

The Case for Smaller Diameter Implants

Dear Editor,
Previous work in the dental literature has discussed occlusal over load of dental implants in function.¹ Thus larger diameter implants have been advocated.¹ However, there are other considerations that may come into play that effect the longevity of an implant. The major parameters are displacement of the implant, occlusal overload, and percutaneous circumference.

It may be that the actual larger displacement of large diameter implants impedes bone remodeling, especially at the crest where the bone may be thinner at the facial and lingual as compared with the deep medullary bone.^{2,4} Even if the crestal bone is greater than 1.8 mm the larger implant may prevent adequate angiogenesis for bone remodeling.^{3,5} Blood supply is important for remodeling. Large diameter implants generally have higher removal torque at initial placement and better stability than smaller diameter implants.¹ However, the large physical displacement of wide diameter implants may impede bone remodeling. There may be resorption but not apposition.² There may be a physical barrier for the blood supply that would inhibit apposition but allow resorption to occur.^{2,6-8}

Assuming, for the sake of simplicity, a length of 10 mm and the implant is a cylinder, the volume of a 5.7 mm implant is 255.047 cubic mm. The volume of a 2.5 mm × 10 mm implant, again assuming a cylinder, is 49.06 cubic mm. This larger volume may physically impede blood supply and thus impede activity of osteoclasts and osteoblasts thereby impeding remodeling, which in turn may make the cervical supporting bone and epithelial attachment susceptible to peri-implantitis.

Occlusal overload is not generally an issue with large diameter implants due to the large surface area. Dental implants are capable of resisting an axial load beyond human capability. Off-axial loads, however, may not be adequately resisted by the facial or lingual cortices depending on bone quality and volume. A large diameter implant spreads any off axial loads over a larger area than small diameter thus lowering the per square millimeter load on the supporting bone.³

Mini implants, <3.0 mm in diameter, may demonstrate little or no bone loss over many years of service.⁹ Nonetheless there is a larger per-square-millimeter load on the supporting bone. Thus control of the off-axial occlusal load is key. Nonetheless, the small surface area puts a larger per-square-millimeter load on the bone. This necessitates more dense bone or multiple splinted implants to lessen the risk for overload on the supporting bone.⁶⁻⁸

Percutaneous circumference may put larger diameter implants at risk for peri-implantitis.^{2,4} Large diameter implants have a much larger percutaneous circumference as compared with small diameter implants. The small diameter/circumference may lessen the risk for late peri-implantitis. At least 1 study suggested that larger diameter implants may be more

prone to peri-implantitis.⁵ The percutaneous circumference of a 5.7 mm implant is 15.7 mm whereas that of a 2.5 mm diameter implant is 7.85 mm, which is a dramatic difference. The smaller circumference presents less of an opportunity for invasive bacteria and less risk for any epithelial detachment and infection.⁶⁻⁸

CONCLUSIONS

Impeded remodeling and increased percutaneous exposure may increase the risk for peri-implantitis in large diameter implants. There may be less risk for peri-implantitis with small diameter implants. Large diameter implant fixtures could be more prone to late peri-implantitis. Long-term randomized controlled studies are needed to elucidate this issue. It may be appropriate to only place implants of a diameter to a maximum of 4.7 mm because larger diameters may impede bone remodeling and present a longer percutaneous exposure. It is not known what thickness, volume, or quality of bone is needed to adequately resist a given occlusal load. It may be that small diameter implants may be surprisingly able to survive long-term occlusal loads. Thus, when selecting an implant for a site, it may be better to err on the side of thin.

Dennis Flanagan, DDS, MSC
Willimantic, Conn

REFERENCES

1. Alghamdi A, Alshehri F, Alghamdi M, Sukumaran A. Influence on dimensions on the primary stability and removal of short dental implants. *J Dent Oral Health*. 2015;1:12.
2. Jimbo R, Janal MN, Marin C, Giro G, Tovar N, Coelho PG. The effect of implant diameter on osseointegration utilizing simplified drilling protocols. *Clin Oral Implants Res*. 2014;25:1295-1300.
3. Spray JR, Black CG, Morris HF, Ochi S. The influence of bone thickness on facial marginal bone response: stage 1 placement through stage 2 uncovering. *Ann Periodontol*. 2000;5:119-128.
4. Ozgur GO, Kazancioglu HO, Demirtas N, Deger S, Ak G. Risk factors associated with implant marginal bone loss: a retrospective 6-year follow-up study. *Implant Dent*. 2016;25:122-127.
5. Bilello G, Currò G, Messina P, Scardina G. Rapid palatal expansion: the role of microcirculation. *Minerva Stomatol*. 2015;64:155-165.
6. Froum SJ, Cho SC, Florio S, Misch CM. Use of narrow-diameter implants in treatment of severely atrophic maxillary anterior region with implant-supported fixed restorations. *Compend Contin Educ Dent*. 2016;37:334-339.
7. Froum SJ, Cho SC, Cho YS, Elian N, Tarnow D. Narrow-diameter implants: a restorative option for limited interdental space. *Int J Periodontics Restorative Dent*. 2007;27:449-455.
8. Cho SC, Froum S, Tai CH, Cho YS, Elian N, Tarnow DP. Immediate loading of narrow-diameter implants with overdentures in severely atrophic mandibles. *Pract Proced Aesthet Dent*. 2007;19:167-174.
9. Flanagan D. Mini implants supporting fixed partial dentures in the posterior mandible: a retrospective. *J Oral Implantol*. 2015;41:e138-e143.