IMPLANT THERAPY IN VERTICALLY ATROPHIC RIDGES: **A Rationale for Short Implants**

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Abstract: There is often some degree of atrophy in sites where implants are to be placed. Pathologic conditions such as periodontitis, endodontic infections, or trauma can have a considerable impact on the alveolar ridge, causing horizontal or vertical bone resorption. As presented here, one solution for the treatment of alveolar ridges with compromised vertical height is the use of short implants, which have demonstrated favorable clinical results comparable to standard-length implants in the literature.

Key Words: implant, short, atrophic, ridge, arch

Numerous therapeutic options are available for performing tooth replacement in patients with vertical deficiencies of the alveolar ridge. One such solution is to augment the alveolar bone prior to implant placement. Vertical augmentation of the alveolar bone may be accomplished by distraction osteogenesis, guided bone regeneration, or block graft. These techniques have the potential to restore aesthetics and function by allowing the placement of restorations that are similar in proportion and appearance to the teeth they are replacing. Sinus augmentation and nerve repositioning constitute additional therapeutic options in the posterior maxilla and mandible, respectively. Both techniques increase the vertical height of the alveolar ridge without raising the bone level relative to the occlusal plane. Therefore, they will not affect the aesthetics, as the proportions of the restoration will not change after the sinus lift or nerve repositioning. One of the limitations of these techniques is their invasive nature and potential morbidity. Vertical augmentation techniques generally have lower predictability than do other augmentation techniques.

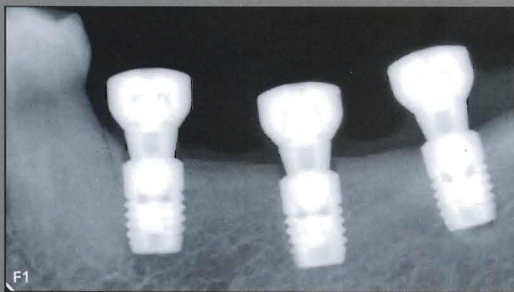
Another therapeutic option for vertically deficient alveolar ridges is the application of short dental implants (Figures 1 through 3). Short implants are defined by some as shorter than 10 mm,[1] while in other studies 10 mm implants are referenced as short implants.[2,3] The European Academy of Osseointegration (EAO) consensus has defined short implants as those 8 mm or shorter.[4,5]

Characteristics of Short Implants

One of the theoretical concerns expressed regarding short implants is the possibility that they will not be able to dissipate the occlusal forces acting on them. The effects of implant length on its ability to distribute stress has been investigated by finite element analysis.[6] Results have shown that most of the stresses are concentrated around the implant's neck, regardless of its length. Moreover, this study found that the difference between stress values on the bone surrounding implants with lengths of 8 mm and 17 mm was only 7.3%. Therefore, longer implants do not appear to offer a significant biomechanical advantage to reduce the peak stresses to surrounding bone.

Clinical Outcome of Short Implants

Although the theoretical considerations of stress distribution are important for an understanding of the biomechanical forces on an implant, the clinical outcomes achieved with implants are the most significant therapeutic considerations. Studies have observed the increased failure (ranging from 13% to 26%) of short implants.[2, 7-9] The implants in these studies, however, have a number of features that may have contributed to their increased failure. Higher failure rates have been observed with machined implants placed by standard techniques. This has included countersinking and the application of screw taps, both techniques that may



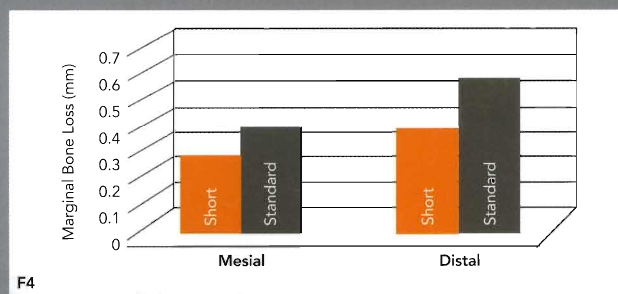


FIG 1: Short implants can be particularly beneficial when used in posterior regions where access can be difficult. FIG 2: Postoperative view demonstrates successful placement of a short (< 10 mm) implants. FIG 3: One-year radiograph of a 4.0s x 6-mm OsseoSpeed™ implant (Astra Tech) placed to replace a missing maxillary first molar with limited vertical height due to sinus proximity. FIG 4: Marginal bone loss in mesial and distal aspects of short- and standard-length OsseoSpeed implants (Astra Tech).

Implants		Implant number (patients)	Mean follow-up (months)	Cumulative survival rate
Short implants				
Standard implants				

TABLE 1: Clinical Outcomes of Short- and Standard-Length OsseoSpeed Implants

reduce primary stability of implants and remove the crestal bone—the most dense portion of the alveolar ridge. Bahat had observed that 60% of failed short implants were the only fixtures in the posterior segment.[10] Subsequently, Bahat reported that when distal-most implants were excluded, the survival of short implants was similar to that of standard implants.[11]

A second set of studies on short implants have also found higher failure rates compared to those of standard-length implants. Since the failure rate of short implants in this group of studies ranged from 5.3%[12] to 9.8%,[13] however, these rates were considered adequate by the authors. It has been asserted that the relatively low morbidity of short implants offers significant advantage over strategies to augment the ridge and place long implants.

A number of studies have reported that implant length does correlate with its survival.[3,14-17] These studies have observed the failure rate of short implants ranging from 0.7% to 19.7% compared to standard implants, which ranged from 0% to 16.6%. Most of the short implants in these studies with favorable survival rates had rough surfaces and, as these were more recent investigations, the authors often used surgical placement techniques designed specifically for short implants.

One of the concerns with short implants has been the possibility that, in the event of lost crestal bone, the remaining length may not provide adequate support for their restoration. Therefore, it is reasonable to examine which implant parameters are responsible for the stability of crestal bone. The addition of microthreads at the implant neck has been shown to be a factor leading to increased crestal bone stability.[21] Another factor has been a conical prosthetic connection, which has been suggested as an important design feature that helps preserve the integrity of peri-implant marginal bone and soft tissues.[14,19]

The authors have followed the outcomes of OsseoSpeed™ implants (Astra Tech) of varying lengths (Table 1). Results have demonstrated that among 31 implants (4.0s x 6 mm) studied in 13 patients over a mean of 10 months, the cumulative survival rate (CSR) was 100%. The CSR for 128 4.0s x 8 mm OsseoSpeed implants in 51 patients followed for a mean 28 months was 97.9%. Conversely, 98.2% CSR was observed for 792 OsseoSpeed implants of varying diameters, with standard lengths ranging from 11 mm to 17 mm, which were followed for a mean of 30 months. No statistically significant differences were found among the three groups. The authors also analyzed marginal bone levels in the mesial and distal aspects of short- and standard-length OsseoSpeed implants; results in Figure 4 have demonstrated no statistical differences between the marginal bone levels of short- and standard-length implants.

Short implants can help in distributing implants favorably around the arch in areas that could have only been treated after augmentation therapy.

Another concern expressed about short implants has been the possibility of their unfavorable crown-to-implant ratio. This theoretical concern has not been borne out by clinical studies.[5,20] The authors, too, have examined crown-to-implant ratios for short- and standard-length OsseoSpeed implants (Astra Tech). The crown-to-implant ratio of the short implants was 1.3, while that of standard-length implants was 0.8. The crown-to-implant ratios of retained and failed implants did not differ significantly among the groups.

Conclusion

Short implants offer an alternative therapeutic option for the management of alveolar sites with vertical atrophy. The clinical outcomes of short implants compare favorably to those of standard-length implants. As some of the theoretical concerns with short implants have been expressed as an extrapolation from natural teeth paradigms, such concerns are not necessarily applicable to osseointegrated implants. Short implants can help in distributing implants favorably around the arch in areas that could have only been treated after augmentation therapy.

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