

*Section Editor*

**Clark M. Stanford, DDS, PhD, MHA**

University of Iowa  
Iowa City, Iowa, USA

**David Chvartzaid, DDS, MSc  
(Prosthodontics), MSc (Perio)**

University of Toronto  
Toronto, Canada

**Thomas W. Oates, DMD, PhD**

University of Maryland  
Baltimore, Maryland, USA

**Emad Estafanous, BDS, MSD**

University of Illinois Chicago  
Chicago, Illinois, USA

**Jan-Eirik Ellingsen, DDS, PhD**

University of Oslo  
Oslo, Norway

**Martin Osswald, BDS, MDent**

University of Alberta  
Edmonton, Canada

## The Use of Short Dental Implants: Where Are We Today?

The rehabilitation of missing teeth using short dental implants was introduced as an alternative to bone augmentation techniques for when the bone volume was too reduced for implant placement. This is often the case in the posterior maxilla, which has a short distance from the marginal bone to the sinus, but may also happen in resorbed posterior mandibles with an elevated risk of damaging the inferior alveolar nerve. Maxillary bone augmentation techniques include placement of bone graft material, but sinus floor elevation can be performed without the use of graft material. Regardless, the additional augmentation surgery requires more advanced surgical skill and has a higher risk for intra- and postoperative complications. Based on this, the use of short dental implants has increased during the last few years, and it is therefore of interest to consider the literature of outcomes of this treatment modality.

In a systematic review, Rameh et al evaluated the survival of short (5 and 6 mm), posterior dental implants that were followed up for a period of 5 years of clinical use in randomized clinical trials and prospective cohort and retrospective studies. The 11 studies that were included in the review comprised a total of 511 short implants placed in 340 patients and 472 standard-length implants placed in both augmented and nonaugmented edentulous sites of 284 patients, with both the short and standard implants evenly distributed between maxilla and the mandible. The authors reported a mean survival rate of 95.54% for the short implants after 5 years in use. On the other hand, the standard implants exhibited a mean survival rate of 99.58% in the posterior maxilla and 96.9% in the

augmented mandible. When evaluating marginal bone level change after 5 years in function, a mean peri-implant bone loss from 0.12 to 1.52 mm for the short implants placed in the posterior maxilla and 0.14 to 1.72 mm for the implants placed in the posterior mandible was reported. The standard dental implants had a loss of marginal bone between 0.14 and 1.85 mm in the posterior maxilla and 0.15 to 2.11 mm in the posterior mandible. The authors concluded that short and standard implants exhibit comparable survival rates and no differences in the marginal bone level change. Interestingly, the authors did not find any differences in survival rate between maxilla and mandible.

Parodo-Zamora et al performed a 1-year prospective observational study that compared short dental implants with a length of  $\leq 8.5$  mm (7 and 8.5 mm) and standard dental implants of  $\geq 10$  mm with respect to survival, implant stability quotient (ISQ), and marginal bone level changes. A titanium implant with a calcium-phosphate surface was used. A total of 74 patients were included, with 47 short implants placed in 33 patients and 52 standard implants placed in 41 patients. The implants were followed for 12 months. The survival rate was 100% in this study for both implant types. No differences in the ISQ were observed between the groups. When analyzing changes in the marginal bone levels in this short-term study, a significantly lower bone loss was observed in the short implant group compared to the standard implant group from loading through 12 months postloading ( $-0.184 \pm 0.191$  mm vs  $-0.412 \pm 0.588$  mm). It should, however, be noted the two groups varied significantly regarding implant location, implant diameter, and type of restoration.

In a retrospective study, Lombardo et al evaluated the survival and peri-implant loss of short (6 and 8 mm) and ultrashort (5 mm) implants placed in the posterior mandible. A total of 98 patients (mean age: 54 years; 65% with a reported history of periodontal disease) were included in the study. In this study, 71 implants had a length of 8 mm, 82 implants had a length of 6 mm, and 48 implants had a length of 5 mm. The implant diameters were 4.0 mm, 4.5 mm, 5.0 mm, and 6.0 mm. All implants were restored with single crowns. The authors reported five implant failures in five different patients after functional loading, all with a history of periodontal disease, giving an overall survival after 36 months of 97.51%, with no statistical significance between the different length groups. A mean crestal bone level change of  $-0.4 \pm 0.95$  mm was reported after 3 years, with significantly greater bone loss for implants placed in premolar sites compared to those placed in molar sites, but no significant difference between the different length groups. The authors concluded that short and ultrashort implants were demonstrated to be a successful treatment option in the atrophic posterior mandible, although long-term investigations with larger sample size should be performed.

In a study by Hakobyan et al, a total of 81 patients had 248 short (5 and 6 mm) implants with a diameter of 4.5 to 5.0 mm placed in posterior mandible and 256 implants with lengths > 10 mm placed in the anterior mandible region. The two groups were evaluated and compared after 1 and 5 years. The marginal bone level from the reference point in the short implant group was 0.74 mm 1 month after installation and 1.27 mm after 5 years. In the group with implants > 10 mm that were placed in the anterior mandible, the mean marginal bone loss was 0.72 mm after 1 month and 1.31 mm after 5 years. The 5-year cumulative implant survival rate was 97.8% in the short implant group and 98.1% in the group with implants > 10 mm. The authors concluded that the use of short implants in rehabilitation of resorbed posterior mandible can be considered favorable, although studies with longer observation periods are needed.

Carosi et al evaluated the survival rate of short dental implants ( $\leq 6$  mm) placed in the posterior maxilla in a systematic review of studies published between 2010 and 2020. The included studies were randomized control trials. The patients in the studies had severe posterior maxillary atrophy. The test groups were treated with short dental implants whereas the control groups were regular-length implants combined with augmentation procedures. Of the 238 titles identified in the search result, 24 studies were considered relevant and 9 of these satisfied the inclusion criteria and were included in the qualitative analysis. In these studies, 370 short implants (4 to 6 mm) were placed in 263

patients, while 463 standard-length implants (8 to 15 mm) were placed in 324 patients. The follow-up time was 1 year in 2 studies, 3 years in 2 studies, and 5 years in 5 studies. The survival rate of the short implants ranged from 91.9% to 100%. The standard-length implant group had an implant survival rate ranging from 82.9% to 100%. The authors concluded that short dental implants placed in resorbed posterior maxilla without bone augmentation reported a high survival rate in short to medium-short follow-up. However, the studies included in this review vary in their observation period from 1 to 5 years, which is an important limitation.

Jagadeesh et al evaluated the survival rate of 580 short (4 mm, 4.5 mm, and 5 mm) dental implants placed in 342 medically compromised patients with a follow-up 6 months, 1 year, and 2 years after placement. The patients were suffering from diabetes mellitus, hypertension, mental disability, oral cancer, and osteomyelitis. Patients who were pregnant, addicted to drugs, smokers, or had periodontal pathology were excluded. The authors reported a mean survival 89.6% for the short implants in the study, with a decreasing survival rate for the shortest implants. The 5-mm implants had a survival rate of 95.3%, whereas the 4-mm implants reported a significantly lower survival rate of 7.2%. The patients with osteomyelitis (total of 46 patients) had a failure rate of 13.3% and diabetes mellitus patients (total of 142 patients) had a failure rate of 12.5%. Within the limitations of this study, the results suggest that care should be taken when considering short dental implant placement in medically compromised patients.

Thoma et al evaluated the survival of two short implants vs one short implant with a cantilever in a 5-year randomized clinical trial. This is a clinical situation that can occur when patients are missing two adjacent teeth in the posterior region. The authors wanted to evaluate if a single short implant with a cantilever could be used in those situations, thereby giving options for restoration in cases of unfavorable anatomical conditions, such as limited mesiodistal space, preexisting bone deficiencies, and close proximity of the alveolar nerve or maxillary sinus. A total of 36 patients were included in the study, receiving a total of 54 implants. Two early failures and four late failures were reported. Due to additional drop-out, 26 of the 36 included patients attended the 5-year follow-up examination. The survival rate at 5 years was 84.2% in the one implant and cantilever group and 80.4% in the group with two implants. There were no significant differences between the groups in terms of implant survival or changes of the marginal bone level, and there were also similar rates of biological and technical complications. The authors conclude that the feasibility and clinical applicability of either of these two treatment options need to be further evaluated.

Li et al evaluated implant survival rate, marginal bone loss, and mechanical complications of short dental implants ( $\leq 8.5$  mm) supporting splinted and nonsplinted prostheses in a systematic review and meta-analysis. Of the 4,891 articles from the initial search, 46 articles were evaluated, and ultimately 12 studies fulfilled the inclusion criteria and were included in the meta-analysis. Of these, only one was a randomized control trial study, while the other 11 were prospective or retrospective cohort studies. The studies included a total of 1,506 short implants (596 nonsplinted and 910 splinted) with a mean follow-up time ranging from 1 to 16 years. Analysis suggested that the survival rate was not statistically significantly different between the splinted and nonsplinted short implants. Of the 8 studies that reported on marginal bone loss, no significant difference was found between the splinted and nonsplinted groups. Five studies reported on mechanical complications, and veneer chipping and screw loosening was most common in the nonsplinted short implant group, whereas veneer chipping was most common complication for splinted short implants. The authors concluded that splinted and nonsplinted short implants showed same rate of survival, marginal bone loss, and mechanical complications.

The use of short dental implants has shown reliable results, particularly in the posterior resorbed mandible, but also for restoration of resorbed posterior maxilla. We do, however, still lack long term randomized control trial studies that use short dental implants, and therefore should be careful in the selection of patients and the performance of the treatment including the design of the prosthetic restoration.

Jan Eirik Ellingsen

**Rameh S, Menhall A, Younes R. Key factors influencing short implant success. *Oral Maxillofac Surg* 2020;24:263–275.**

This systematic article reviews the literature on the confounding parameters that affect short implant survival in order to establish specific surgical and prosthetic protocols that create an optimal biomechanical scenario and ensure implant longevity. The available literature was screened for randomized clinical trials and prospective cohort and retrospective studies, published up to February 20, 2020, on the prognosis of short-length implants placed in posterior jaws. Studies evaluating the 5-year clinical performance of short dental implants (5 or 6 mm) in fixed rehabilitations of partially edentulous posterior jaws were included. After assessment of inclusion and exclusion criteria, 11 studies were selected, 8 of which were RCTs, 2 were prospective studies, and 1 was a retrospective study. After 5 years in function, 22 short (12 in the maxilla and 10 in

the mandible) and 10 standard (2 in the maxilla and 8 in the mandible) implants were lost, resulting in high survival rates independent of implant length or location. More biologic complications were found in standard implants, especially those placed in augmented posterior mandibles (135 complications compared to 48 in short mandibular implants). Splinted prostheses were associated with fewer technical complications (15 out of 53 complications affecting short implants). The findings of this review showed that, short implants achieve predictable and promising long-term outcomes when used correctly, provided they are placed following a comprehensive surgical and prosthetic protocol, based on the different biomechanical parameters essential to optimize long-term prognosis. The use of short implants in clinical practice has considerably increased in a wide variety of cases, given that they offer several advantages for both patient and practitioner. Recent literature shows that, when specific criteria are respected, new generations of short implants present high, long-term survival rates. This review is designed to provide a thorough understanding of the surgical and prosthetic protocols that create an optimal biomechanical scenario for short implants and improve their prognosis.

**Correspondence to:** ronald.younes@hotmail.com

**Pardo-Zamora G, Ortiz-Ruiz AJ, Camacho-Alonso F, et al. Short dental implants ( $\leq 8.5$  mm) versus standard dental implants ( $\geq 10$  mm): A one-year post-loading prospective observational study. *Int J Environ Res Public Health* 2021;18:5683.**

Recent data have shown that short dental implants can be the preferred treatment in most of cases of posterior atrophic alveolar ridges, offering higher survival and lower complication rates than long implants. The survival rates, stability, and marginal bone level changes were compared between short implants (7 and 8.5 mm) and standard-length implants ( $\geq 10$  mm). This was a prospective observational study in which adult patients requiring  $\geq 1$  osseointegrated implants to replace missing teeth were recruited consecutively. A clinical examination was performed on the day the definitive prosthesis was placed and after 6 and 12 months. Implant stability quotient (ISQ), marginal bone level (MBL) changes, and the correlation between these parameters and the characteristics of the implants were evaluated. A total of 99 implants were placed (47 short, 52 standard) in 74 patients. The 12-month survival rate was 100%. ISQ values showed a similar pattern for both types of implants. No correlation was found between ISQ changes after 1 year and MBL values, nor between the latter and the characteristics of the implants. With clinical treatment criteria, shorter implants (7 and 8.5 mm in length) can be just as useful as standard-length implants in atrophic alveolar ridges, demonstrating similar rates of survival, stability, and crestal bone loss.

**Correspondence to:** gparza@um.es

**Lombardo G, Signoriello A, Simancas-Pallares M, Marincola M, Francesco Nocini P. Survival of short and ultra-short locking-taper implants supporting single crowns in the posterior mandible: A 3-year retrospective study. J Oral Implantol 2020;46:396–406.**

The purpose of this retrospective study was to determine survival and peri-implant marginal bone loss of short and ultrashort implants placed in the posterior mandible. A total of 98 patients received 201 locking-taper implants between January 2014 and January 2015. Implants were placed with a 2-stage approach and restored with single crowns. Clinical and radiographic examinations were performed at 3-year recall appointments. At that time, the proportion of implant survival by length, and variations of crestal bone levels (mean crestal bone loss and mean apical shift of the first bone-to-implant contact point position) were assessed. The significance level was set at .05. The total number of implants examined 36 months after loading included 71 implants that were 8.0 mm in length, 82 implants that were 6.0 mm in length, and 48 implants that were 5.0 mm in length. Five implants failed. The overall proportion of survival was 97.51%, with 98.59% for the 8.0-mm implants, 97.56% for the 6.0-mm implants, and 95.83% for the 5.0-mm implants. No statistically significant differences were found among the groups regarding implant survival ( $P = .73$ ), mean crestal bone loss ( $P = .31$ ), or mean apical shift of the first bone-to-implant contact point position ( $P = .36$ ). Single-crown short and ultrashort implants may offer predictable outcomes in the atrophic posterior mandibular regions, though further investigations with longer follow-up evaluations are necessary to validate our results.

**Correspondence to:** giorgio.lombardo@univr.it

**Hakobyan G, Jilavyan A, Khachatryan G, Mathevosyan D, Tunyan G, Ghambaryan N. Evaluation of the survival rate of short implants placed in the posterior atrophic mandible: A 5 year clinical study. Quintessence Int 2022;53:690–696.**

The aim of the study was to assess the long-term prognosis of short (5 to 6 mm) implants placed in the posterior region of the atrophic mandible. The study included 81 patients with severe vertical atrophy of the bone in the posterior region. The patients had 248 short implants (5 to 6 mm) implants placed in the posterior mandibular region and 256 implants with length greater than 10 mm in the anterior mandibular region. Analysis of implant and prosthesis failures, cumulative survival rate, and marginal bone loss was determined at 1 year and 5 years of follow-up ( $58 \pm 7$  months). Mean marginal bone loss after 1 year of prosthetic loading was 0.74 mm for short implants and 0.72 mm for implants with length greater than 10 mm; after 5 years of prosthetic loading, this was 1.27 mm for short implants and 1.31 mm for implants with length greater than 10 mm. Of 248 short implants (5 to 6 mm), 6 failed: 4 due to peri-implantitis and 2 due to lack of osseointegration (early

rejection). Of 256 implants with length greater than 10 mm, 5 failed: 3 due to peri-implantitis and 2 due to lack of osseointegration (early rejection). On average, over the observation period ( $58 \pm 7$  months), the 5-year cumulative implant survival rate was 97.8% in short implants, and 98.1% in longer implants; the prosthesis cumulative survival rate was 98.2%. Based on the results, it was concluded that the prognosis of the use of short implants for prosthetics in the posterior resorbed mandible can be considered favorable and reasonable.  
**Correspondence to:** prom\_hg@yahoo.com

**Carosi P, Lorenzi C, Lio F, Laureti M, Ferrigno N, Arcuri C. Short implants ( $\leq 6$  mm) as an alternative treatment option to maxillary sinus lift. Int J Oral Maxillofac Surg 2021;50:1502–1510.**

The aim of this systematic review was to evaluate the survival rate of short dental implants placed in the posterior area of the maxilla. The electronic literature search of studies published between January 1, 2010 and February 29, 2020 was performed using specific word combinations. The outcome was to meta-analyze the implant survival rate (ISR). The search generated 238 potential studies. After screening procedures, only 9 randomized controlled trials fulfilled the inclusion criteria and were selected for qualitative and quantitative analysis. The ISR of short implants ranged from 91.9% to 100%, while the standard-length implant ISR ranged from 82.9% to 100% with a follow-up from 1 to 5 years in function. The risk ratio difference was 1.24 (95% confidence interval: 0.63–2.45,  $P = .52$ ) for short dental implant failure when compared to standard dental implants and was not statistically significant. Based on the evidence of the included studies, short implants ( $\leq 6$  mm) reported high survival rates over short to medium follow-up in the posterior maxilla, but the long-term success is as yet not demonstrated.

**Correspondence to:** carosipaolo29@gmail.com

**Jagadeesh KN, Verma AK, Parihar AS, Kochhar AS, Das AC, Razi MA. Assessment of the survival rate of short dental implants in medically compromised patients. J Contemp Dent Pract 2020;21:880–883.**

The aim of this study was to assess the survival rate of short dental implants in medically compromised patients. This follow-up study was conducted on 342 medically compromised patients of both genders (580 dental implants). The failure rate of dental implants was assessed. There were 142 patients with diabetes mellitus with 254 dental implants, 108 patients with hypertension with 190 dental implants, 26 patients with mental disabilities with 40 dental implants, 20 patients with oral cancer with 36 dental implants, and 46 patients with osteomyelitis with 60 dental implants. There were 60 (10.5%) short dental implant failures, of which a maximum of 25 (22.7%) had a 4-mm diameter. Maximum failure was seen with osteomyelitis

patients (8; 13.3%) followed by diabetes mellitus (32; 12.5%). Out of 270 dental implants in 130 control patients, implant failure was seen in 11 (4.07%). There was a significant ( $P < .05$ ) bone loss on follow-up at 6 months, 1 year, and 2 years. Medically compromised patients are more prone to dental implant failure compared to healthy subjects. Since medically compromised patients are prone to implant failure, careful selection of cases is necessary.

**Correspondence to:** dr.anujparihar@gmail.com

**Thoma DS, Wolleb K, Schellenberg R, Strauss F-J, Hämmerle CHF, Jung RE. Two short implants versus one short implant with a cantilever: 5-Year results of a randomized clinical trial. J Clin Periodontol 2021;48:1480–1490.**

The aim of this study was to test whether or not the use of a short implant with a cantilever results in similar clinical and radiographic outcomes compared to two adjacent short implants with single tooth reconstructions. A total of 36 patients with two adjacent missing teeth in the posterior region were randomly assigned to receive either a single 6-mm implant with a cantilever (ONE-C) or two 6-mm implants (TWO). Fixed reconstructions were inserted 3–6 months after implant placement and patients were re-examined up to 5 years (FU-5). A total of 26 patients were available for reexamination at FU-5. The survival rate amounted to 84.2% in ONE-C and to 80.4% in TWO (intergroup:  $P = .894$ ). Technical complication rates amounted to 64.2% (ONE-C) and to 54.4% (TWO) (intergroup:  $P = 1.000$ ). From baseline to FU-5, the median changes of the marginal bone levels were 0.13 mm in ONE-C and 0.05 mm in TWO (intergroup:  $P = .775$ ). Probing depth, bleeding on probing, and plaque control record values showed no significant differences between the two treatment modalities ( $P > .05$ ). Short implants with a cantilever render similar clinical and radiographic outcomes compared to two adjacent short implants at 5 years; however, they tend to fail at earlier time points, suggesting an overload of the implants. Considering the modest survival rates, the clinical indication of either treatment option needs to be carefully evaluated. ClinicalTrials.gov (NCT01649531).

**Correspondence to:** daniel.thoma@zzm.uzh.ch

**Li Q-L, Yao M-F, Cao R-Y, Zhao K, Wang X-D. Survival rates of splinted and nonsplinted prostheses supported by short dental implants ( $\leq 8.5$  mm): A systematic review and meta-analysis. J Prosth 2022;31:9–21.**

The aim of this study was to evaluate and compare the implant survival rates, marginal bone loss, and mechanical complications of prostheses supported by splinted and nonsplinted short implants ( $\leq 8.5$  mm). Electronic database (MEDLINE, CENTRAL, Web of Science, and EMBASE) and manual searches up to May 2021 were conducted to identify studies that compared splinted and nonsplinted short implants ( $\leq 8.5$  mm). The primary outcome was implant survival rate. Secondary outcomes were marginal bone loss and mechanical complications. The quality of included studies and risk-of-bias were assessed according to the Newcastle-Ottawa Scale. A random-effects model was used to analyze the data. A total of 12 studies fulfilled the inclusion criteria and featured 1,506 short implants (596 nonsplinted and 910 splinted) with a follow-up time ranging from 1 to 16 years. Quantitative analysis found no statistically significant differences between splinted and nonsplinted short implants ( $\leq 8.5$  mm) for survival rate (RR = 0.98; 95% CI = 0.96, 1.01;  $P = .26$ ) and marginal bone loss (SMD =  $-0.08$ ; 95% CI = 0.23, 0.07;  $P = .28$ ). Veneer chipping, abutment screw breakage, screw loosening, and loss of retention were reported in the selected studies as common complications. However, no statistically significant difference was found between splinted and nonsplinted short implants (RR = 0.56; 95% CI = 0.20, 1.54;  $P = .26$ ). Within the limitations of the present meta-analysis, it might be concluded that splinted short implants ( $\leq 8.5$  mm) do not present superior performance in survival rate, marginal bone maintenance, or prevention of mechanical complications compared with single-unit prostheses.

**Correspondence to:** wangxd33@mail.sysu.edu.cn