Mandibular Ridge Augmentation Using a Mineralized Ilium Block: A Case Letter

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Introduction

Several dental procedures address implant placement in partially or totally edentulous patients. Problems associated with implantation in these patients often arise due to limited bone height or width of the mandible.[1] In such cases, mandibular augmentation is required before implantation can take place.[2–4] Other regeneration techniques, such as guided bone regeneration, also address these bone defects.[5,6] Some techniques focus on ridge augmentation before implant placement, while both procedures are performed simultaneously in others.[2,4]

Loss of residual ridge is an age-old and predictable problem that can affect treatment options as well as the final outcome. Bone responds to the forces placed upon it.[7] When the physiologic need for bone in a particular locale ceases to exist, the sequence of loss is predictable, has been well described, and can be classified into 6 atrophy stages.[8] Horizontal loss occurs quickly, while vertical loss occurs in the late stages.

The loss of teeth can create many problems, including the disintegration of jaw structure, loss of face support, and damage to the remaining teeth, which must bear the full stress of chewing. When enough teeth are missing, food choices and nutritional changes begin to cause medical problems and can affect general well-being. Even after the loss of 1 tooth, the jaw bone irreversibly changes if an implant does not replace the tooth.

While autograft is generally recognized as the most appropriate solution to regenerate the site of lost bone due to its osteoconductive, osteoinductive, and osteogenic properties, autograft is not an option for all patients.[9] Second-site morbidity, lack of volume of material needed, and patient wishes must all be considered. Block allografts have been used successfully in a number of selected applications.[10,11] When anatomy dictates, an alternative method of treatment used in ridge augmentation involves a mineralized ilium block, which has demonstrated application in a variety of specialties, including orthopedics, neurosurgery, and craniomaxillofacial procedures.[12,13] These block allografts have been demonstrated to support missing bone structure and remodel appropriately via normal regenerative pathways.[12] The following case presentation involves mandibular ridge augmentation using a mineralized ilium block allograft.

Case Report

A 25-year-old man presented with partial edentulism in the area of #20 to #28, with #22 and the roots of #25 and #26 remaining (Figure 1). A preoperative dental scan of the patient with template diagnostics showed considerable atrophy of the symphysis in this area (Figure 2). The areas with missing teeth had Cawood and Howell Class 3 to Class 4 ridges. Nothing in the patient's medical history precluded planned treatment.

Following administration of local anesthesia with 4% articaine and 1:200 000 epinephrine (Septodont, Louisville, Colo), a full-thickness dissection, decortication of the buccal aspect of the alveolar ridge, and grafting of the atrophic area were performed using 3 mineralized human ilium block allografts, (OraGraft, LifeNet Health, Virginia Beach, Va) (Figures 3 and 4). The blocks were secured using screws (Meisinger, Neuss, Germany). Corners were smoothed, and gaps between the block and the surgical bed were filled with a mineralized cortical particulate (OraGraft, LifeNet Health).

Ilium block grafts are unique in that they possess a cortical exterior with a cancellous center (Figure 5). The cancellous portion was easily trimmed and shaped for placement against the prepared surgical bed using standard dental instruments. The blocks and particulate material were hydrated using sterile saline. A resorbable membrane, Bio-Gide (Geistlich, Wolhusen, Switzerland), was used to cover the grafted area. No sutures or

Figure 1. Atrophy of the lower jaw.

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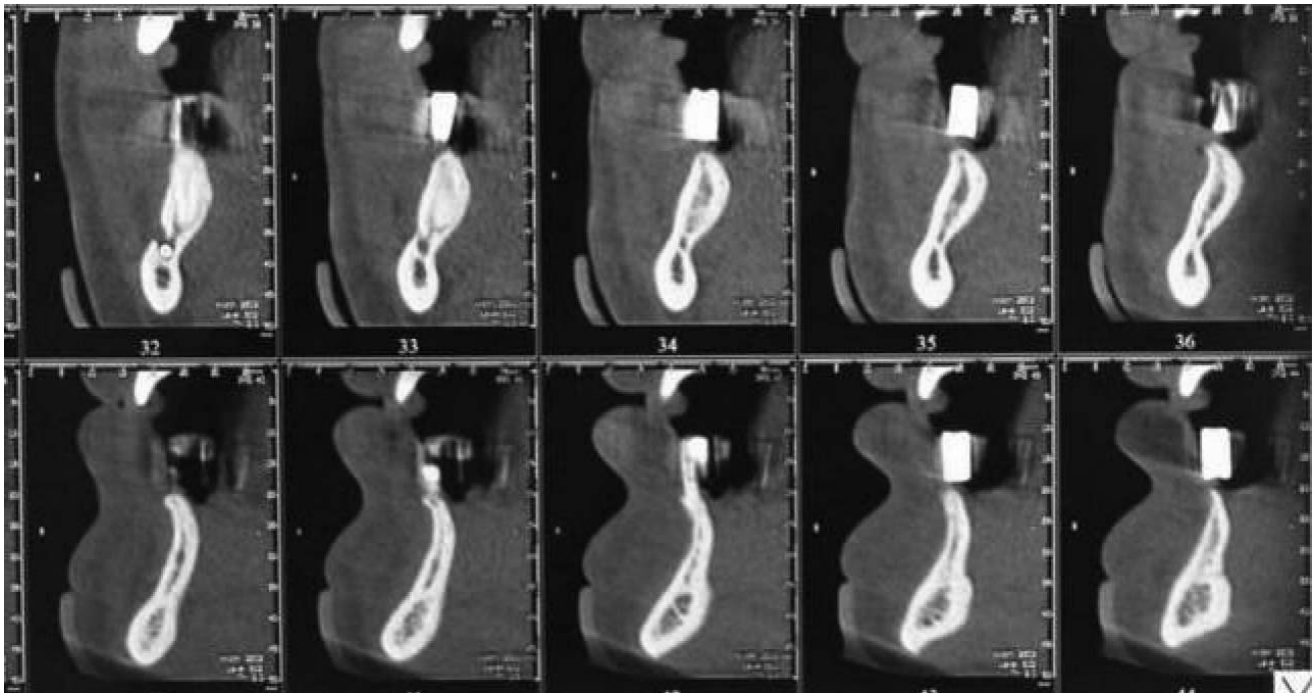
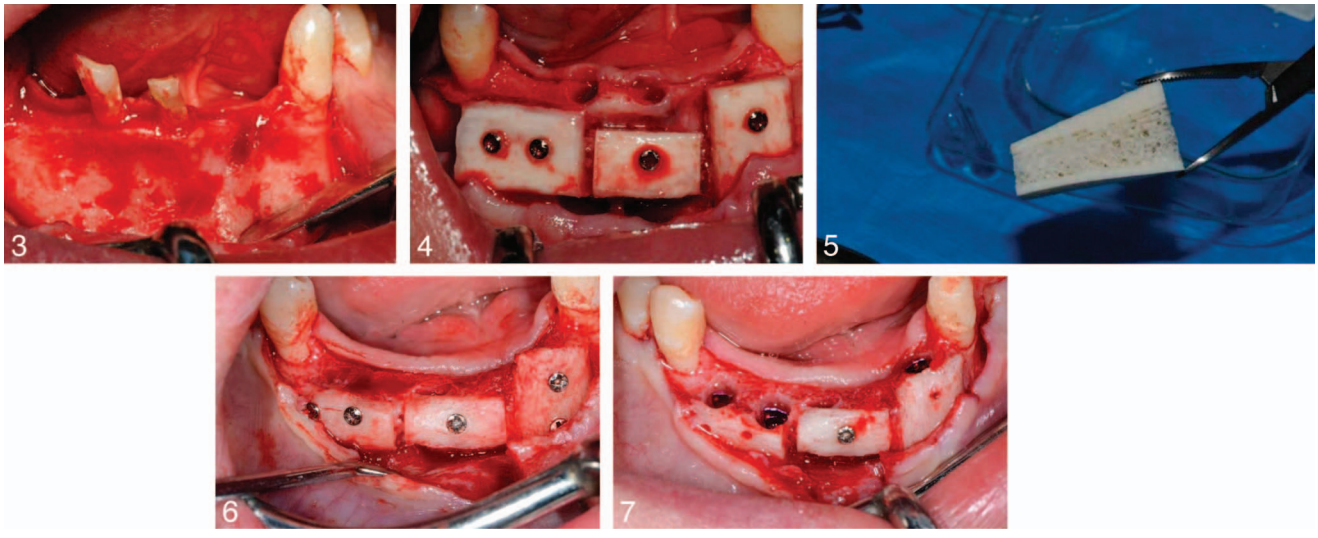


Figure 2. Preoperative template scan.

pins were needed for the membrane due to its hydrophilic and adhesive properties. The site was closed using Vicryl sutures (Ethicon, Somerville, NJ). The patient was provided with postoperative instructions and prescriptions for antibiotics (amoxicillin and clavulanic acid) for 10 days as well as analgesics (ibuprofen) as needed.

Three-month follow-up

The grafted area was exposed via a crestal incision (Figure 6). Little change in the shape of the block grafts was demonstrated over time. The blocks were checked for stability, and retaining screws were then removed. A screw was purposely left in one of the grafts to provide orientation. In areas where implants were to be placed, an osteotomy was performed to improve ridge contour, per the treatment plan (Figure 7). Three 3.75 × 11.5 mm ReActive implants (Implant Direct, Las Vegas, Nev) were placed in the prepared ridge. Healing caps were placed on the implants, and the area was closed with polytetrafluoroethylene Cytoplast sutures (Osteogenics, Lubbock, Tex).



Figures 3–7. Figure 3. Full-thickness dissection of atrophic area. **Figure 4.** Grafting of atrophic area with 3 mineralized human ilium block allografts. **Figure 5.** One of the cortical plates will be removed based on the surgeon's evaluation and surgical need. **Figure 6.** Three-month exposure showing stable grafting. **Figure 7.** Prepared implant site after ridge osteotomy.

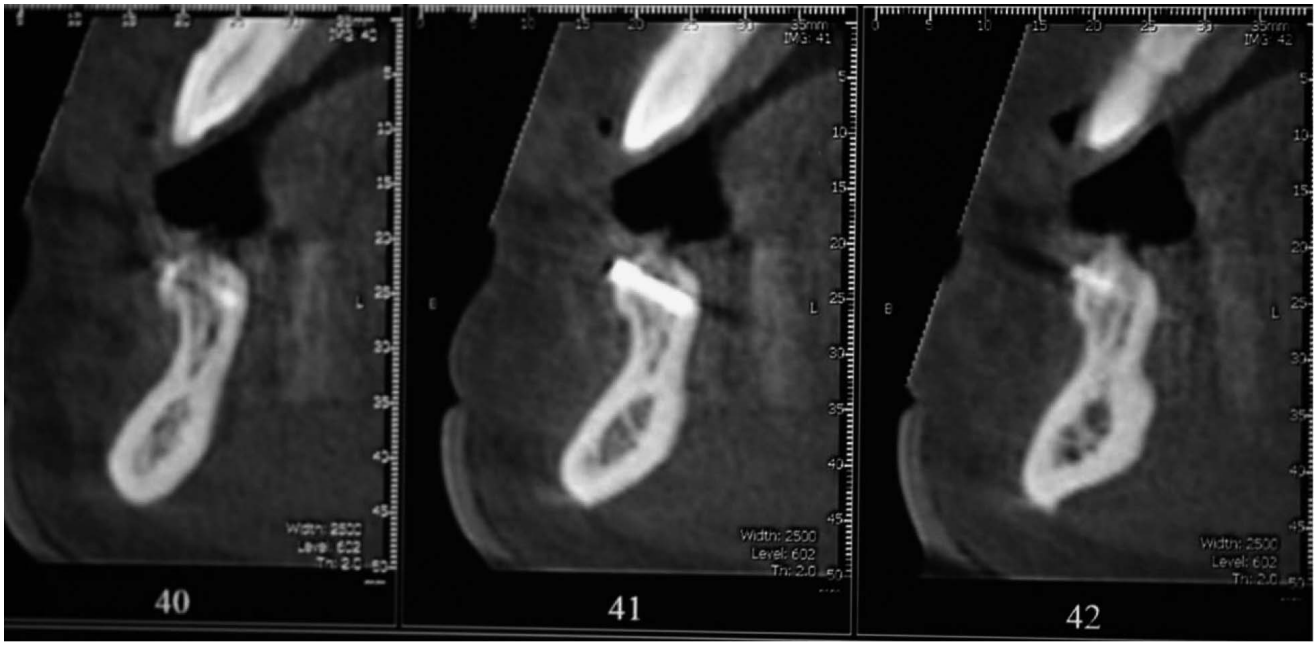


Figure 8. Section 41 of the cone beam computerized tomography image clearly shows retained pin and the presence of a maturing cortical plate and cancellous bone within the alveolar ridge

Ten-month follow-up

The treated area was exposed via a crestal incision. The implanted sites showed good healing, and all implants were stable. A 2.5-mm core was taken immediately mesial to the retained bone screw at the interface of the ilium block and the host bone (Figures 8 and 9). The core was placed in formalin and sent to LifeNet Health (Virginia Beach, Va) for histologic evaluation.

Histology

The specimen was serial sectioned, and all slides were stained with hematoxylin and eosin (Figure 10a through c). With few exceptions, all the slides were similar and composed primarily of variably sized bony trabeculae. Graft bone was identified by enucleated lacunae. Host bone, which predominated, was composed of well-nucleated lacunae. Lamellar and woven bone were identified. Some sections showed new bone deposited on graft bone. Some of the graft bone also contained newly formed, well-vascularized osteons (Haversian systems). Intertrabecular spaces varied in size and shape and contained stromal cells embedded in a loose connective tissue matrix. Neovascularization was prominent. Mature adipocytes were seen juxtaposed to osteoblasts.

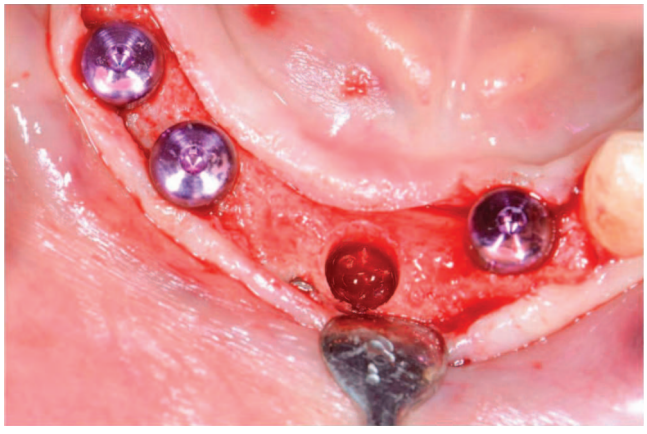


Figure 9. Core taken for histologic study at 10 months. Excellent healing is obvious along with adequate space for dental implantation.

Discussion

While many options exist for horizontal augmentation of an atrophic mandibular ridge, each varies in technical expertise needed and predictability of outcome. It is paramount that early intervention occurs while an edentulous area is resorbing in order to make any correction before loss of vertical height. This provides the clinician with more implant options and potentially a better clinical outcome.

Lateral ridge augmentations are traditionally performed using autogenous bone grafts to support membranes for guided bone regeneration. The bone-harvesting procedure, however, is accompanied by considerable patient morbidity (eg, second-site pain, infection).[14] When using an alternative, such as allograft or xenograft, emphasis must be given to flap technique, perforation of the cortex to open the marrow cavity, stable placement of the graft(s), precise adaptation of the membranes, and stabilization, along with tension-free primary soft tissue closure.[15]

Perforation of the cortical plate at the site of placement is necessary, and its benefits, via the regional acceleratory phenomena, have been well studied.[16–18] Regional acceleratory

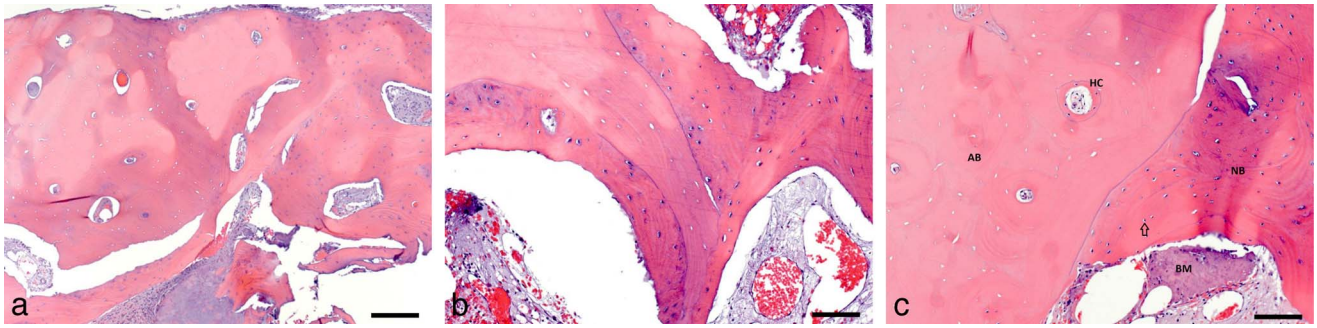


Figure 10. (a) Magnification (×5 original) showing the interface between native bone and allograft. (b) Magnification (×10 original) showing new bone surrounding the allograft spicule. (c) Magnification (×10 original) showing active bone marrow development. The figure clearly illustrates allograft bone (AB), a Haversian canal (HC) forming in the area of allograft initiating remodeling, and an area of new bone (NB) with osteocytes clearly visible within the lacunae (arrow). Bone marrow (BM) is evident in the lower portion of the photomicrograph, indicating bone maturity.

phenomena occur in the areas adjacent to perforations and, in this case, rapid bone apposition occurs on the open cancellous face of the ilium graft described. In addition, a solid block graft is less prone to micromotion than particulate graft, thus providing more predictability. In some cases, depending on the ridge area needing augmentation, the use of particulate with the addition of metal mesh or a nonresorbable titanium-reinforced membrane makes the procedure unnecessarily complex. These options may be outside of the skill set of the average clinician. Sometimes particulate alone, without additional support, will fail to hold the area as predicted. Two systematic reviews show that while various techniques can augment the bone horizontally and vertically, it is unclear which techniques are the most efficient.[19,20]

Many examples of cancellous cube and block use exist, with most being studied in maxillary ridge applications.[10,11,21–23] One of the earliest examples reported a 2- to 4-mm horizontal gain versus the 1- to 6-mm gain reported in prior studies.[10] A study involving 12 patients showed a horizontal gain averaging more than 4 mm.[22] Of the 5 studies reviewed, all had high success rates for both grafting and subsequent implant placement. Where histology was performed, there was no evidence of an inflammatory reaction, and bone appeared to remodel predictably.

Two recent studies have given more attention to corticocancellous grafts. The first required a Cawood and Howell Class IV maxillary ridge for inclusion (98 onlay block grafts in 22 patients). In this study, fresh frozen corticocancellous grafts were compared with autogenous chin grafts.[24] Results were equivalent, with an average horizontal gain of 3.13 mm. The second involved 8 cases in which a sterile prototype of the recipient bed was fabricated from the cone beam computerized tomography scan. This prototype provided a model on which to custom fashion a corticocancellous block to correct maxillary defects. These blocks were chosen because the authors thought that block grafts were preferable in the presence of severely resorbed ridges. This is primarily because block grafts, being corticocancellous, are able to maintain the 3-dimensional space needed for bone regeneration.[12]

Another case used corticocancellous blocks versus autografts from the mental symphysis to study vertical augmentation in 16 patients with bilateral partial edentulism in the posterior mandible. The authors concluded that both procedures had good results, although the bone block allograft was less invasive and preferable to harvesting autograft.[25]

The case illustrated here provides a good example of an available treatment option that can be readily performed by an implantologist. Also, this approach provides a predictable and stable base, even at 3 months, for implant therapy and subsequent dental restoration.

To the best of our knowledge, this is the first published report of freeze-dried corticocancellous allograft block use in the anterior mandible. While this case shows excellent results, additional studies are needed to assess the predictability of block grafting in the anterior mandible.

Abbreviations

AB: Allograft bone
HC: Haversian canal
NB: New bone
BM: Bone marrow

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