated implant (SOI) is an accepted and satisfactory treatment. It allows greater preservation of adjacent teeth and solves the potential problems caused by other alternative procedures.<sup>1-8</sup>

While there are many articles in the literature concerning replacement of a single anterior tooth using SOI, very few refer to its use in the molar area. One unpublished report observed that single implants that replace molars can fracture as a result of bending forces. They and others suggested the use of wide implants (more than 3.75 mm) or multiple implants that can withstand the occlusal forces better.<sup>3,9,10</sup>

The purpose of the present study is to present the survival rate of 78 osseointegrated single implants, inserted specifically in the molar area, and to perform prosthetic rehabilitation on these implants with a follow-up of up to 5 years.

### MATERIALS AND METHODS

This clinical retrospective study involved 78 osseointegrated implants that were placed between 1990 and 1996. The study involved a group of 55 consecutive patients, 27 women and 28 men, ranging in age from 20 to 68 years (mean 43 years). All patients were free from known diseases. Individuals with known bruxism or clenching habits were excluded.<sup>1,7,11</sup>

All patients had a SOI in the posterior area of the maxilla or the mandible. This treatment modality was performed after discussing alternative treatment plans. A clinical evaluation included the intra-arch relationship, the buccolingual width, and the intermaxillary relationship. Radiographic evaluation included panoramic and periapical x-rays. Only patients with sufficient bone width and height were included; i.e., those who needed bone augmentation were excluded.<sup>4,6,10</sup>

Amoxicillin (1 g) and dexamethasone (8 mg) were administered 1 hour presurgery. For the penicillin allergic patients, erythromycin (0.5 g)

\* Department of Oral and Maxillofacial Surgery, The Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel.

**Table 1.**

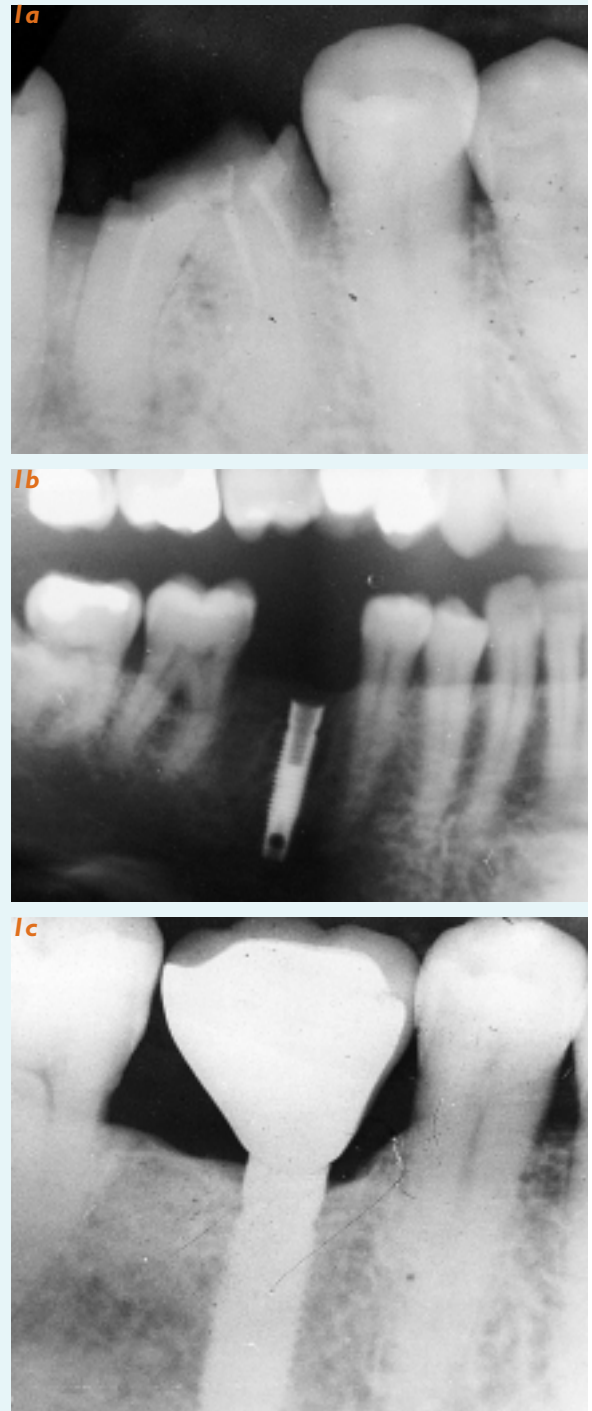
## Types of Implants

Type	Length	Diameter (mm)	Area (mm <sup>2</sup> )	Number	
Cylinder (all HA-coated)	13	3.5	165.18	2	
	16	3.5	198.97	1	
	10.5	4.5	168.41	1	
	13	4.5	203.56	10	
	16	4.5	245.54	2	
Total				16	
Screw					
	HA-coated	13	4.25	236.55	3
	Titanium (acid-etched)	10	3.75	157.98	8
		13	3.75	210.48	36
		16	3.75	260.76	14
	13	4.7	277.43	1	
Total				62	

was the drug of choice. Either amoxicillin (1.5 g/day) or erythromycin (2 g/day) was continued for 5 to 7 days postsurgery, and dexamethasone (4 mg/day) was administered for 2 additional days.<sup>12,13</sup>

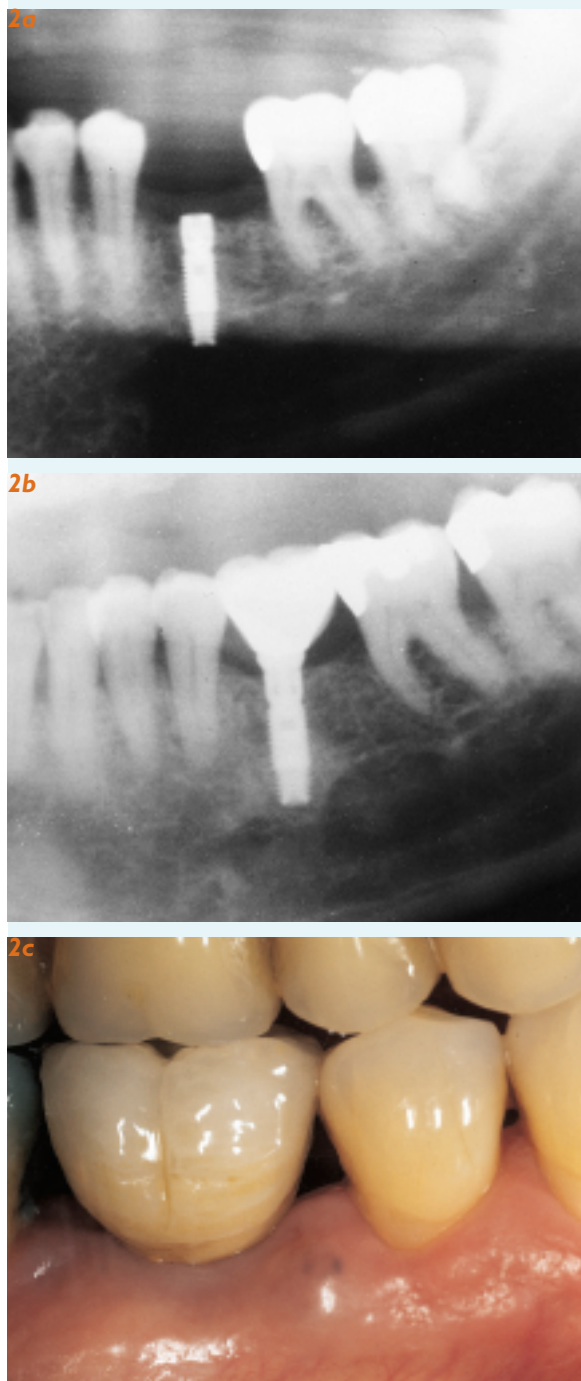
Distribution of implants was 75 in the mandible and 3 in the maxilla. Four immediate implants were placed. The type, diameter, and number of each kind of implants are listed in Table 1. The senior oral and maxillofacial surgeon (DSA) at the clinic placed all implants.

The 2-stage technique was used in all cases. In the first stage, full thickness mucoperiosteal flaps were reflected. In the immediate implant cases, flaps were designed to attain primary closure. The teeth were extracted with maximum care and the sockets debrided. Sockets were prepared with standard drills in the interdental bone, if present<sup>11-13</sup> (Fig. 1). Patients were followed-up at least once a month prior to second stage surgery, an average of 4 appointments before implant exposure. Second stage surgery was performed on an average of 4.2 months in the mandible and 7.1 months in the maxilla after implantation. Mucoperiosteal flaps were reflected exposing the implant head and surrounding bone. The cover screws were removed and healing abutments placed. After varying intervals, implants were restored with fixed prosthesis by several prosthodontists (Fig. 2).



**Figure 1.**

a) A periapical radiographic view of the residual roots of right mandibular first molar. b) A screw titanium implant placed in the interdental bone. Notice the socket walls surrounding the implant. c) The same implant, 6 years after placement, with the abutment and crown. Note the healing of the bone with no evidence of resorption.



**Figure 2.**

a) A panoramic radiographic view of a single screw implant replacing a missing mandibular first molar. b) The implant, 3.5 years after placement, with the abutment and crown. c) A mirror clinical view of the same crown.



**Figure 3.**

a) A panoramic radiograph of the area of the second mandibular molar immediately after extraction. b) A wide diameter (4.5 mm) cylinder type implant in the mandible. In this case, a delayed implantation was performed. At implantation, socket walls are still noticeable. c) Implant 2 years after placement with the abutment and crown.

## RESULTS

Sixteen cylinder-type (Fig. 3) and 62 screw-type implants were placed. The mean diameter of the implants used was 3.89 mm and the mean length was 12.93 mm. The mean contact surface area of cylinder type implants was 201.21 mm<sup>2</sup> and 221.88 mm<sup>2</sup> for the screw type (Table 1).

The results are based on placement of 78 implants in 55 patients. Follow-up ranged from 9 to 80 months (average 27 months). All implants in the mandible were exposed after 3 to 10 months (average 4 months) and after 6 to 11 months (average 7 months) in the maxilla.

The cumulative survival rate after one year was 93.6%. Of the 78 implants, 6 implants failed (7.7%): 5 failed during the surgical phase (before exposure) and 1 after exposure. The survival rate after 2 years was 92.3% (Table 2). The average time of prosthetic function was 24 months.

Out of 62 screw implants, 5 failed (8%) and out of 16 cylinder implants only 1 failed (6.3%).

All screw failures were titanium (acid-etched), 3.75 in diameter. Table 3 shows the surgical failures according to length and type.

Minor surgical complications were defined as implant exposure prior to the expected date requiring the use of chlorhexidine rinses and oral antibiotics, without surgical intervention. Major surgical complications were defined as implant exposure prior to the expected date requiring surgical intervention for curettage and primary closure.<sup>12,13</sup> Major complications occurred in 3 screw implants (4%), 2 were 3.75 mm in diameter and one 4.7 mm. The healing process of the 4 immediate implantation cases presented no complications. There was no bone loss around implants in a follow-up period of 3.5 to 6 years (Figs. 1 and 4).

Table 4 shows the number and percentage of hydroxyapatite (HA)-coated implants versus titanium (acid-etched) and of screw implants versus cylinder implants.

Prosthetic complications occurred in 11 cases (14%) and included loosening of the post and crown (9), fracture of 1 post, and fractured porcelain (1). Three of the prosthetic complications occurred in the cylinder wide diameter implants (17.6% of all wide diameter implants) and 8 were screw implants (13.1% of all narrow diameter implants). No implant fracture occurred.

## DISCUSSION

Most of the data available in the literature apply to single implants that replace anterior teeth.<sup>2,4-7,9,14</sup> This treatment modality has been accepted as a routine procedure. There are only a few studies where replacement of a molar using a single osseointegrated implant is reported.<sup>1,4,11</sup>

In a study in which 24 implants replaced single molars, the 1-year survival rate was 95.7% (1 patient had died, 1 moved out of town and 1 was lost to follow-up).<sup>1</sup> In the present study, the survival rate after 1 year and the cumulative survival rate (CSR) after 5 years were analyzed. The 5 year CSR was 92.3%, compatible with the former study.<sup>1</sup> In another study that included 423 implants in the posterior mandibular region of 195 patients, 14 had failed and the life table success rate after 5 years was 92.2%.<sup>15</sup> This study does not refer to single implants only.

**Table 2.**

### Cumulative Survival Rate

Follow-Up	Number	Failures	Survival Rate	Cumulative Survival Rate
Surgery	78			
Exposure	78	5	93.6%	93.6%
1 year	72	1	98.6%	92.3%
2 years	41	0	100%	92.3%
3 years	35	0	100%	92.3%
4 years	27	0	100%	92.3%
5 years	15	0	100%	92.3%

**Table 3.**

### Surgical Failures

Type and Length (mm)	N Placed	N Failures	Percentage
Cylinder 13 (HA)*	2	1	6.25%‡
Screw 10 (Ti)†	8	1	
Screw 13 (Ti) †	36	3	
Screw 16 (Ti) †	14	1	8.06%§

\* 3.5 mm diameter.

† 3.75 mm diameter.

‡ Of the 16 HA implants placed.

§ Of the 62 Ti implants placed.

There was no statistically significant difference between titanium screw-type implants and HA-coated implants in the posterior areas with low bone quality in the current study. A further investigation is required to analyze the difference between these types of implants with regards to the healing phase and the long-term function.

One implant manufacturer (unpublished data) has cautioned against the use of one implant to replace a single molar. Using one implant in these cases may present problems of distribution or stress to the implant and to the bone that can cause fractures in the abutment or in the implant, or may cause failure of the implant. The same manufacturer suggests the use of wide single implants (4 mm in diameter or more) to replace single molars. The 4 mm implants are reported to be 30% stronger than the 3.75 mm ones, and may be more resistant to bending forces.<sup>3,10,16</sup> In our study, wider implants were not favorable considering the complication of screw loosening.

When using one implant, there is a discrepancy between the implant's length and width and the size of the restored crown. The results of our study showed that prosthetic problems occurred

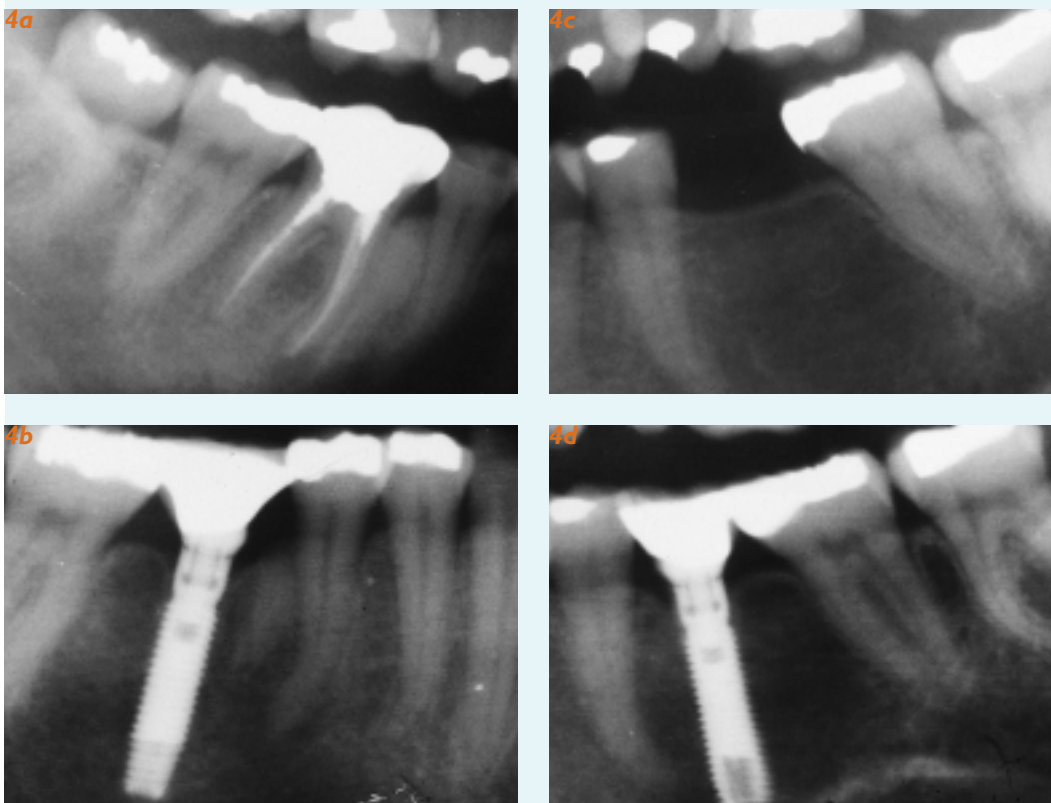
in 8 of the 54, narrow diameter implants (13.1%), and in 3 of the 17 wide diameter implants (17.6%). There was no difference in prosthetic complication between narrow or wide implants.

In 11 cases (14.1%), the prosthetic complications were loosening of the screws of the abutments or loosening of the crowns or ceramic fractures. In one case, a fracture of the abutment occurred. While using a single implant, the most common prosthetic complication was abutment screw loosening (8 of the 11 cases).<sup>4,10</sup> This probably occurred because of the cantilevering forces on the crown and implant. Torque forces occur during chewing, swallowing, and para-functional tooth contacts, even if the restored

**Table 4.**

### Implant Characteristics

Characteristic	N Implants	Percentage
HA-coated	19	24.4
Titanium (acid-etched)	59	75.6
Screws	62	79.5
Cylinders	16	20.5



**Figure 4.**

a) Panoramic preoperative view of right mandibular molar tooth before extraction and immediate implantation. b) Panoramic postoperative view 3.5 years after immediate implantation. Note the healing of the bone around implant with no evidence of resorption. c) Panoramic preoperative view of the same patient with left missing molar tooth, a few years after tooth extraction. d) Panoramic postoperative view 3.5 years after late implantation.

crown allows mainly centric contacts. These forces could contribute to screw loosening.

The hypothesis that prosthetic complications may be reduced using 2 implants in the area of a single molar needs further investigation.<sup>10,17</sup>

There were more prosthetic than surgical complications regarding single implant replacing molars. In the first year before second stage surgery, 5 implants were lost and one in the following 5 years (6.4% of all implants); there were 11 cases of prosthetic complications (14.1% of all cases). The fact that the bone quality that is not as good in the posterior area as in the anterior area must be considered.<sup>4,9,18-20</sup> Out of the lost 5 implants, 4 were replaced using the same type of implant and are still functioning. One patient refused to undergo the surgery required for another implant.

## CONCLUSION

From the results of our retrospective study, it can be concluded that: 1) Replacing a single molar using a single implant is a valid and successful treatment modality, with a high survival rate. 2) The main implant failure was in titanium screw-type implants. Low quality bone in the posterior area and better integration in HA-coated implants may explain this. 3) The most common prosthetic complication was screw loosening in both narrow and wide implants.

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Send reprint requests to: Dr. Devorah Schwartz-Arad, Department of Oral and Maxillofacial Surgery, The Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel. Fax: +972-3-6409250; e-mail: dubish@post.tau.ac.il

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