Original Article

Evaluation of the Survival Rate and Bone Loss of Implants with Various Lengths

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Abstract:

Statement of Problem: The replacement of missing teeth with implant-associated restorations has become a widely used treatment modality in recent years. The length of dental implants may be a critical factor in achieving and maintaining osseointegration.

Purpose: The aim of this study was to evaluate the survival rate and bone loss of dental implants with different lengths

Materials and Methods: A retrospective cohort study was performed on 60 ITI-system implants, evenly distributed into three groups including 8, 10 and 12 mm high implants in the posterior segments of both jaws. Demographic information, oral hygiene, cigarette smoking, implant length, duration of implant placement (at least 24 months), bleeding on probing index and pocket probing depth were recorded for all participants. Bone loss was calculated using pre- and post-operative panoramic radiographs.

Results: The mean rate of bone loss was different among the three groups and were found to be 0.21 (0.45), 0.3 (0.41) and 0.43 (0.55) mm in the 8, 10, and 12 mm high implants, respectively. Neither mean bone loss nor bleeding on probing index showed significant differences with implant length. A significant correlation was found between implant length and pocket probing depth ($P<0.0001$).

Conclusion: The results of this study suggest that both short (8 mm high) and long (10 or 12 mm high) implants may be used with nearly equal success rates in the posterior segments of the jaws.

Key Words: Implant length; Bone loss; Pocket probing depth

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INTRODUCTION

Treatment of partial and total edentulism with dental implants has evolved into a predictable procedure for most patients and is expected to play a significant role in oral rehabilitation. Long-term outcome studies which are now available for most implant techniques indicate that an increase in the success rate of integration and restoration of implants can be expected in the future. Nowadays, long-term survival rates of over 90% (in the maxilla) to 95% (in the mandible) are considered to be realistic treatment outcomes in the general population [1-4]. In an investigation on osseointegrated implants, partially edentulous patients were followed for 1 to 5 years and survival rates were reported as 94% in the maxilla and 99% in the mandible [5]. Another study evaluated the survival rate of osseointegrated fixtures 6 to 36 months after prosthesis loading and documented failure rates of 13% and 8% in maxillary and mandibular implants,

respectively [6].

Implant failure is the result of a multifactorial process [7]. Numerous investigations have analyzed the outcome of different implant systems and have described various factors affecting their survival and failure rates. Some controversy exists on the subject of implant length. A number of reports clearly indicate that shorter implant failure is more often than longer ones [8-10], while others failed to demonstrate that length could have an influencing impact on the survival rate of dental implants [11-13].

The aim of the present study was to evaluate the survival and failure rates of ITI implants during a follow-up period of approximately 2 years. The amount of crestal bone loss was also assessed using panoramic radiographs.

MATERIALS AND METHODS

The current investigation was designed as a retrospective cohort study.

A total of 25 patients were selected from those referred to the Department of Oral Implantology, Faculty of Dentistry, Tehran University of Medical Sciences. The inclusion criteria consisted of a history of implant insertion for at least 24 months and a panoramic radiograph taken up to 2 months after surgery or implant placement. Exclusion criteria were class II and III malocclusion, bruxism and/or clenching, immuno-compromising diseases, partial or full denture prosthesis in an opposing position to the implants, bone graft or GTR implantation, and immediate implant placement.

Sixty sandblasted, large grit and acid etched (SLA) implants (ITI, Straumann Institute, Basel Switzerland) were used in this study. The implants were allocated to three groups, according to their length (8, 10 and 12 mm) and placed in the posterior part of the jaws. Each group consisted of 20 implants with a diameter of 4.1 mm.

Survival criteria were assessed according to Buser et al [14] and Cochran et al [15], which included the following items: (1) absence of clinically detectable implant mobility, (2) lack of persistent or irreversible signs and symptoms such as pain or any subjective sensation, (3) absence of recurrent peri-implant infection, and (4) absence of concrete evidence of continuous peri-implant radiolucency.

Informed consents were signed by each of the patients after thorough explanation of the clinical investigation. The University's Ethical Committee approved the consent form and experimental protocol. Age, gender, history of systemic disease, date of surgery, the tooth which was replaced by implant and implant length were registered for all participants and panoramic radiographs were obtained. Physical examination was performed and occlusal relationships (class I), oral hygiene status (Simplified Oral Hygiene Index), implant conditions, bleeding on probing (BOP) indices, and peri-implant probing depths were recorded [16-18]. The rate of bone loss was calculated comparing the two panoramic radiographs. Bone loss was measured on the radiographs using the implant threads as suggested by Haas et al [19].

Descriptive statistics including frequencies, mean values, ranges, and standard deviations were calculated for the different variables. Statistical analysis was carried out using SPSS 11.0, software. Chi-square test, ANOVA, multi-variant ordinal regression, and Spearman correlation coefficience were employed for data analysis. Mean and standard deviations were calculated for crestal bone loss measured after at least 2 years of implant insertion.

RESULTS

A total of 25 patients with a mean (SD) age of 55.10 (6.51) years were included in this study. The demographic information of the participants is shown in Table I. Implant distribution according to the jaw and region has been demonstrated in Table II. The mean (SD) duration of implant placement was 47.15

Table I: Demographic information of the participants.

Variables		No. (%)
Sex	Female	14 (56)
	Male	11 (44)
Oral hygiene	Good	34 (56.7)
	Moderate	26 (43.3)
	Poor	0 (0.0)
Cigarette smoking	Smoker	8 (13.3)
	Non-smoker	52 (86.7)

(15.54), 34.55 (5.20) and 35.10 (13.82) in the 8, 10 and 12 mm high implants, respectively. The mean value of bone loss was 0.38 (0.52) and 0.23 (0.40) mm in patients with moderate and good oral hygiene, while it was 0.27 (0.31) and 0.32 (0.50) mm for smokers and non-smokers, respectively. There was no statistically significant difference between the various lengths of implants and BOP (P=0.735). However, different rates of bone loss were detected in different grades of BOP (P=0.005). Pocket Probing Depth (PPD) varied from 1 to 7 mm with an average of 2.06 (1.04) mm (Table III). Multivariate ordinal regression showed a significant difference in PPD between the 8 and 12 mm high implants (P< 0.0001).

The mean value of bone loss was 0.31 mm, with a maximum of 1.67 mm. No significant difference was found in the rate of bone loss between different pocket probing depths (P=0.186). The mean value of bone loss increased in longer implants (Table III), but the difference was not significant (P=0.328). Spearman's correlation coefficient was 0.043 between the mean value of bone loss and implant length (P=0.746) and 0.229 between the patients' age and implant length (P=0.079). During the whole period of the investigation, implant mobility, recurrent peri-implant infection and radiolocency was not observed around the implants. None of the patients complained of pain. According to the survival criteria employed in the present study, failure did not occur in any of the participants and the overall survival rate was 100% for both jaws.

DISCUSSION

This retrospective study demonstrated a 100% implant survival rate. Similar studies reported an increased risk of failure associated with placement of implants in the posterior segment of the maxilla, smaller implant width and other factors [10-12]. Scurria et al [20] studied 99 patients, in whom 384 implants were placed. At 3.6 years, a total of 34 (8.9%) implants had failed. When prosthesis type was excluded from the modeling process, the data indicated posterior location and an implant width of less than 4.0mm to be associated with implant failure. Similarly, Naert et al [21] studied 1956 Branemark implants in 660 patients over 16 years and found that 91.4% of the implants survived. The failures were mostly associated with shorter implant lengths, bone grafted sites, larger numbers of implants per patient and implants restored with acrylic veneers. Single versus multiple abutments made no difference in survival rate. Chuang et al [22] reviewed 2286 implants in 660 patients and reported a survival rate of 90.91%. Several local factors were found to affect implant failure such as size and length, immediate implants and implant stage.

According to the results obtained in the present study, the outcome of short and long implants was similar and both revealed a survival rate of 99-100%. These findings are in accordance with those reported by Deporter et al [23] and Griffin et al [24] but are in contrast

Table II: Implant distribution according to the jaw and the region.

Jaws	Second Premolar No. (%)	First Molar No. (%)	Second Molar No. (%)	Sum No. (%)
Maxilla	9 (15.0)	8 (13.3)	1 (1.7)	18 (30.0)
Mandible	9 (15.0)	20 (33.4)	13 (21.6)	42 (70.0)
Sum	18 (30.0)	28 (43.7)	14 (23.3)	60 (100)

Table III: Descriptive statistics of the measured variables considering different implant length.

Implant Length	Mean rate of bone loss mm (SD)	Pocket probing depth mm (SD)	Bleeding on probing	
			grade 0 No. (%)	grade 1 No. (%)
8 mm	0.21 (0.45)	2.40 (1.17)	13(21.6)	7(11.7)
10 mm	0.30 (0.41)	1.95 (0.96)	15(25.0)	5(8.3)
12 mm	0.43 (0.55)	1.84 (0.87)	13(21.6)	7(11.7)
Total	0.31 (0.47)	2.06 (1.04)	41(68.3)	19(31.7)

to those that demonstrated implant survival rates of 88 to 94.6% for implants with different lengths [27,28]. Nedir et al, found a 2-year survival rate of 99.6% for standard ITI implants placed by the same practitioner [25]. A 5-year cumulative survival rate of 99.1% was stated by Mericske-Stern et al [26] for standard ITI implants placed in posterior sites. Patient selection, implant placement region, implant surface, type of prosthetic rehabilitation and bone quality of the patient may be possible explanations for the large difference observed in various studies.

Stefani et al [29] reported that implant success was strongly affected by peri-implant hard and soft tissues which were directly dependent on oral hygiene. They found that pocket depths greater than 5 mm may lead to anaerobic bacterial accumulation. In the current study, oral hygiene levels were good or moderate and none of the patients had poor oral hygiene. In addition longer implants revealed smaller pocket depths. Minsk et al [30] showed a positive relationship between bone loss and pocket depth; in contrast, we were unable to demonstrate a statistically significant difference between bone loss and various pocket depths. This might be due to the small sample size in our study and the use of panoramic radiographs to measure the marginal bone loss. Smoking like periodontal disease, can increase the failure rate of implants. Habsha et al [31] indicated that implant failure was 1.69-1.91 times greater in smokers as compared to non-smokers.

In the present study, the average marginal bone loss adjacent to the implants was low during the 2 year period of implant placement. There was no difference in the rate of bone loss between the three studied implant lengths. In similar investigations, Tawil et al [32] and Winkler et al [33] also did not find a significant correlation between bone loss and implant length.

CONCLUSIONS

Under the limitations of the current study, it seems that implant length does not play an important role in its survival and similar survival rates were observed in short and long implants. Our findings suggest that both short (8 mm high) and long (10 or 12 mm high) implants may be used with nearly equal success rates in the posterior segments of the jaws.

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