The concept of prosthetic-guided treatment plans has evolved over the years as a method for achieving and maintaining predictable results when replacing the natural dentition. To satisfy the ideal goals of implant dentistry, the hard and soft tissues need to present ideal volumes and quality. The alveolar process is affected so often after tooth loss that augmentation is usually indicated to achieve optimum results, especially in the aesthetic zones. Augmentation is also required relative to functional conditions of the implant treatment plan, because a reduction of stress at the crestal bone region and a greater resistance to screw loosening and fatigue fracture occurs with a greater number and/or larger-diameter implants.1

The number of key factors present to grow bone and the geometry of a bony defect are important considerations in the selection of a modality for ridge augmentation.2 The residual ridge deficit size and topography is a major key condition in the surgical approach for augmentation. The topography of the graft site affects soft tissue closure, space maintenance, graft immobilization, vascularization and the need for additional growth factors. It is also a factor for the selection of the graft material. The fewer the number of remaining bony walls in the host bone site, the greater the need for osteopromotive techniques. In 1993, Misch and Dietsh classified bone defects by the number of surrounding bony walls.3 Each of these topographies have different factors to consider when bone augmentation is performed. This article will present concepts related to the two- to five-wall bony defect.

Five-wall Bony Defect

When the surrounding bone of an extraction socket is greater than 1.5 thick on the facial, lingual, mesial, distal and apical regions, a five bony wall defect is present. This is an ideal environment for bone growth, as most all the keys necessary to grow bone are already present, especially when the conditions exist immediately after the extraction of a tooth. The space will be maintained by the surrounding walls of bone and the graft is immobilized by the bony walls. Growth factors are released and a regional acceleratory phenomenon (RAP) begins from the periodontal complex and walls of bone as a result of the tooth extraction. As a result, bone grows in the site, even without initial soft tissue closure over a graft material. However, the rate of bone and soft healing is affected by the absence and/or graft materials selected.4

Three- to Four-wall Bony Defect

In the periodontal literature, it is well documented that a defect next to a tooth root with three walls of bone can be restored more predictably than a defect with two walls of bone. Likewise, a defect with three to four walls of bone in an edentulous site can be augmented with fewer osteopromotive techniques than a defect with two walls of bone. Most often, a three- to four-wall defect in implant dentistry corresponds with a 0 to 3mm lack of facial bone. The bone is present on the lingual, mesial, distal and apical regions (four-wall defect), or the apical region is too narrow or compromised (three-wall defect).

Guided Bone Regeneration (GBR)

The three- to four-wall bony defect requires more keys for bone augmentation than a five-wall defect, including: soft tissue closure, space maintenance, more osteopromotive graft material and graft immobilization. For example, the graft material in a three- or four-wall defect more often requires an autograft as a

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component, although not always the only material. Guided Bone Regeneration (GBR) using a barrier membrane and longer healing time are also usually necessary. As a general rule, particulate grafts with or without a guided tissue membrane are easier to learn and to perform than block bone graft procedures. They incur less incision line opening, have less postoperative discomfort from donor sites, have less altered nerve feeling from the donor site, may be more easily adapted to complex bone geometries in the host site and may be used more easily at the same time as implant insertion.

**Two Bony Wall Defects**

The most common two bony wall defects are residual sites, which require more than 3mm horizontal augmentation to the facial and the lingual/palatal bony wall is usually still present, but may be also deficient. A bony wall defect is treated very different than a three- to five-bony wall defect. Since defect size is usually larger and fewer walls of bone are present for vacularization and stabilization of the graft, more autograft is required in the bone graft and primary closure is mandatory. Rather than using a little autograft material mixed in the graft mixture, it is of benefit that an entire layer of bone from the ramus or symphysis be placed directly on the receptor site. As a consequence, more often a donor site from the mandible is required. Incision line opening is more of a complication than a three- or four-wall defect, as the residual ridge form has less soft tissue and the soft tissue flaps must be advanced over the graft site.

Allografts and guided bone regeneration techniques have been used predictably in slight-to-moderate bone regeneration (primarily for inadequate width). However, these methods have limitations and have been found to produce less favorable results in the treatment of larger bone deficiencies. As a result, bone augmentation with GBR are usually limited to width augmentations of less than 3mm. The larger the defect, the less predictable the GBR result. Hard and soft tissue contours are more difficult to predict beyond this dimension. Extended healing times are necessary beyond 3mm of augmentation. The bone quality is often less than ideal in these defects. As a consequence, when more than 3mm of augmentation is required, more advanced osteopromotive procedures are indicated, including block bone grafts to fulfill the prosthetic-guided treatment plan. In other words, autologous cortical/trabecular bone grafts may be considered the gold standard in the repair of moderate to severe alveolar atrophy and bone defects. Block-type grafts are usually harvested from the residual ridge, mandibular symphysis, body, or ramus area. However, extraoral sites may be required in larger graft sites. The width
and height requirements for augmentation will influence the donor site selected. As a general rule, when more than 4mm of width is desired, the mandibular symphysis is the most common donor site. A mandibular ramus is selected as a donor site when the bone graft width is less than 4mm. The ideal goal of a donor block harvest is to obtain sufficient bone, so the entire bone defect/augmentation dimensions are composed of the block autograft.

**Summary**

Prosthetic driven treatment plans in implant dentistry often require bone augmentation procedures to improve aesthetics and/or biomechanical stress factors. The reduced bone volume is one of the more important factors to consider when determining the osteopromotive techniques to predictably obtain ideal bone volumes. An extraction site may be surrounded by bone (a five-wall defect) and most any treatment method may be successful. When only a minimum to moderate amount of bone width augmentation is required (four- to three-wall defect) GBR procedures are effective. A two-wall defect (less bone in the site and more augmentation required), requires more advanced procedures, as block bone grafts. Regardless of the procedures, the goal is to obtain ideal bone volumes, which support the aesthetics and function of the final restoration.

**References**


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