Short dental implants in reduced alveolar bone height

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Reduced alveolar bone height is very common in the posterior jaws. The current treatment modality to replace the missing teeth with an implant-retained fixed partial denture includes sinus bone grafting in the maxilla and onlay bone graft in the mandible. These procedures are invasive and require more time and cost. Short dental implants are used as an alternative treatment modality to bone grafting procedures. To enhance success rate, certain principles should apply. Short implants could provide comparable results to those of longer implants. The present article reviews the current literature on the use of short implants, discusses the biomechanical considerations when utilizing short implants, and presents a case. *(Quintessence Int 2010;41:xxx–xxx)*

Key words: alveolar bone, fixed partial denture, PFM-FPD, porcelain-fused-to-metal, short implant[Au: additions ok?]

Clinicians often face challenges when placing implants in an area of reduced alveolar bone height. This is seen in both the maxilla and mandible due to alveolar bone resorption, pneumatization of maxillary sinuses, and the presence of anatomical structures (eg, inferior alveolar nerve). The accepted treatment for this condition has been conventionally to perform a sinus lift and bone grafting procedure. Despite good predictability and success rate of grafting procedures, patients are often reluctant to undergo the surgery because of the risks, morbidities, cost of the procedure, and the stress of undergoing an invasive procedure. Short implants (≤ 8 mm) have been introduced recently as a potential alternative treatment to bone grafting procedures in patients with limited alveolar bone height in the posterior maxilla and mandible.[1–5]

This article reviews the current literature on the use of short implants and presents a case treated with short implants.

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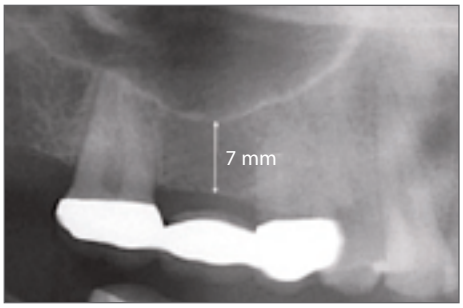
CASE REPORT

A 47-year-old white female in good general health presented with porcelain fracture on a three-unit porcelain-fused-to-metal fixed partial denture (PFM-FPD) replacing the maxillary right first molar. The porcelain fracture was limited to the pontic area with metal exposed. Clinical examination revealed wear facets on the occlusal aspects of all teeth. The attrition of the teeth was compatible with bruxism. The parafunction could be the etiologic factor for the porcelain fracture. In addition to the clinical examination, periapical radiograph showed excellent marginal adaptation of the retainers (second premolar and second molar) (Fig 1). The patient was not aware of the parafunction and never had a nightguard prescribed.



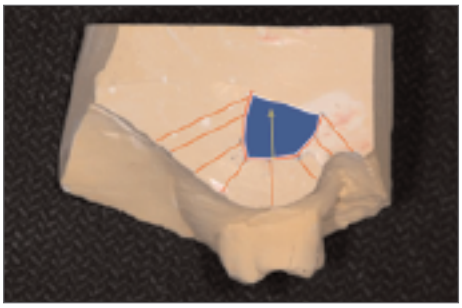



Fig 1 *(left)* Pretreatment radiograph, showing limited bone height.
Fig 2 *(center)* Clinical ridge mapping.
Fig 3 *(right)* Schematic illustration of an A. B. short implant.

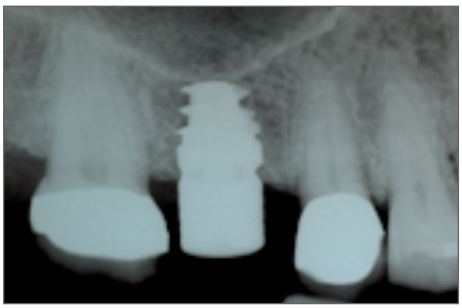
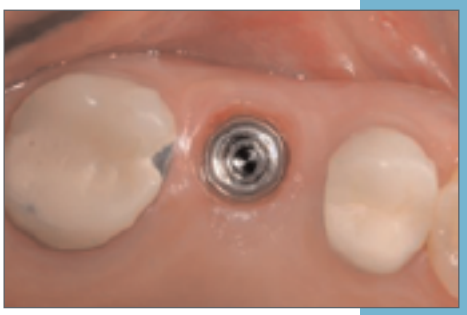




Fig 4 *(left)* Postsurgical clinical presentation of the healing screw.
Fig 5 *(center)* Radiograph obtained after the placement of an I5, 6 × 6 mm implant with healing abutment. **[Au: what is I5?]**
Fig 6 *(right)* Clinical occlusal view of the implant restorative platform.

Three treatment options were presented to the patient: *(1)* replacement of the PFM-FPD with a new PFM-FPD; *(2)* to section the pontic, keep the retainers on the second premolar and second molar intact, and replace the missing first molar with an endosseous implant-retained crown; and *(3)* removal of the remaining porcelain from the pontic and casting of a PFM single onlay (U shape) to address the esthetic and functional deficiencies.

Because of lower sinus location and lack of alveolar bone height for placement of an implant of conventional length, sinus lift procedure was introduced to the patient as an adjunct to the implant surgery. Being a health care provider and working as a nurse in a hospital, she was reluctant to accept the sinus lift procedure, as for her it was an invasive procedure that she did not approve. The idea of keeping the two crowns intact was appealing to the patient. The option of placing a short-length implant was presented to the patient and discussed with her. The patient accepted the short implant option.

Before implant placement, alveolar bone volume was measured using panoramic and periapical radiographs and clinical ridge mapping. Bone volume was found to be 7 mm in height and 8 mm in width (see Figs 1 and 2).

A short, tapered, wide-diameter implant (A. B. Dental Devices, I-5 6 × 6 mm)**[Au: What is "I-5"? Legend used "I5."]** was placed in the edentulous site (Fig 3). This self-tapping implant design consists of very sharp and deep threads, which increase the implant surface area, resulting in an improved primary stability. The implant was torqued to 32 Ncm.

According to a single-stage procedure (nonsubmerged), a healing screw was connected (Fig 4). Periapical radiograph was taken to confirm implant orientation, which was found to engage the cortical bone of the sinus floor (Fig 5). The healing process was within normal limits. No adverse effects were reported.

Six months postimplantation the healing screw was removed (Fig 6). Final impression

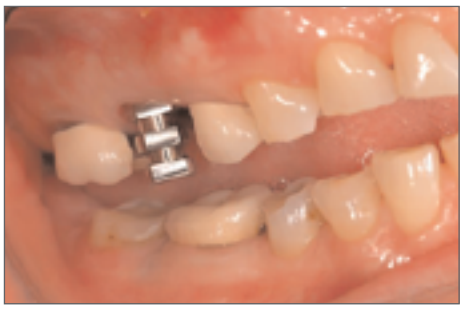
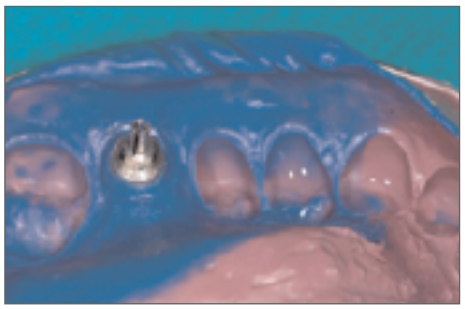
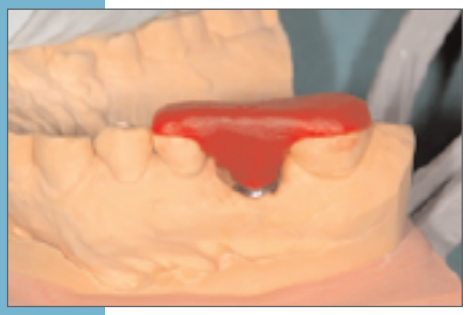



Fig 7 *(left)* Close-tray, press-fit, hex-locked impression coping in place.
Fig 8 *(right)* Final impression obtained.



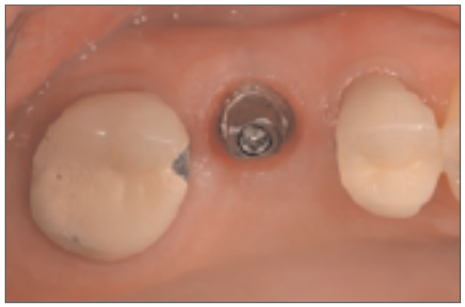


Fig 9a *(left)* Hex-locked abutment on model with a resin jig for proper placement.
Fig 9b *(center)* Abutment positioned in the mouth with a resin jig.
Fig 9c *(right)* Final abutment in place.

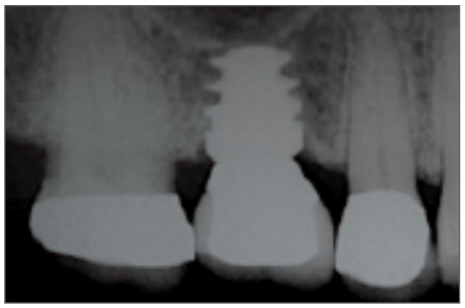



Fig 10 *(left)* PFM crown, temporarily cemented with Tempbond.
Fig 11 *(right)* Posttreatment radiograph of the implant, abutment, and crown.

was taken using a press-fit, hex-locked impression coping (A. B. Dental Devices) (Fig 7).

Polyether, heavy-body impression material, Impregum,[Au: Who is the manufacturer?] and light-body material, Permadyne (3M ESPE Pentamix) were used to pick up the impression coping (Fig 8). A straight hex-locked abutment was placed, using a resin jig for its ideal orientation (GC Pattern Resin LS, GC) (Fig 9).

A PFM crown was fabricated and temporarily cemented (Tempbond-Ne, Kerr)[Au: Please confirm product/mfr names. confirm use of "Ne."] (Fig 10). A postinsertion radiograph was taken showing the platform switch concept used to better maintain the alveolar bone crest (Fig 11). To address the parafunction, a light occlusal contact in centric occlusion and complete disclusion in lateral and protrusive excursions were performed. In addition, a Hawley bite appliance with anterior platform was prescribed as a nightguard.

The 18-month follow-up revealed no clinically significant findings. The patient's esthetics and function were satisfactory.

DISCUSSION

In the last decade, studies revealed conflicting results concerning the long-term survival and success rates of short implants.[6,14][Au: There is no ref 14; but see query in reference list. Please verify/fix numbering.] One of the difficulties encountered when evaluating these studies is the subjectivity of the term "short" implants. Most of the studies consider short implants as being less than 10 mm,[5–7] while few studies have included implants of 7 mm or less in length.[8,9]

Implant length is generally selected according to the maximum amount of bone height present at the recipient site. This is based on the principle that longer implants provide better primary stability and a favorable distribution of occlusal forces due to an increased total surface area.[10,11] However, an important difference exists between total surface area and functional surface area. Total surface area represents the overall surface area of the implant, while a functional surface area represents the area that transfers the compressive and tensile loads to bone and does not include the passive portion of the implant.[10] It was illustrated that unlike what occurs with the stresses applied to a natural tooth and the periodontal ligament, stresses around implants are greatest at the crest of the ridge and less[Au: or "least"?] in the apical portion.[10,12,13] Based on this principle, an increased length would simply improve primary stability of the implant during initial placement and enhance osseointegration. On the other hand, a wider diameter implant would increase not only primary stability but also the functional surface area at the crestal bone level, and thus lead to a better distribution of occlusal forces to the surrounding bone. Therefore, short wide-diameter implants should bear functional stresses as effectively as longer implants.

Several parameters need to be evaluated before the placement and restoration of short implants. The type of bone is an important variable when placing implants. Since bone quality is considered a major risk factor for implant failure because of the lack of primary stability, the increased stability provided by the wide diameter would be a considerable advantage especially in the posterior maxilla where bone quality and quantity is often less than ideal. Prosthetic loading of short implants also requires careful planning. Most studies on short implants have reported that these implants can be restored with any type of prosthesis (ie, single crowns, FPDs, and removable prostheses).[4] However, crown-to-implant ratio, excessive occlusal forces, and presence of cantilevers are some of the risk factors that may lead to an increased stress on the implants and may therefore compromise implant survival.[5] Other parameters are the distance between the threads (thread pitch) and the depth of the threads. High number of threads and deeper threads provide greater surface area that could compensate for the short length implant.

SUMMARY

The aim of this report was to evaluate and discuss the clinical use of short wide-diameter implants in the posterior maxilla as an alternative treatment modality to sinus bone grafting procedures.

In this case, an existing FPD was replacing the missing maxillary first molar. Therefore the easiest treatment plan would probably have been fabrication of a new FPD. One of the disadvantages of an FPD is the difficulty to maintain good home care. By replacing the missing tooth with a single implant-retained crown, the patient was able to floss her teeth (something she could not do before).

In selected cases, short wide-diameter implants could be used effectively in an area of limited bone height, and therefore represent an appropriate alternative treatment option to bone grafting.

The authors would like to add that although short wide-diameter implants could provide sufficient primary stability and functional surface area, further research on their long-term success in cases of reduced alveolar bone height is still necessary.

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