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Journal of Dentistry (Tehran, Iran)
Tehran University of Medical Sciences

Clinical Evaluation of Small Diameter Straumann Implants in Partially Edentulous Patients: A 5-Year Retrospective Study

M. Yaltirik, B. GÖKÇEN-RÖHLIG, [...], and G. EVLIOGLU

Additional article information

Abstract

Objective:

The aim of the present study was to retrospectively evaluate small-diameter (3.3 mm) Straumann® dental implants placed in the maxilla or the mandible over a period of 5 years in function.

Materials and Methods:

Twenty-eight partially edentulous patients received a total of 48 implants over a 5-year period. After the standard healing period (3 to 6 months), the implants were restored with single-tooth prostheses or fixed partial dentures. All patients were followed according to a strict maintenance program with regular recalls. The cumulative survival rates of implants were analyzed and prosthetic complications were assessed.

Results:

After 5 years of function, one single 10-mm-long implant in the maxillary premolar region was lost because of recurrent peri-implant infection in a female patient. Two single 10-mm-long maxillary implants placed in the posterior region were lost due to body fracture. The cumulative 5-year survival rate of the implants was 93.75 %. The most common prosthetic complication was loosening of the occlusal screw.

Conclusion:

Within the limited observation period and the number of patients included in this study, it may be concluded that the use of small-diameter implants appears to be predictable if clinical guidelines are followed and appropriate prosthetic restorations are provided. However, it should be noted that fatigue fracture may occur.

Keywords: Small Diameter Implants, Complications, Follow-Up, Partial Fixed Prosthesis

INTRODUCTION

Small-diameter implants (3, 0–3 and 3 mm) are generally used for alveolar ridges that are thin for regular implants with a diameter of approximately 4.0 mm to avoid advanced surgical procedures, such as local bone augmentation [1–8]. They are also indicated when the bone deficiency is circumferential around an implant or the interdental space is limited, as in the replacement of mandibular incisors and maxillary lateral incisors [7] or when the proposed implant site is not suitable for bone grafting or orthodontic repositioning of teeth [8–10]. When they are compared with regular size implants, small-diameter implants demonstrate lower structural strength [1]. The reduced implant diameter leads to decreased mechanical strength which may result in implant fracture. The aim of the present study was to retrospectively evaluate small-diameter (3.3 mm) Straumann® dental implants (Institut Straumann® AG, Basel, Switzerland) placed in the maxilla or in the mandible over a period of 5 years in function.

MATERIALS AND METHODS

Patients included in the present study were treated at the Department of Oral Surgery and Department of Maxillofacial Prosthodontics, University of Istanbul, Turkey between 2001 and 2002. Totally, 28 patients out of 146 patients were consecutively enrolled in this study and treated with 48 Straumann® small-diameter implants (3.3 mm in diameter) in lengths of 10, 12 and 14 mm (Institut Straumann® AG, Basel, Switzerland). One-stage procedure implants (31.25%) were placed in the maxilla and 33 (68.75%) implants were placed in the mandible. All patients included in the study presented good general health without any debilitating medical conditions which may contraindicate implant therapy at the time of the surgical procedure. The inclusion criteria for enrollment in this study were

(1) age between 18 and 65 years, (2) the presence of single tooth gap or edentulous space in the maxilla or mandible not in post extraction sockets, (3) insufficient bone volume at the surgical site for a standard implant placement (a width of 5 mm or smaller for thin alveolar ridges) as assessed by clinical and radiological examination and (4) the absence of periodontal and mucosal diseases. The surgical technique complied with the general guidelines defined by Brånemark et al [11] and the specific indications recommended by Buser et al for Straumann implants [12]. The patients received 2.000.000 I.U. penicillin V one hour before the surgery and 2.000.000 I.U. was given twice a day for 7 days postoperatively. Chlorhexidine 0.2% one-minute mouth rinses were prescribed twice daily for two weeks. In addition, a prescription for a nonsteroidal anti-inflammatory drug (50 mg diclofenac) for 4 days was given to the patients for reducing the postoperative swelling and pain. Sutures were removed 7 days after operation. Implants were checked after a healing period of three to six months and the successfully osseointegrated implants were restored. Prosthetic treatment: Porcelain-fused to metal crowns and fixed partial bridges were fabricated. Eight of the implants were restored with single crowns. Forty implants were used to support fixed partial bridges. All of the restorations were cemented. It was the prosthodontist's decision to fabricate cement-retained restorations due to ease of fabrication, better esthetics and lower prosthodontic costs compared to screw-retained restorations. Generally recognized rules of fixed prosthodontics were applied to restorations. Conventional impression techniques, fixed partial denture fabrication steps and cementation procedures were applied. Single and multiple-unit implant retained bridges were cemented. After completion of prosthodontic treatment, patients were enrolled in a recall program of supportive therapy and visits every six months by means of clinical and radiographic examinations. At follow-up examinations, the implants were examined for tissue integration according to the strict parameters defined by Buser et al [12]. Specifically, the integration was considered successful if the following parameters were met: (1) absence of recurring peri-implant infection with suppuration, (2) absence of persistent subjective complaints such as pain, foreign body sensation and/or dysesthesia, (3) absence of a continuous radiolucency around the implant and (4) absence of any detectable implant mobility [12–17]. The clinical evaluation parameters included modified plaque index (MPI), sulcus bleeding index (SBI), width of keratinized mucosa (KM) and probing depth [13]. Clinical attachment levels were recorded by measuring the distance between a fixed reference point on the superstructure and the base of the peri-implant sulcus. Probing was performed at four sides (mesial, vestibular, distal and palatinal/lingual) [12]. Following soft tissue assessments, mobility of the implants and restorations were evaluated. Mobility control was performed with a pinzette or percussion with a metallic instrument, such as a mirror handle. When it was clear that the peri-implant tissue was healthy, any movement indicated a superstructure or an abutment loose. All implants were subsequently assessed clinically and radiographically at seven follow-up examinations which occurred 1, 6, 12, 18, 24, 48 and 60 months after prosthesis placement. The patients were also evaluated for symptoms of pain, prosthesis mobility and evidence of infection and any adverse reaction reported by the patients was also recorded.

RESULT

A total of 48 implants, of which 15 were in the maxilla and 33 were in the mandible, were placed in 28 patients. Patients were treated with eight implants supporting single tooth prosthesis and

40 implants supporting fixed partial prosthesis. Three patients lost implants. One of the failed implants was a 10 mm implant placed in the maxillary molar region. The implant was lost because of recurrent peri-implant infection. The other two implants were also 10 mm implants supporting single crowns in the maxillary molar region. They were lost because of body fractures. There were no symptoms of pain, prosthesis mobility, infection and any adverse reaction reported by the patients. The characteristics of failed implants are summarized in Table 1. This represents an overall implant survival rate of 93.75%. The five-year survival rate was 80.0% in the maxilla and 100% in the mandible. The failed implants were replaced with standard implants after bone augmentation procedures. They have

been in function for about two years. Prosthetic complications were minimum in the study. The most common prosthetic complication was loosening of the restoration. Two single crowns replacing first molars in the mandibula had to be re-cemented after a period of 6 months after loading. Veneer, abutment fractures and abutment loosening were not encountered in the study.

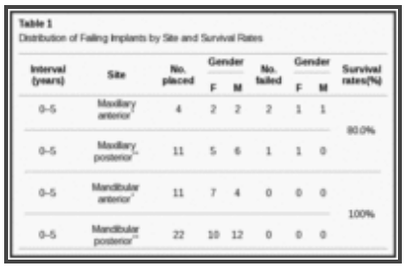

Table 1

Interval (years)	Site	No. placed	Gender		No. failed	Gender		Survival rates(%)
			F	M		F	M	
0–5	Maxillary anterior[1]	4	2	2	2	1	1	80.0%
0–5	Maxillary posterior[2]	11	5	6	1	1	0	
0–5	Mandibular anterior[3]	11	7	4	0	0	0	100%
0–5	Mandibular posterior[4]	22	10	12	0	0	0	

Table 1

Distribution of Failing Implants by Site and Survival Rates

DISCUSSION

It has been suggested that small diameter implants are less prone to stand against stress structurally and could increase the stress transmitted to the bone [18–20]. For example, it was estimated that fracture resistance of the implant decreases approximately 25% when implant diameter reduces from 3.75 to 3.3 mm [18].

It has also been reported in a study of 30 single-tooth restorations on 3.0-mm-diameter implants that one implant fractured at its neck after approximately 66 months of function [1]. The present data on 3.3-mm-diameter implants were subjected to function under fixed partial bridges and single crowns and the rate of implant fracture was 4.17% (two implants out of 48) at the end of five-year function. The failed implants were supporting single crowns replacing molars.

The failures in the present work may be explained with the location of the implants. Narrow-neck implants should be cautiously used when they are going to support single crowns replacing molars [24–26]. The results of this study demonstrate that the success rate of a small-diameter implant supporting a fixed partial bridge in the maxilla and mandible is 100% after five years of function. [20] For an optimum and a safe result, they may be used as supporting implants by standard diameter implants in the posterior region. There are contradictory clinical results about comparing the success of small-diameter implants and regular size implants.

The 5-year survival rate of the 3.3 mm cylindrical implant (91%) (IMZ) was lower in comparison with the 4.0 mm cylindrical implant (95%)[19]. Similarly, over a 3-year observation period, the survival rate of 3.25 mm self-tapping titanium implants (93.8%) (3i) was lower than that of the 3.75 mm implants (100%)[20]. Conversely, a 5-year retrospective study showed that the success rate of 3.3 mm cylindrical implants (96.0% in the mandible and 95.5% in the maxilla) excelled that of the 4·0 mm cylindrical implants (95.0% in the mandible and 92.0% in the maxilla) [21]. In addition, over a 3-year observation period, none of fifty-one 2.75 mm and fifty-eight 3.0 mm titanium alloy screw implants (osteo ti) failed, while five of 261 (98% survival) 3.75 mm or 4.50 mm implants failed [22]. The favorable result was also claimed of 3.3 mm titanium plasma-sprayed implants (ITI). Using the definition of survival as an implant is still present in the patient's jaw bone 99.4% survival was reported of 182 implants after

1 year of loading [23].

CONCLUSION

In this study, the overall survival rate of 48 implants was 93.75%. The survival rate in the maxilla (80%) was less than that in the mandible (100%). Only 6.25% of the patients lost implants. The only prosthetic complication was de-cementation of the restorations. Restoration loosening, which was reported by patients restored with single crowns was encountered in 4.17% of the patients. Fixed partial dentures retained with small diameter implants may be a highly safe treatment option, even in distal extensions.

None of the patients in this study lost implants or abutments when they received such a restoration. Further investigations and long-term evaluations are certainly needed to confirm the encouraging results of this clinical study.

Article information

J Dent (Tehran). 2011 Spring; 8(2): 75–80.

Published online 2011 Jun 30.

PMCID: PMC3184735

PMID: 21998812

M. Yaltirik,[1] B. GÖKÇEN-RÖHLIG,[2] S. OZER,[3] and G. EVLIOGLU[4]

[1]Associate Professor, Department of Oral Surgery, Faculty of Dentistry, Istanbul University

[2] Assistant Professor, Department of Maxillofacial Prosthodontics, Faculty of Dentistry, Istanbul University

[3] Resident, Department of Oral Surgery, Faculty of Dentistry, Istanbul University

[4] Professor, Department of Maxillofacial Prosthodontics, Faculty of Dentistry, Istanbul University

Corresponding author: M. Yaltirik, Department of Oral Surgery, Istanbul University, Faculty of Dentistry, Istanbul, Turkey, myaltrk@yahoo.com

Received 2011 Dec 29; Accepted 2011 Mar 23.

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