A “Graft Less” Approach for Dental Implant Placement in Posterior Edentulous Sites

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Vertical bone augmentation techniques are more invasive than other procedures, and success rates often vary according to the surgical expertise of the clinician. As a result, there has been a trend over time towards minimally invasive treatment options in implant dentistry. This article discusses a “graft less” treatment philosophy that emphasizes the use of less-demanding augmentation techniques for the purpose of placing shorter implants in atrophic posterior sites, avoiding more complicated procedures for implant placement. In the posterior maxilla and mandible, the use of short implants (< 8.0 mm) can reduce the need for vertical bone grafting. Patients often prefer this strategy over more complex procedures that can cause complications, increase morbidity, and require longer treatment times with higher costs. When inadequate available bone is present for implant placement, planned bone augmentation procedures may be performed for the purpose of placing shorter implants; these procedures are less demanding, less invasive, and more predictable, allowing long-term outcomes for the implant-supported restoration. Int J Periodontics Restorative Dent 2019;39:771–779. doi: 10.11607/prd.4414

In the past, a common guideline for selecting implant size was to choose the maximum length without impinging on anatomic boundaries. When there was inadequate available bone for placement of a 10-mm (or longer) implant, surgeons often favored vertical bone augmentation to allow placement of a longer implant. However, vertical augmentation techniques are more invasive and less predictable, and success rates often vary according to the surgical expertise of the clinician. Several advancements have led to the greater use of, and better outcomes with, shorter and narrower implants. Microtextured implant surfaces enhance early bone formation and provide a higher percentage of bone-implant contact. Design improvements in the implant-abutment connection have resulted in better fit and greater stability. Stronger grades of titanium, including titanium alloys, improve implant strength and decrease the risk of fracture. The use of cone beam computed tomography and virtual implant planning allows clinicians to better evaluate constrained bone volumes for placement of implants with reduced dimensions.

There has also been a trend over time towards minimally invasive treatment options in implant dentistry. This approach attempts to avoid more complicated procedures involving bone augmentation for
implant placement. In the posterior maxilla and mandible, the use of short implants (≤ 8.0 mm) can reduce the need for extensive vertical bone augmentation. The use of reduced-diameter implants in the posterior region is also well documented, allowing rehabilitation without augmentation or using smaller simultaneous grafts. Patients often prefer this strategy over more complex procedures that can cause complications, increase morbidity, and require greater treatment time and costs. This article discusses a “graft less” treatment philosophy that emphasizes the use of less-demanding augmentation techniques for the purpose of placing implants with reduced dimensions in atrophic posterior sites.

**Short Implant Outcomes**

Recent evidence-based reviews on short implants with textured surfaces reveal similar survival rates compared to standard-length implants. A systematic review and meta-analysis performed by Lemos et al evaluated 13 short-implant studies and found that implant survival was similar between standard and short implants (97.3% vs 96.1%, respectively). Additionally, no statistically significant difference was found between standard and short implants placed in posterior regions. Furthermore, there were no significant differences between implant length in the maxilla or mandible. Analysis of the studies evaluating marginal bone loss showed no significant difference between short and standard implants. These positive findings also support the inclusion of an 8.0-mm-length implant in the standard-implant category. However, when evaluating implants < 8.0 mm, there were slightly lower survival rates than standard implants. A recent systematic review on the long-term effectiveness (> 5 years) of extra-short implants (< 6.0 mm) found a mean survival rate of 94% (90% in the maxilla; 96% in the mandible) and a maximum bone loss of 0.53 mm. Therefore, extra-short implants should be used with some discretion, especially in the maxilla.

One consistent finding is that when short implants fail, it typically occurs early in the healing period. This may be due to reduced bone-implant contact and difficulty in obtaining primary stability in a constrained bone volume with compromised bone quality. Short implants designed with a tapered body and/or a more-aggressive thread design may provide better anchorage and improve primary stability.

Some clinicians question using short implants, as they may create an unfavorable crown-to-implant (C/I) ratio. Biomechanical studies have shown that the implant crown height, including the abutment, is much more influential than the implant length. Three systematic reviews revealed that marginal bone loss and the survival rate of implants did not seem to be influenced by the C/I ratio of the implant prosthesis. However, greater implant crown height can increase the incidence of technical problems. Several studies have found that an unfavorable C/I ratio could be considered a potential risk factor for screw loosening and abutment fractures in posterior areas.

When using short implants to replace multiple teeth, the implant crowns may be splinted to help reduce this complication.

One important consideration is that many studies compare the survival rates of short and longer implants placed in native bone. The survival rate of short implants should actually be compared with the success rate of more invasive, staged grafting procedures to place longer implants. Large bone augmentation procedures are very technique-sensitive, and poorer outcomes and more complications are expected when performed by less experienced clinicians. Although the use of short and/or reduced-diameter implants still requires surgical expertise and careful planning, they offer an opportunity for less experienced clinicians to avoid complex augmentation procedures and successfully treat their patients with less surgical risk and morbidity.

**“Graft Less” Vertical Bone Augmentation**

**Posterior Maxilla**

Vertical bone augmentation is included among the treatment options for managing posterior partial edentulism with jaw atrophy, as it allows the placement of short or standard-length implants. In the posterior maxilla, the sinus floor can often limit the bone available for implant placement. The management of maxillary atrophy and sinus pneumatization for dental implant
placement has evolved over the years. When sinus bone grafting was first developed, clinicians favored the use of long dental implants. This was thought necessary to achieve adequate surface area for integration, optimal biomechanical loading of the implant, and prosthetic support. In addition, shorter machined-surface implants (< 10 mm) showed lower survival rates in the posterior maxilla. Under these constraints, it was often necessary to perform sinus bone grafting through a lateral window approach to allow placement of longer implants. Improvements in implant materials, design, and surface properties have led to the increased use of shorter dental implants. Studies have shown that the survival rate of short implants in native bone below the sinus is the same as that of longer implants placed in grafted sinuses. However, sinus bone grafting has a higher incidence of complications, higher morbidity, greater cost, and additional surgical and healing times.

In the posterior maxilla, clinicians may favor using shorter implants, as they may avoid the need for grafting or reduce the volume of bone graft material needed for sinus floor augmentation. Use of shorter implants may also allow the surgeon to consider a transalveolar sinus floor lift for implant placement rather than a lateral window technique. For example, a vertical bone height of 6.0 mm below the sinus floor would allow placement of an 8.0-mm implant via a transcresstal lift. Although favorable outcomes have been reported with extra-short implants (6.0 mm) in the posterior maxilla, a systematic review found that implants < 8.0 mm placed using an osteotome technique had lower cumulative survival rates than longer implants. Following preparation of the implant osteotomy short of the sinus, an osteotome may be used to fracture the floor superiorly (Fig 1). Another alternative is to use osseodensification burs in a counterclockwise rotation to elevate the sinus floor and lift the membrane a few millimeters. The implant apex can tent the sinus mucosa, allowing a blood clot to form, or bone graft material may be introduced into the osteotomy and elevated superiorly before implant placement. If a lateral window approach is used for sinus grafting with simultaneous implant placement, it may also be advantageous to consider using a short implant (8.0 mm). The bone graft material surrounding the portion of the implant within the sinus cavity provides no additional primary stability. A smaller window size may be prepared, and less sinus mucosa manipulation is required; this can have a positive effect on vital bone formation.

A smaller volume of bone graft material is needed to place a shorter implant, and this in turn requires less healing time for bone formation. If there is minimal bone height and a lateral window technique is used for grafting and delayed implant insertion, shorter implant lengths may also be considered. However, the bone quality of the healed graft may be more critical with short implants. Using 100% bovine bone mineral for sinus grafting has shown favorable implant survival, but it produces smaller amounts of new bone and may compromise the bone-implant contact around a short implant. If a majority of the short implant would be placed in xenograft, it may be prudent to add local autograft or use an alternative bone substitute.

**Posterior Mandible**

Increasing bone height in the posterior mandible is more complex and less predictable than vertical bone augmentation in the maxilla via sinus bone grafting. Vertical bone augmentation procedures are more technically difficult and require advanced surgical skills; even when performed by experienced surgeons, complications are not uncommon and failure can occur. These procedures also increase costs, require greater healing time, and risk greater morbidity for the patient. In the posterior mandible, vertical bone augmentation can be achieved by guided bone regeneration, onlay block grafting, titanium mesh grafting, interpositional grafting, or distraction osteogenesis, but there is no consensus on which is the best method to deliver predictable results. Vertical onlay bone grafting in the posterior mandible, using a membrane or mesh, usually requires harvesting some autogenous bone or using a growth factor, such as recombinant human platelet-derived growth factor-BB or recombinant human bone morphogenetic protein-2. The most common complication of vertical augmentation with blocks, membranes, or mesh is wound dehiscence, which
can compromise bone formation or result in a complete failure. Most clinicians stage the augmentation procedure and place implants secondarily after bone healing. This increases the overall treatment time. Several studies on treating the atrophic posterior mandible with short implants vs various bone augmentation procedures for longer implants have all concluded that short implants may be the preferred and most predictable method. Implant and prosthetic survival are similar in comparison studies, but groups that underwent augmentation procedures had more complications.

Another viable option to consider for managing the partially edentulous patient with bilateral posterior atrophy is to extract the remaining teeth for implant placement in the anterior mandible. As few as four implants can be inserted between the metal foramina for a fixed prosthesis. In this situation, an immediate-load provisional prosthesis can be placed onto the implants as well. This alternative may be preferred if the periodontal or restorative prognosis of the remaining teeth is guarded or the caries risk is high. Overall, this option may be more costly, but the patient benefits from immediate implant replacement and a shorter treatment time than bone augmentation.

When placing short dental implants in the posterior mandible, it is critical to maintain a safe distance of a few millimeters from the mandibular canal. This allows for potential inaccuracies in radiographic measurements, drilling depth, and implant insertion. For example, if an 8.0-mm-long implant was planned in the atrophic posterior mandible, then at least 10.0 mm of available bone would be needed. Extra-short implants (6.0 mm) have favorable survival rates and bone maintenance in the posterior mandible. Therefore, vertical bone augmentation may not be required for placing extra-short implants until there is less than 8.0 mm of bone height superior to the canal. Ultrashort implants (4.0 mm) could be used when there is even greater atrophy, but they are not available in every country. When more severe atrophy is present, the clinician can consider augmentation for a more modest vertical bone gain to place short implants. Smaller amounts of augmentation (< 4.0 mm) may be accomplished with guided bone regeneration, using collagen or polytetrafluoroethylene membranes, titanium mesh, intrapositional grafting, or block bone grafting from the ramus. This lower thresh-

Fig 1 Preoperative cone beam computed tomography scan of (a) the right posterior maxilla and (b) the first molar site. (c) The implant osteotomy is prepared short of the sinus floor. (d) An osteotome was used to perform an internal sinus lift and insertion of bovine bone mineral. (e) Postoperative periapical radiograph and (f) clinical view of the 8.0-mm implant restored with a screw-retained crown at 3 years.
old for vertical bone augmentation may reduce surgical complexity and complications. The bone augmentation should be staged with the placement of short implants after graft healing. When multiple posterior teeth are missing, several short implants can be inserted for the support of splinted crowns.

“Graft Less” Horizontal Bone Augmentation

Sometimes there is adequate bone height for short implant placement in the atrophic posterior maxilla and mandible, below the sinus or above the canal, but the ridge has resorbed medially with deficient width. In these cases, it may be possible to perform a more predictable horizontal bone augmentation for the placement of short implants instead of attempting to gain additional bone height for longer implants. This is especially the case in the posterior mandible, where vertical bone augmentation is more difficult than sinus floor manipulation. Horizontal augmentation may be accomplished by guided bone regeneration, block bone grafting, titanium mesh grafting, or ridge expansion. The choice of technique may depend on the residual ridge dimension and morphology, the amount of bone gain needed, and the operator’s preferred method.28 Guided bone regeneration using a collagen membrane or titanium mesh grafting may be performed using locally harvested particulate bone and/or bone substitutes. A block bone graft can be harvested from the tuberosity or ramus, as these donor sites are in the same surgical field (Figs 2 and 3).37 Short implants may be placed upon graft healing. Ridge expansion can be considered if the ridge width is at least 3.0 millimeters.38 Implant placement may be performed simultaneously within the expanded ridge or staged after 2 months of healing. If simultaneous implant placement is performed, short tapered implants are useful as their shape does not require as much expansion at the base of the buccal cortex (Fig 4). If a full-thickness flap is reflected to perform the ridge split, the buccal cortex is at risk for resorption.39 In this instance, the buccal bone should be augmented with a protective layer of bovine bone mineral and covered with a collagen membrane.

Fig 2 (a) A ramus cortical bone graft was used for horizontal augmentation of the atrophic posterior mandible. (b) Cross-sectional image of the healed bone graft. (c) Clinical and (d) cross-sectional views of a 6.0-mm implant inserted into the healed bone graft in the posterior mandible. (e) Three dental implants were then placed into same healed bone graft and (f) restored with splinted crowns. (g) A postprosthetic periapical radiograph of the implants.
Fig 3 (a) Preoperative view of the left posterior maxilla. Note the facial concavity and slight vertical ridge defect. (b) Occlusal view of the narrow ridge in the left posterior maxilla. (c) A block bone graft was harvested from the tuberosity with a piezoelectric saw and (d) fixed to the maxilla with a screw. (e) The bone block was augmented with particulate autograft mixed with bovine bone mineral and covered with a ribose cross-linked collagen membrane. (f) The bone graft is well incorporated after 4 months of healing. (g) Short implants (4.2 × 8.0 mm) are inserted into the grafted posterior maxilla.
Conclusions

The successful use of short and/or reduced-diameter implants for prosthetic support offers clinicians and patients a less complex approach for replacement of the posterior teeth. When there is inadequate available bone, planned bone augmentation procedures may be performed for the purpose of placing short implants. This “graftless” approach allows clinicians to choose augmentation methods that are more predictable and less invasive than techniques previously used.

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References


