Evolution of Bone Grafting for Improved Predictability

When the time comes to reflect the tissue and learn the results of the bone graft placed 16 to 24 weeks earlier, the overriding concern is, "Will the bone graft result in enough bone for proper implant placement?" Personally, I have been doing bone grafts since 1983. Early on, the results were often disappointing, but with the advances in bone graft products and techniques, the likelihood of achieving a successful result has improved. The clinical life of the Implant Dentist who provides bone-grafting services is certainly easier today than it was in 1983. Every aspect of bone grafting has improved considerably. These developments have resulted in not just having "enough bone" but, rather "having enough bone in the right place."

Simion et al,[1] in 1998, reported on vertical ridge augmentations using a nonresorbable membrane and autogenous bone grafts around dental implants. The findings revealed a significant 5.0 mm increase in bone height at 7-month re-entries. However, there was a 20% complication rate.[1] Sixteen years later Urban et al[2] reported an average 5.45 mm vertical height gain with titanium-reinforced, dense-PTFE membranes and a combination of particulate autogenous bone and anorganic bovine bone-derived mineral. No complications were observed.[2] The modest gain in vertical height in comparison to Simion's work appears to be of marginal clinical significance; but the reduction in complications from 20% to 0% makes for improved patient satisfaction and less anxiety for the clinician.

Surgical implantation of biologics has further improved predictability with results that are oftentimes remarkable. Recombinant BMP-2 use in vertical alveolar ridge augmentation as an additive or stand alone agent in a collagen carrier has been shown to induce significant bone formation.[3] Recombinant PDGF-BB and growth factors found in PRP/PRF have demonstrated the capacity to enhance and accelerate bone regeneration.[4,5,6] For the most part, biologics have been accepted by the profession and are used routinely. These agents can be technique sensitive; therefore, manufacturer's directions must be followed. Recombinant BMP-2, PDGF-BB, and autogenous PRP/PRF are just the beginning of an exciting era that will lead to the use of additional biologics in implant dentistry.

Adult mesenchymal stem cells (MSCs) are being used today as additives for bone growth in various oral reconstructive procedures. Jakobsen et al[7] recently provided a literature review for the intraoperative use of MSCs in oral surgery, tissue engineering, sinus augmentations, and bone regeneration. It was concluded that MSCs could be used for bone augmentations; however, satisfactory results are not always seen. Therefore, before MSCs become a first-choice treatment, more predictable outcomes need to be observed.[7]

Through continued research, stem cells should further improve the predictability of bone grafting procedures. Dental pulp stem cells can be harvested from extracted teeth, isolated, stored in liquid nitrogen, thawed, and at a future point in time, differentiated into osteoblasts. Additionally, self-renewing pluripotent stem cells are being isolated from whole blood and reprogrammed into a variety of cell lines. This defies the notion of tissue-specific stem and progenitor cells.

There are many unsolved clinical problems with this technology, but when (*not if*) this technology is mastered, bone grafting should be even more predictable.[8] We are all fortunate to be involved in implant dentistry during these evolving times.

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