

# Prosthetic Management of Implants with Different Osseous Levels

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**T**he osseointegrated implant has become a standard treatment with a high degree of predictability for patients missing one or more teeth. It is especially recommended when the patient has a clear medical history and normal bone levels in both width and height in the edentulous areas. In constant search for improvement, clinicians find themselves looking into every element relating to the replacement of a missing tooth or teeth: existing bone structure, surgical technique, implant placement, implant design, abutments, implant-prosthetic connection, prosthetic components, and ceramic/restorative materials. When ultimately used together, these components attempt to mimic nature. A healthy environment promoting long-term stability of the implant-prosthesis is the primary goal and should not be compromised at any point. Clinicians must constantly push the envelope to solve more complex cases and work with knowledgeable patients who have developed higher expectations than ever before.

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## SURGICAL CONSIDERATIONS

Considering the technique and design<sup>1</sup> of the Brånemark implant, current protocols for implant indications have widened beyond belief. Implants are no longer limited to use in the anterior mandible but are also utilized in the posterior region, the maxilla, and under the sinus cavity. When considering implant placement, there are five main scenarios relating to the available bone:

1. Adequate bone in height and width allows for traditional implant placement.
2. Adequate width with a minimum of 5 mm of bone in height under the sinus cavity calls for the Summers Technique.<sup>2-4</sup> With this technique the sinus-lining membrane is elevated and, with minimum bone grafting, the implant is placed at the same appointment.<sup>5-10</sup>
3. Adequate bone height with deficient width requires bone grafting to build up the width. Although this is a complex process, it is fairly predictable and can offer excellent results.<sup>11-16</sup>
4. Available bone is often limited in all dimensions under the maxillary sinuses or in the mandibular posterior quadrants. While ridge-augmentation procedures have been employed for several years,<sup>17</sup> the predictability of crestal augmentation in the coronal direction is questionable.<sup>18</sup> In



**Fig 1a** Fixed resin-bonded composite provisional restoration with healing bone graft.

**Fig 1b** Loss of maxillary left canine due to vertical fracture. Mild bone loss and gingival recession is present.

**Fig 1c** Soft tissue profile after removing the healing cap. (Implant placed by Ken Peskin, DDS, oral surgeon, Skokie, Illinois.)



some instances, clinicians use remote intra- and extraoral donor sites, such as the mandibular symphysis and ramus, cranium, or hip bone, to harvest bone for sinus augmentation<sup>19-21</sup> or posterior bone grafting.

- When bone grafting has already been done but is still insufficient for proper implant placement, osteodistraction techniques are used to improve the bone bed.<sup>22,23</sup>

## CLINICAL CASES

Regardless of the reason teeth need to be extracted,<sup>19</sup> the management of the future implant site prior to and during the extraction is critical to the esthetic outcome of the restoration. Once a tooth has been set for extraction, consideration to orthodontic supraeruption, if at all possible, can improve the bone and soft tissue environment to predictably preserve the interproximal papilla.<sup>24,25</sup> This procedure may not always be implemented, due to the patient's preference, age, financial considerations, time, and the location of the affected tooth. If supraeruption was not part of the selected treatment, papilla preservation or regeneration will be limited to the success of the bone-grafting technique as well as the design of the provisional restoration. The provisional restoration must sup-

port the soft tissues immediately following the extraction, during the healing phase, and once the implant is uncovered.<sup>24,26-29</sup> Removable transitional appliances can be uncomfortable and bulky, and do not always support the soft tissues continuously; therefore, fixed composite-bonded restorations are preferred (Fig 1a). Once the implant has been uncovered (Fig 1b), soft-tissue contours will be established with the healing cap or with the new provisional restoration, which will restore esthetics, function, and guide the soft tissues to heal with the correct shape for the final restoration (Fig 1c).<sup>30</sup>

The best location for an implant in the anterior region is lingual to the incisal edge if the crown is to be screw retained.<sup>24,31</sup> If the implant is not placed deep enough, it could result in a final restoration with a bulky lingual contour. If the final crown has a lingual or transversal screw, or the crown will be cemented (temporarily or permanently), the implant can generally be centered where the root was present. Among the prosthetic benefits of having the implant centered within the best available bone is that a premachined 15-degree angle or custom abutment can be utilized (Fig 1d) and the natural incisal taper and lingual contour of anterior teeth can be more easily reproduced.

For the color selection of the final crown, it is important to consider color (Fig 1e) as well as the correct contours and texture. It is possible to have

**Fig 1d** Custom abutment allows for the correct buccal emergence profile and incisal contour of the restoration. Soft-tissue profile has been created with the provisional restoration.

**Fig 1e** Shade selection with conventional tab. Customized corrections with chroma and hue adjustments made based on tooth-tab discrepancies.

**Fig 1f** Black-and-white picture to determine if the selected shade has the correct value for the final restoration.

**Fig 1g** Horizontal lingual screw-retained crown for retrievability and better lingual contours.



1d



1e



1f



1g



**Fig 1h** (left) Final radiograph showing excellent fit of the crown and bone preservation around the implant.



**Fig 1i** (right) Final implant-supported crown on maxillary left canine. (Prosthetics by Sergio Rubinstein, DDS, and laboratory work by Fujiki Toshi, RDT.)

teeth with different chroma and hue, but if the wrong value is selected, the final restoration will clearly stand out (Fig 1f).

For many clinicians, the preference is to have the single-tooth implant-supported restoration cemented in place. However, it is an excellent alternative to have the crown screw retained to allow for ease of retrievability without damaging the crown (Fig 1g). Some of the advantages of this technique are an excellent fit to the abutment

since no cement is present (Figs 1h and 1i), no concern of leaving any subgingival cement, and ease of retrievability to make corrections to the crown or adjacent teeth if needed. By making the restoration retrievable, if an adjacent tooth is lost, the crown can be easily removed and the implant-abutment utilized to support a new provisional restoration, eliminating the need for a removable transitional appliance.



2a



2b

**Fig 2a** Maxillary central incisors with short roots and failing root canals.

**Fig 2b** Maxillary central incisor crowns with poor esthetics and anatomic contours. Altering the unfavorable proportions is critical to improve the final outcome of the new crowns.

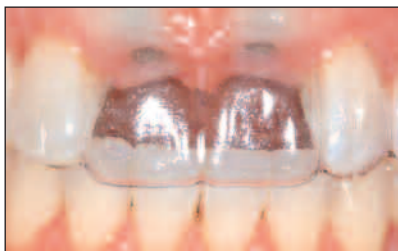


2c

**Fig 2c** Protrusion of mandibular incisor is a limiting factor on the creation of proper contour for the maxillary central incisor crowns.



**Fig 2d** Ovate pontics created with a removable appliance. Different tissue levels mean different bone levels. This could misguide the surgeon for proper depth during implant placement.



**Fig 2e** Buccal view of vacuum-form to guide surgeon with buccal contours and incisal edge position for proper implant placement.



**Fig 2f** Buccal view of impression post. (Implants placed by Nolen Levine, DDS, periodontist, Chicago, Illinois.)

Today having patients keep their teeth for as long as possible is not necessary in all instances. As clinicians help patients make the best decision for their dental treatment, it is important to tie such choices to the final outcome and its longevity.

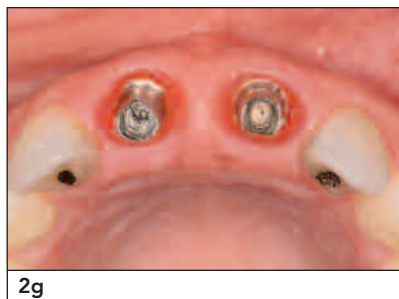
When a tooth has a failing root-canal treatment and/or has had an apicoectomy with unfavorable results (Fig 2a), the desirable approach is to extract the involved teeth and plan for replacement with implants, provided all indications are favorable.<sup>24</sup>

A clear understanding of the existing problems from the patient's point of view (Fig 2b) will ultimately allow the clinician to deliver a final restoration with the expected results. While proper shade matching is extremely important, especially

as it relates to anterior teeth, it is just as important to have correct contours, proportion, texture, and value on the final crown.

Clinicians cannot underestimate the importance of occlusion and anterior guidance for the longevity of restorations. Evaluation during the diagnostic phase (Fig 2c) must lead to proper treatment carried out until completion, thus helping to determine the success, short- and long-term, of the implant-crown unit. The lack of a periodontal ligament and decreased proprioception on the implant creates an impact on the design and loading forces that crowns will carry. Critical evaluation of the opposing dentition, as well as the overall status of the patient's occlusion, habits, and para-

**Fig 2g** Incisal view of modified temporary abutments guiding the soft tissue with provisional restorations. The gingival-buccal profile asymmetry needs to be corrected on the provisional restoration if correct contours are desired on the final restorations.



**Fig 2h** Final prepared ceramic abutments, screw retained for cementable crowns.



**Fig 2i** Buccal view of definitive all-ceramic crowns. (Prosthetics by Sergio Rubinstein, DDS, and laboratory work by Fujiki Toshi, RDT.)



**Fig 2j** Lateral view with final crowns and corrected position of mandibular incisor. (Orthodontics by Robyn Silberstein, DDS, Highland Park, Illinois.)

functional activity, may influence not only the design of the crown, but also the material selection.

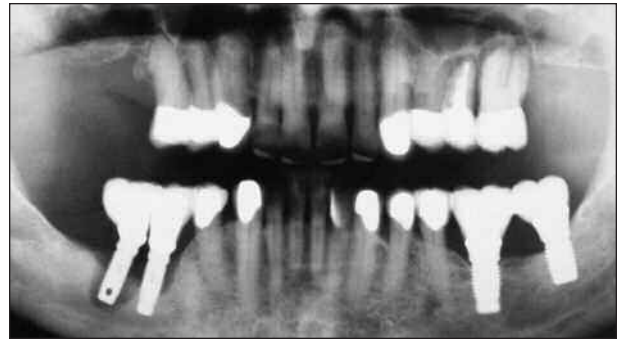
The more anterior the restoration is, the more critical the patient will be of the final result.<sup>32</sup> Once the teeth are extracted, osseous and soft tissue levels will shrink and need to be rebuilt, guided, and corrected during the early stages of treatment to achieve an esthetic outcome (Fig 2d). For this reason clinicians must always fabricate a diagnostic/radiographic/surgical guide to aid the surgeon in proper placement of the implants (Fig 2e). Even with planning and bone grafting, clinicians can sometimes find themselves with shortcomings in the levels of bone/soft tissue or in the final position of the implants (Fig 2f). With the aid of digitalized surgical guides, the sequencing from diagnostics and treatment planning to surgical execution has made the final implant location more predictable and accurate.<sup>33-37</sup> When dealing with anterior esthetics, it is critical to evaluate provisional restorations in light of the patient's expectations while the soft tissues are healing (Fig 2g). Determining if any

problems are present will facilitate the selection of angled, modified (Fig 2h), or customized prosthetic abutments<sup>38</sup> for the final crowns, which can correct misalignment and help reach the original prosthetic-cosmetic goals (Figs 2i and 2j).

When feasible, it is helpful to evaluate radiographs from previous years in order to piece together a longitudinal analysis on bone preservation or deterioration. It can help determine, with all the diagnostic procedures, what might have been the cause of the bone loss. The clinician must also consider genetics, iatrogenic factors, deficient oral hygiene, parafunctional habits, and/or occlusion. If, for example, there are only prosthetic restorations in the posterior quadrant where the bone loss is present, improper occlusal design of the restorations may be a contributing factor to the bone loss (Fig 3a). When implant-supported crowns are included in the equation, and vertical/horizontal bone loss is present, the lack of a passive fit is another possible reason for bone deterioration (Fig 3b), because of the lack of a periodontal ligament.



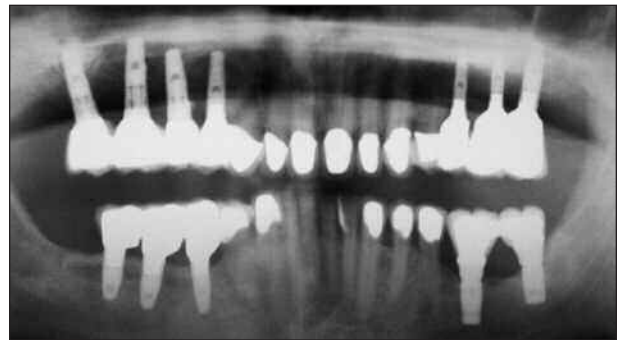
**Fig 3a** Full-mouth radiograph showing advanced posterior bone loss.



**Fig 3b** Panoramic radiograph 4 years later showing further posterior bone loss. Excluding the mandibular left quadrant, all maxillary posterior teeth present Class III mobility. Mandibular right implants with advanced bone loss and proximity to the mandibular nerve.



**Fig 3c** Surgical site after removal of maxillary second premolars and molar mandibular right implants. (Extraction and surgical cleanup by Maurice A. Salama, DMD, periodontist, Atlanta, Georgia; calvarian bone grafts and sinus bone grafts by JF Tulasne, DDS, oral surgeon, Paris, France.)



**Fig 3d** Final prosthetic reconstruction. (Implants placed by Maurice A. Salama, DMD; prosthetics by Sergio Rubinstein, DDS; and laboratory work by Fujiki Toshi, RDT.)

In the first stage, rebuilding the lost bone involves a surgical cleanup by removing hopeless teeth and failing implants to control periodontal disease. After initial healing has taken place, careful planning and precise execution is critical, since rebuilding bone in a vertical dimension is not a predictable procedure. Among the best donor sites for block grafting are bone from the skull, chin bone, lateral ramus in the mandible, and the hip (Fig 3c).

Even though posterior implants may not have the same esthetic demands of anterior implants, it is still crucial to utilize surgical guides, or acceptable alternatives, to direct the surgeon in proper mesiodistal and buccolingual implant placement.

After a minimum healing time of 4 to 6 months, final impressions can be taken and the fabrication of final restorations can proceed. Metal try-in is a

critical step to verify a passive fit of all implant components. Osseointegrated implants can carry vertical loads extremely well, while lateral stress is better absorbed if implants are splinted (Fig 3d). Therefore, preventing excessive lateral or torsional occlusal contacts on the prosthesis<sup>39-42</sup> will minimize undesirable lateral forces, for which a narrow occlusal table could prevent or reduce buccolingual cantilevering effects.

## CASE REPORT

Previous methods of approximating the buccal plate following extraction to speed up healing time lead to narrow ridges that complicate the placement of dental implants. A 23-year-old patient presented



4a

**Fig 4a** Patient is unhappy with the esthetics of the fixed prosthesis.



4b

**Fig 4b** Preliminary periapical radiographs showing hopeless prognosis for maxillary left lateral incisor.

**Fig 4c** Incisal view without prosthesis. Patient has undergone the extractions and two unsuccessful bone-grafting procedures.



4c

with dissatisfaction concerning the esthetics of an anterior fixed partial denture (Figs 4a and 4b). The patient wanted to improve the esthetics on his current fixed partial denture by using implants to replace the lost bone and root structure. Such bone loss would continue over time if the ridge was not stimulated with proper implant loading. While there was a thought to augment the soft tissue and create a fixed prosthesis from maxillary canine to canine, the patient wanted to rehabilitate the lost/collapsed bone from the missing roots, as well as increase the chewing comfort that can be achieved from utilizing dental implants. Several techniques have been used to induce vertical and horizontal bone augmentation,<sup>43-47</sup> with horizontal bone regeneration being a predictable technique. The healing following these techniques may be compromised by poor soft tissue beds secondary to multiple previous failed surgeries (Fig 4c). Distraction osteogenesis permits the regeneration of bone and stretching of the donor bed when less-than-ideal circumstances exist. Vertical height deficiency can be addressed using this technique, but it does not address the horizontal

deficiency and can often exacerbate it. As a result, subsequent onlay grafting has been utilized to permit placement of implants of adequate width and height (Figs 4d to 4k).

Over the last decade, a great deal of attention has been placed on the preservation, handling, manipulation, and regeneration of the interdental papilla.<sup>48-52</sup> It is important to understand this concept as it relates to dental implants, since the recommended distance between implants has been 3 mm,<sup>49,53-55</sup> with the accepted understanding that bone will be lost in the coronal aspect of the majority of implants. The ability to vascularize a column of gingival papillae above the crestal bone is variable, yielding varied interdental/implant esthetic results. The evolution of dental implants from a polished collar to microthreads, beveled collar, or new surface texture, as well as loading to a narrower table than the width of the implant,<sup>39,56-59</sup> may allow the clinician to vary the recommended distance, as long as implant collision is avoided and interimplant bone viability is not infringed upon. A better understanding of this newly



**Fig 4d** Donor site. (Surgery by Leslie B. Heffez, DMD,MS, oral surgeon, Highland Park, Illinois.)



**Fig 4e** Chin bone graft with particulate bone chips secured with gold screws. (Surgery by Leslie B. Heffez, DMD, MS.)



**Fig 4f** Osteodistractor.



**Fig 4g** Two-week postoperative insertion of osteodistractor, in place and ready to be activated. Note deficient bone at gingival level. (Surgery by Leslie B. Heffez, DMD, MS.)



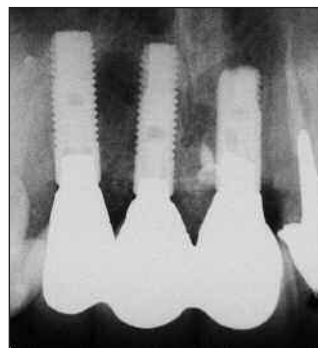
**Fig 4h** Incisal view of three implants with custom abutments tapped to accommodate a screw-retained prosthesis. (Implants placed by Leslie B. Heffez, DMD, MS.)



**Fig 4i** Buccal view of the three implants with the custom abutments after seven surgical procedures.



**Fig 4j** Buccal view of final prosthesis. (Prosthesis by Sergio Rubinstein, DDS, and laboratory work by Masayuki Hoshi, RDT.)



**Fig 4k** Final radiograph showing bone preservation by the implants.

formed attachment and biological-width relationship to implants will help determine its clinical predictability in bone and papilla preservation.<sup>60</sup>

## CONCLUSION

Today's technology and materials are beginning to allow the treatment of the mild to extreme bony

defects that ultimately determine the soft-tissue architecture. Treatment plans today are based on current knowledge. The ability to delay treatment may have, in some instances, untold rewards. As shown in several cases, clinicians now know that pre-extraction planning of hopeless teeth is paramount to avoid disfigurement of the soft tissues.



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