# Simple Bone Augmentation for Alveolar Ridge Defects

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**KEYWORDS**

• Osteoconductive • Osteoinductive • Bone grafting • Alveolar defect • Block graft augmentation • Ramus graft • Chin graft • Socket preservation graft

**KEY POINTS**

- Alveolar augmentation is frequently required to restore volume lost as a result of disuse atrophy (acquired and congenital), dentoalveolar trauma, infection, periodontal disease, traumatic extractions, and previous failed implant insertion.
- Practitioners are required to have a basic understanding of grafting principles, bone physiology, autogenous graft harvest techniques, and modern grafting materials to reliably and predictably restore lost alveolar volume.
- Numerous grafting materials are available for alveolar reconstruction and include autografts, allografts, xenografts, synthetic grafts, and osteoinductive agents.
- Numerous grafting options are available for in-office use, including socket preservation grafting, particulate onlay grafting, block onlay grafting, ridge split, interpositional osteotomy, distraction osteogenesis, and guided barrier regeneration.
- As bone sources continue to evolve, the previous "gold standard" will continue to shift toward nonautogenous sources and shorter treatment times.

## INTRODUCTION

The global dental implant market was valued at approximately $6.8 billion in 2011 and is estimated to grow at a compound annual growth rate of 9% per year between 2011 and 2016.[1] In 2013, an estimated 1,260,000 dental implant procedures were performed in the United States, and this number is expected to double within the next 7 years.[2] The US dental implant market is currently valued at approximately $900 million and is expected to grow at a rate of 9% per year between 2011 and 2021.[2,3] As the perceived profitability of dental implants increases, so does the number of "implant surgeons" within the market place. In 2006, the American Academy of Implant Dentistry estimated that of the number of dentists placing dental implants, 56% were general dentists.[2] As the number of general practitioners placing dental implants increases, the complexity of implant and grafting procedures performed by the oral and maxillofacial surgeon will continue to increase, as the simpler cases are "cherry picked" by our general dentistry colleagues. It is auspicious that oral and maxillofacial surgeons' advanced knowledge of oral anatomy and grafting principles will enable continued success and advancements in dental implants and alveolar bone grafting.

Many patients who desire dental implant placement present with significant alveolar bone loss as a result of disuse atrophy (acquired and congenital), dentoalveolar trauma, infection, periodontal

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disease, traumatic extractions, and previous failed implant insertion.[4] Before dental implant placement, alveolar ridge augmentation procedures are frequently required to correct reverse maxillomandibular relationships, to correct vertical distance discrepancies between the jaws, to re-create ideal interarch occlusal relationships,[5,6] and to add sufficient bone volume to allow for restoration-driven implant placement. Fortunately, although the harvest of extra-oral bone is typically required to reconstruct large bone defects, most alveolar ridge defects are amendable to reconstruction with alloplastic bone, osteoinductive agents, or the harvest of bone from intraoral sites.[7]

Numerous grafting options are available for alveolar reconstruction and include autografts, allografts, xenografts, synthetic grafts, and osteoinductive agents. Most practitioners realize the advantages and disadvantages of the available grafting materials and select various grafting options based on the location, size, and nature of the site to be augmented. For argument's sake, the ideal grafting material would exhibit a combination of osteogenic, osteoconductive, and osteoinductive properties. It would possess high rates of incorporation with inconsequential resorption and minimal morbidity, provide reliable and proven long-term success rates, and be cost-effective.[4,7–10] In addition, the ideal graft material would allow for the sufficient bulk of bone to be regenerated that would allow for recontouring according to the recipient site and permit the placement of dental implants within the healed graft with a high success rate.[8]

The selection of a grafting procedure is based on the amount of bone missing from the recipient site, the restorative-driven treatment plan (number and location of desired dental implants), the availability of adjacent intraoral donor sites, the patient's willingness to accept complications, and the implant-to-crown time frame (1-stage vs 2-stage procedures). Autogenous grafts have often been referred to as the "gold standard" because they possess osteogenic, osteoconductive, and osteoinductive properties. However, autogenous grafts are often unpredictable, involve a second surgical site, have a higher morbidity than nonautogenous grafts, increased operating time, increased cost, and thus, are frequently unacceptable to the patient because of the abovementioned issues. When possible, intraoral bone harvesting is preferred to extraoral (cranium, hip, tibia) harvesting to eliminate the need for endotracheal anesthesia, gait disturbances, prolonged hospitalizations, and thus, added patient recovery and expense. Bone from a bottle (alloplastic, xenograft, and synthetic bone) eliminates the potential complications associated with the donor site, but typically lacks osteoinductive characteristics and the ability to transfer osteoprogenitor cells to the recipient site. Agents such as bone morphogenic proteins (BMP) possess osteoinductive properties without involving a second surgical site, but are often cost prohibitive and, depending on the site, are often used as an off-label application.

## GRAFTING NOMENCLATURE

### *Autografts*

Autografts are grafts harvested from the same individual (genetic match). They are typically considered the "gold standard" because autogenous grafts encompass all 3 mechanisms of bone healing (osteogenesis, osteoconduction, and osteoinduction).[11,12] Advantages of autogenous grafts include its nonimmunogenic characteristics, osteogenic potential, affordability, and the ability to acquire cancellous, cortical, or combination grafts depending on the requirements of the recipient site. Disadvantages of autografts include donor site morbidity, prolonged operating times, and lower patient acceptance rates.[13]

### *Allografts*

Allografts are grafts harvested from the same species, but are genetically different. They may be fresh, frozen, freeze-dried (lyophilized), mineralized, or demineralized. Most allografts are osteoconductive, although some possess osteoinductive properties as well. Advantages of allografts include a lack of donor site morbidity, shortened operating times, and numerous configurations of grafting mediums. Disadvantages of allografts include the inability to transplant osteoprogenitor cells, patient unwillingness to have cadaveric bone grafts due to the potential for disease transfer, and the fact that most allografts lack considerable osteoinductive capability.[14]

### *Xenografts*

Xenografts are grafts that are derived from the inorganic portion of bone from a different species (ie, bovine and porcine). Xenografts share many of the advantages of allografts, but debate exists concerning their efficacy compared with allografts. Compared with allografts, xenografts are reported to have increased connective tissue ingrowth, delayed vascularization, and slower rates of resorption.[15,16]

### *Alloplastic (Synthetic) Grafts*

Alloplastic (synthetic) grafts are grafts derived from nonbiologic materials, such as hydroxyapatite, calcium sulfate, and bioactive glass. Relatively few indications exist for the use of synthetic bone