

# Outcomes of Placing Short Dental Implants in the Posterior Mandible: A Retrospective Study of 124 Cases

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**Purpose:** The purpose of this retrospective study was to determine the overall success of short dental implants (8 mm in length) placed in the partially or completely edentulous posterior mandible restored with fixed and removable prostheses.

**Patients and Methods:** A total of 124 patients had 335 8-mm-long implants placed from May 2005 until June 2007. Of the 124 total patients, 35 were men and 89 were women, with a median age of 56 years and an age range of 18 to 80 years at the time of implant surgery. There were 112 patients who were partially edentulous and 12 who were completely edentulous. Of the patients, 32 had a single implant placed whereas the other 92 had multiple implants placed. One patient had the implants immediately provisionally loaded. All of the implants were restored by use of fixed prostheses. Of these fixed prostheses, 245 were splinted together whereas 75 were restored individually.

**Results:** A total of 335 short dental implants were placed in 124 patients. Of the 335 implants placed, 331 integrated successfully. In the 2 cases that failed, the sites were grafted with porous hydroxyapatite and platelet-rich plasma. The implants were replaced at 5 months after the initial failure in the first patient and at 7 months in the second patient. These replacement implants integrated and have been restored and in function for more than 16 months. There was 1 fracture of an implant with a restoration. The implant had been restored with an individually fabricated fixed restoration, with the fracture occurring at the head of the implant, requiring removal. The implant and restoration had been in function for 10 months before fracture. There were no other fractures of implants or restorative hardware noted in this study. The survival rate for 8-mm implants placed in the mandible was 99% from stage I surgery to a functional prosthesis for up to 2 years.

**Conclusions:** Placement of short dental implants is a predictable treatment method for patients with decreased posterior mandibular bone height.

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Placement of endosseous dental implants is subject to anatomic limitations. In the posterior mandible that limitation is the position of the inferior alveolar nerve. Methods to increase vertical height of the posterior

mandible, such as autogenous bone augmentation and inferior alveolar nerve repositioning, have shown high levels of morbidity.<sup>1-11</sup> For patients with inadequate vertical height of the posterior mandible, placement of short-length dental implants can be considered.

Although many studies have shown higher failure rates for shorter-length implants, recent reports have shown success rates comparable to longer-length implants.<sup>12,13</sup> In 2006 Misch et al<sup>13</sup> published a literature review of failure rates associated with dental implants less than 10 mm long in the posterior regions of partially edentulous patients undergoing placement from 1991 to 2003. They reported that among the 2,837 short implants, the survival rate was 85.3%. Moreover, they and other authors have shown that most of the failures occurred after prosthetic loading and that the failure rate was independent of implant length.<sup>14-26</sup>

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**FIGURE 1.** Clinical case example of edentulous mandible with decreased bone height in posterior region.

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**FIGURE 3.** Eight-millimeter implants in posterior mandible that are splinted to longer implants in anterior mandible.

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The aim of this retrospective study was to determine the success of short dental implants 8 mm in length placed in the partially or completely edentulous posterior mandible from June 2005 through May 2007. These implants were restored with fixed restorations that were either splinted together or restored individually.

**Patients and Methods**

A total of 124 patients who had 8-mm-long dental implants placed from June 2005 through May 2007 were identified for the study. Patients presented and were treated for replacement of single and multiple teeth in the partially or completely edentulous mandible. Of the 124 patients, 35 were men and 89 were women. The median age of the patients was 56 years, with a range of 18 to 80 years, at the time of implant surgery.

Alveolar availability at the edentulous sites was evaluated through the use of an Orthopantomograph (Instrumentarium Imaging, Milwaukee, WI) and/or i-CAT 3-dimensional dental imaging system (Imaging Sciences International, Hatfield, PA). This allowed the most anatomically accurate depiction of the patient's arches in terms of not only vertical height but also buccolingual width and shape of the alveolus. The



**FIGURE 2.** Six short dental implants placed in posterior mandible.

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information provided by 3-dimensional imaging allowed determination of the most appropriate length of implant leading to the most predictable surgical outcome. All patients in this study had less than 10 mm of available alveolar bone height above the inferior alveolar nerve and were therefore surgical candidates for short dental implants (8 mm in length).

A total of 335 short dental implants were placed in the partially or completely edentulous mandible during this period. These implants were surgically placed following the original protocol described by Brånemark et al<sup>27,28</sup> of a 2-stage procedure. All implants were uncovered after 3 to 6 months with the exception of 1 patient who had the implants provisionally restored with an immediately loaded fixed provisional prosthesis. There were 112 partially edentulous patients and 12 completely edentulous patients identified in the study. Of the patients, 32 had single implants placed whereas the other 92 had multiple implants placed. These patients all underwent restoration with fixed implant-supported prostheses that were either splinted together or individually restored.

**Results**

A total of 335 short dental implants were placed in the 124 patients from June 2005 through May 2007 (Figs 1-3). All implants were 8 mm in length, with a diameter ranging from 3.5 to 6.0 mm. A total of 42

**Table 1. IMPLANT DIAMETER AND LENGTH DISTRIBUTION**

Implant Diameter and Length	No. of Implants	% of Implants
3.5 × 8 mm	42	12
4.3 × 8 mm	212	65
5.0 × 8 mm	75	21
6.0 × 8 mm	6	2

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**Table 2. IMPLANT RESTORATION TYPE**

Implant Restoration	No. of Implants	% of Implants
Fixed, splinted	255	77
Fixed, individual	75	23

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implants were 3.5 mm in diameter, 212 were 4.3 mm in diameter, 75 were 5.0 mm in diameter, and 6 were 6.0 mm in diameter (Table 1).

Of the 335 implants, all but 4 implants in 2 patients integrated from stage I surgery to the final prostheses. The first patient had 3 implants placed in the right posterior mandible that did not integrate. The patient was a heavy smoker, and even though recommendations to cease smoking were made to all patients, no patient was refused implant placement or excluded from the study based on this or any other lifestyle factor. Despite this, there are multiple reports confirming that smoking leads to a higher failure rate of dental implant osseointegration during the initial healing phase.<sup>29-31</sup> The site in this case was grafted, and 5 months later, the 3 implants were replaced. In the second patient the implant placed in the region of the mandibular left third molar became infected and was removed. A bone graft was placed in the area of the mandibular left third molar, and 7 months later, an implant was placed mesial to the initial site. In both cases the failed sites were grafted with porous hydroxyapatite (Pro Osteon; Interpore Cross International, Irvine, CA) and platelet-rich plasma (Harvest Technologies, Plymouth, MA). All 4 implants that were replaced osseointegrated successfully. These implants have since been restored and have been in function for more than 16 months.

All patients had stage II surgery performed 3 to 6 months after the stage I procedure. Most of these patients then underwent restoration by the referring dentist within 1 month, with all restorations completed by 3 months from uncovering. All implants were restored with a fixed restoration that was either splinted together or restored individually (Table 2).

**Table 3. EIGHT-MILLIMETER IMPLANTS RESTORED WITH FIXED RESTORATIONS SPLINTED TOGETHER**

Duration of Restoration	No. of Implants	% of Total Implants
<1 yr	46	18
1-2 yr	167	65
≥2 yr	42	16

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**Table 4. SHORT IMPLANTS RESTORED WITH FIXED RESTORATIONS INDIVIDUALLY RESTORED**

Duration of Restoration	No. of Implants	% of Individual Implants
<1 yr	11	15
1-2 yr	30	40
≥2 yr	34	45

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Of the implants, 245 (77% of the total) were restored with fixed restorations that were splinted together. Of the restorations, 42—comprising 13% of the total—have been in function for more than 2 years whereas 167 (50% of the total) have been in function for more than 1 year (Table 3).

The remainder of the implants were restored with a fixed restoration that was individually restored. Of these, 34 (10% of the total) have been in function for more than 2 years whereas 30 (9% of the total) have been in function for more than 1 year (Table 4).

The dentition opposing the restored 8-mm implants comprised 4 categories. The majority of the restored implants, 125 (38% of the total), were opposed by fixed restorations by use of crowns for fixed partial dentures; 67 (20% of the total) were restored opposite the patients' natural dentition; 91 (28% of the total) were restored opposite a fixed implant-retained restoration; and 47 (14% of the total) were restored opposite either a complete or removable denture (Table 5).

After the implants were restored, there was 1 fracture of an implant. This implant was restored with an individually fabricated fixed restoration. The fracture occurred at the head of the implant, requiring removal via trephination. The site has been grafted and is awaiting maturation before replacement of the implant. The implant and restoration had been in function for 10 months before fracture.

Implant success was defined in this study as clinical evidence of osseointegration at stage II surgery and, after restoration, loss of cervical bone around the implant-retained restoration of less than 1 mm for the first year and 0.1 mm for each successive year. The overall

**Table 5. DENTITION OPPOSING 8-MM IMPLANTS**

Opposing Dentition	No. of Implants	% of Total Implants
Natural teeth	69	21
Fixed restoration	125	37
Implant-retained fixed restoration	92	28
Removable or complete denture	28	14

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**Table 6. CUMULATIVE SUCCESS RATE OF SHORT-LENGTH IMPLANTS**

Total No. Placed	Total No. of Implants With Failed Osseointegration	Total No. of Implants That Failed After Restoration	Success Rate
335	4	1	99%

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survival rate for short dental implants placed in the mandible was 99% (Table 6).

## Discussion

A treatment option of short dental implants is of benefit to both the patient and the surgeon (Table 7). For the patient, there is the avoidance of the surgical procedures of autogenous bone grafting and nerve transposition. Not only are these additional procedures, but they also have associated negative sequelae of donor site morbidity for the bone graft and sensory alterations of the mental nerve for nerve transposition procedures. There is also a significant cost savings via obviation of the procedures and the benefits of decreased treatment time and less discomfort. For the surgeon, there is the benefit of placing a smaller implant in the confined space of the mouth and the ability to offer implant therapy to a patient population that had previously been denied.

Most of the implants that were placed in this study were restored with fixed prostheses that splinted the implants together. This was done by the referring dentists because of the poor bone quality in the posterior mandible and the high occlusal loads that are borne by the posterior teeth. Studies by Guichet et al<sup>32</sup> have shown better sharing of occlusal loads and distribution of stress with splinted versus individually restored implant designs. Rangert et al<sup>33</sup> also concluded that prostheses supported by 1 or 2 implants

**Table 7. ADVANTAGES OF SHORT IMPLANTS**

- Less bone grafting in height
  - Less time for treatment
  - Less cost of treatment
  - Less discomfort
- Less surgical risk
  - Paresthesia
  - Osteotomy heat
  - Adjacent tooth root
- Surgical ease
  - Decreased interarch spaces
  - Less inventory/cost

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**FIGURE 4.** Short dental implants immediately loaded in area 20 and 21 with 4.3 × 8-mm implants.

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that were replacing missing posterior teeth were at an increased risk of bending overload. It is of note that the 1 failure of a restored implant was with an individually restored fixture, even though it made up a minority of the restorations.

Even though for most of the cases, the surgeon chose a 2-stage procedure for implant placement, there is a huge advantage of offering patients a treatment option in which the implants undergo immediate provisional restoration at the time of surgery. It has been documented in the literature that immediate loading is successful and that the total surgical time is decreased, stage II is eliminated, and the patient does not have to wear a removable prosthesis in the interim.<sup>34,35</sup> However, there are limited studies on the efficacy of immediate loading of short dental implants. Recently, Degidi et al<sup>36</sup> reported on 133 short dental implants that were immediately loaded, with a survival rate of 97.7%. They also concluded that implant length and diameter were not a limiting factor to implant success. In our study there was 1 patient who had 2 implants immediately provisionally restored. The patient was a 56-year-old woman who was partially edentulous in the mandible. She had implants placed in the areas of the lower left second and first bicuspid, which were 4.3 mm in diameter and 8 mm long (Fig 4). The patient recovered uneventfully, and the definitive restoration was delivered 4 months after surgery. The implants have been in function for more than 1 year.

Short-length (8-mm) dental implants offer an effective treatment alternative to bone grafting and nerve lateralization for the height-deficient atrophic posterior mandible. Further long-term follow-up and evaluation will be needed.

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