

Closed Approach for Horizontal Augmentation of the Maxilla



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The narrow ridge in the anterior maxilla often requires horizontal augmentation for ideal implant placement. This article reviews the historical use of a closed, tunnel approach to augment deficient alveolar ridges and describes its application for augmentation of the narrow ridge in the anterior maxilla. The use of a tunnel approach through a vertical incision in the unattached mucosa provides access to the ridge while maintaining crestal attachments without displacement of the crestal attached gingiva. This approach is atraumatic and provides excellent access for placement of graft material for ridge augmentation.

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To augment bone, the bone surface must become exposed to the graft material for the graft to become stabilized with osseous tissue ingrowth. Exposure of the bone can be accomplished with open approaches that include crestal or vestibular incisions with full-thickness flap reflection for direct visualization of the crest and facial bone. The augmentation is accomplished and often requires membrane or other scaffold placement to hold the graft in the desired position. The inner aspect of the elevated flap may require relaxing incisions to allow for a tension-free closure. The incisions, closed under minimal tension, will heal as long as there is no pressure on the incision line, swelling does not open the incision, the graft becomes vascularized, and the scaffold or membrane does not become exposed during the healing period.¹⁻³

When an edentulous jaw was augmented by open approaches, these complications led clinicians to use a closed or tunnel approach to maintain the peripheral attachments of the tissue to maintain graft position, maintain crestal tissue continuity to avoid incisional dehiscence, and lower the overall morbidity for the patient. The history of ridge augmentation for the edentulous patient provides support for using tunneling procedures for ridge augmentation for the implant patient.

Tunneling has been used in the past for ridge augmentation in preparation for dentures. An anterior

vertical incision alone or combined with lateral vertical incisions has been used to develop subperiosteal tunnels for insertion of grafts for vertical and horizontal ridge augmentation. These procedures were performed with patients under local anesthesia in the clinical setting. Patient morbidity was low. Incisional dehiscence showed a low incidence and was easily treated if it did occur. If incisional dehiscence did occur, only a small portion of a particulate graft was lost. Complications using tunneling for the edentulous ridge augmentation included migration of the material or separation of the graft from the bone due to periosteal tissue trapped during the procedure. Augmentation of the ridge with particulate materials required maintenance of the peripheral tissue attachments within the tunnel and careful attention regarding placement of the graft under the periosteum directly on the bone surface.⁴⁻⁷

The use of dental implants eliminated many of the edentulous ridge augmentation needs because the implants improved prosthesis retention. The procedure advocated by Brånemark et al⁸ used an open approach with incisions and reflection of crestal tissue for implant placement, which has been summarized in books and proceedings.⁹

When there was a need for horizontal ridge augmentation for implant placement and positioning, augmentation included an open procedure to expose the

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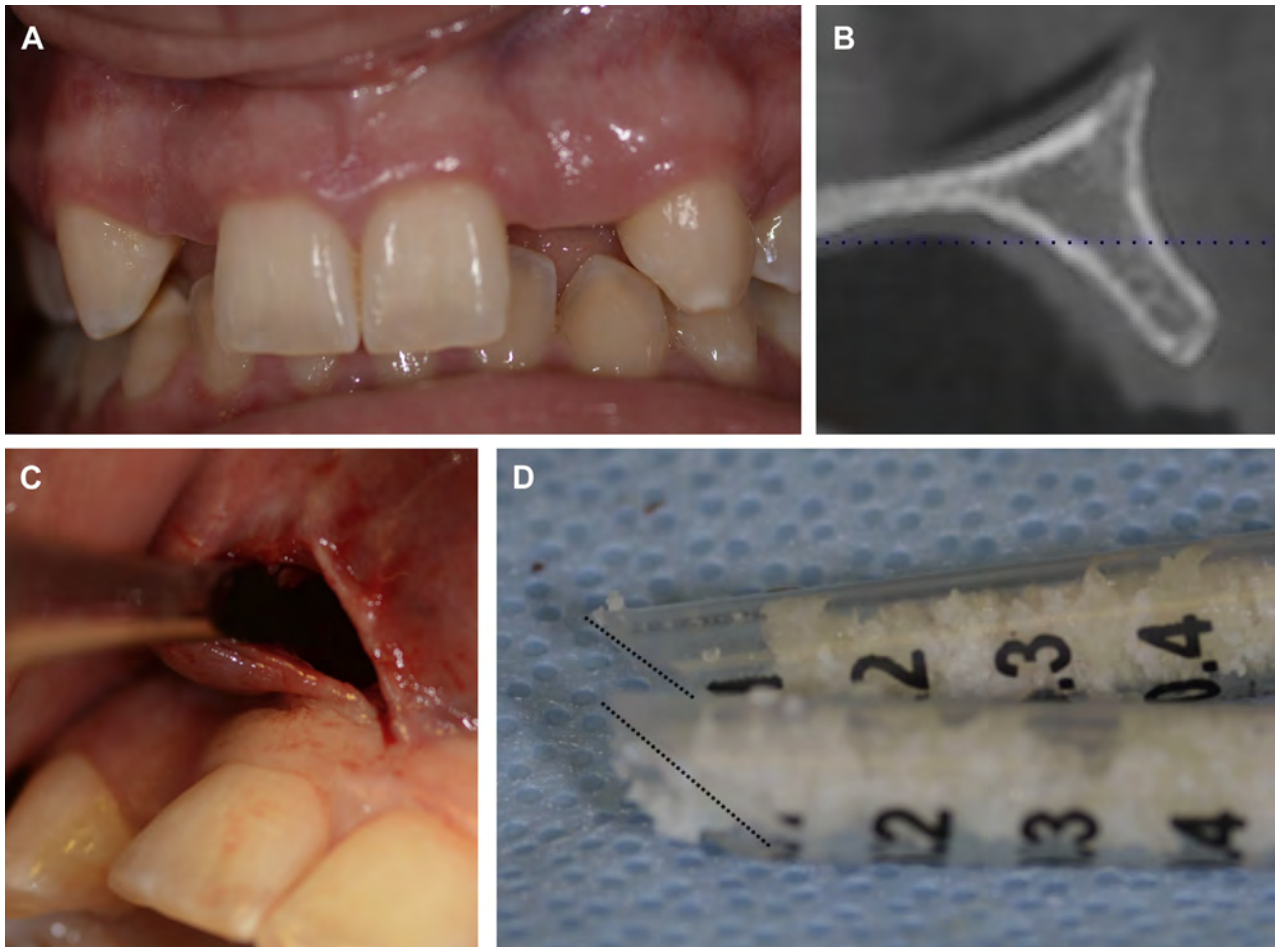


FIGURE 1. A, Patient with agenesis of lateral incisors with concave ridge form. B, Cross-sectional image showing adequate crestal width with concave ridge form on middle and apical region of ridge. C, Midline vertical incision with development of subperiosteal tunnel to lateral incisor regions. D, The opening of the syringes has been beveled (dotted lines), with graft placed within the syringes for delivery. (Fig 1 continued on next page.)

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bone, with placement of blocks or particles of bone and/or other graft materials, with an assortment of membranes or meshes. These procedures exposed the bone after full-thickness tissue reflection with appropriate tissue release for tension-free closure. Patients did have swelling and discomfort after extensive tissue manipulation, which was necessary with the use of an open approach.

When augmentation of the narrow posterior mandibular ridge was performed, a tunnel approach was shown to provide for maintenance of graft positioning and minimize tissue trauma. Patient morbidity was low, the incisional dehiscence rate was low, and success was similar to successful open procedures.¹⁰⁻¹²

Patients underwent more postoperative visits and had an increase in antibiotic use, swelling, and discomfort, as well as a larger dehiscence rate, when an open approach was compared with a closed approach.¹²

Vertical incisions with no horizontal crestal component allow for adequate access to the bone in the anterior and posterior regions of the maxilla and mandible. Maintenance of the crestal tissue allows for preservation of ridge anatomy without movement of the attached tissue from the crest. One vertical incision in the lateral aspect of the maxilla, followed by development of a tunnel, can provide access for sinus augmentation procedures as well as lateral augmentation using autogenous bone to shape the graft. The method of Khoury et al¹³⁻¹⁹ is an example of the use of a subperiosteal tunnel to gain access to atrophic bone for augmentation. This method has been confirmed.²⁰⁻²²

In the anterior maxilla, augmentation of concave regions of bone provides the ridge for ideal esthetic implant restoration. These concave regions can be isolated to the crest, can be apical near the piriform rim, or can include the ridge from the crest to the

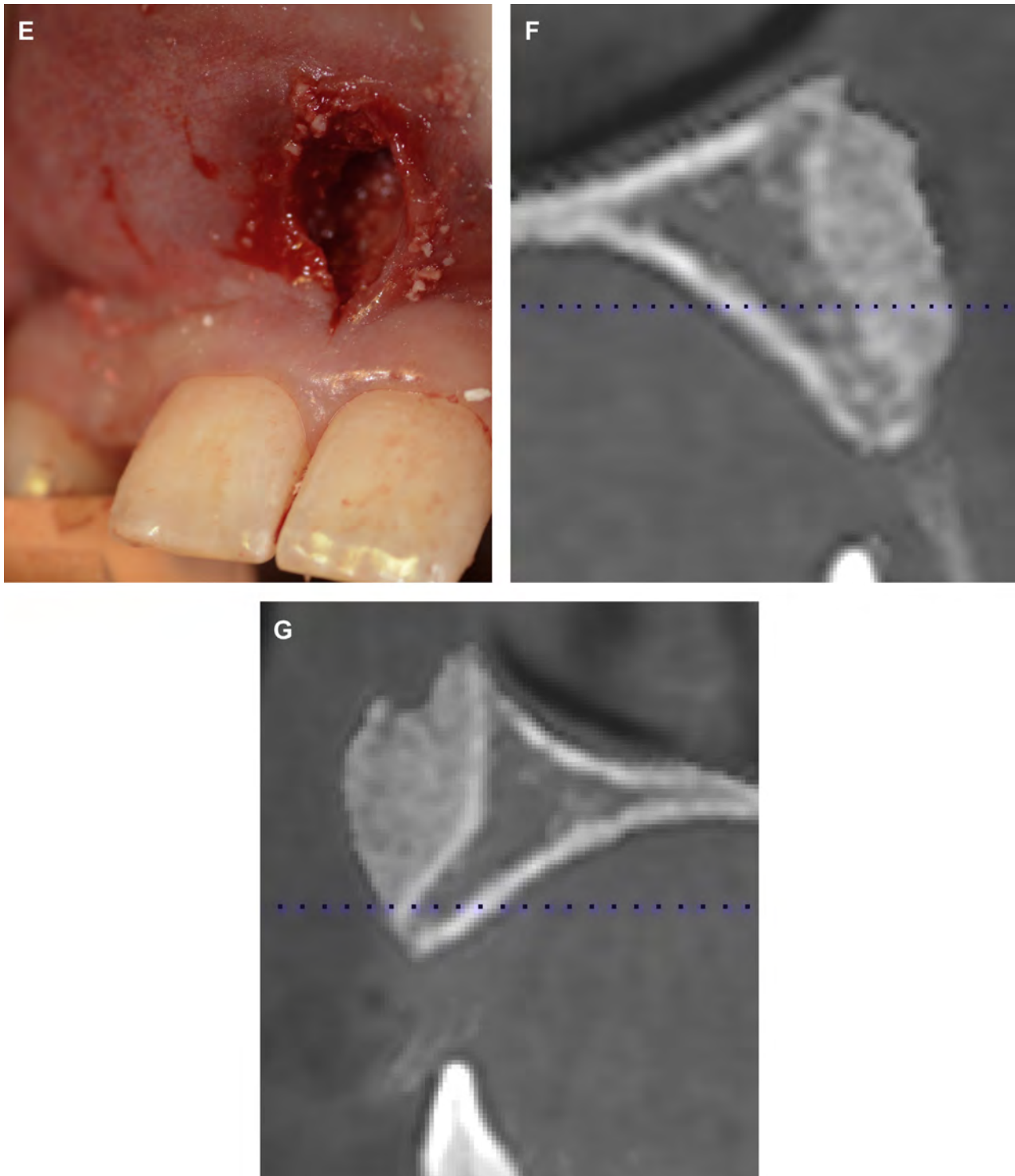


FIGURE 1 (cont'd). E, Graft has been inserted bilaterally and compacted firmly apically over the lateral incisor ridge. F, G, Cross-sectional images of augmentations over left and right lateral incisor regions.

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piriform rim. A vertical midline incision in the frenum to the anterior nasal spine can be used to gain access to the concave bone defect. The periosteum is incised on either side of the anterior nasal spine. Subperiosteal

dissection is accomplished through the midline incision to create a tunnel, which can extend from canine-to-canine teeth regions. The tunnel is formed maintaining soft tissue attachments to allow for stable

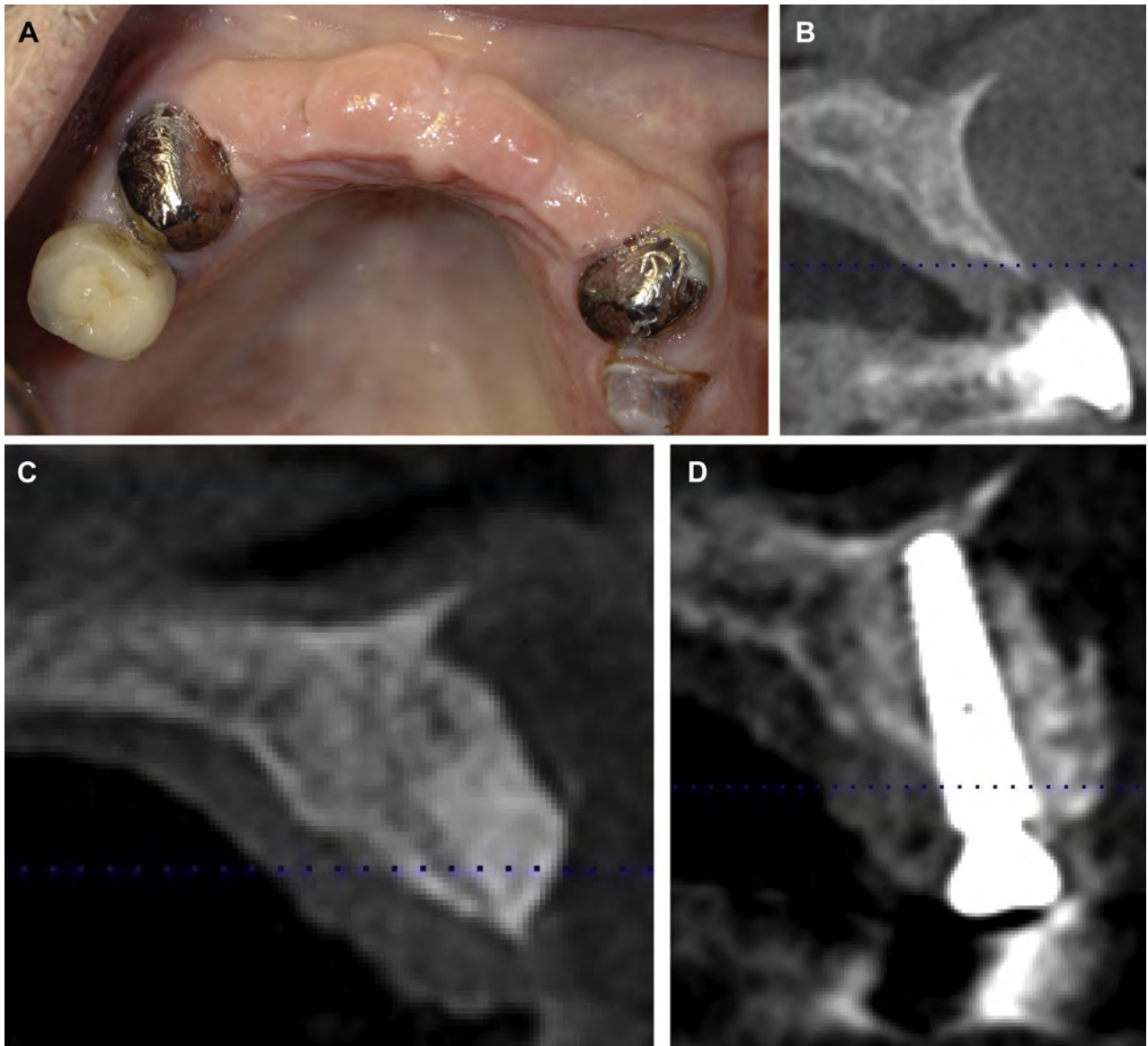


FIGURE 2. A, A 75-year-old male patient with a failing fixed bridge abutted to the canines. The concave form of the ridge over the incisor regions should be noted. B, Cross-sectional image of concave ridge over left lateral incisor site. C, Immediate post-augmentation image after midline vertical incision to place graft within tunnel. D, Cross-sectional image 6 months after ridge augmentation, immediately after implant placement. (**Fig 2 continued on next page.**)

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graft position maintenance with minimal migration. When the tunnel close to the junction of the attached and unattached mucosa is being developed, great care is taken to avoid perforation of the gingiva. Instruments with gentle curves and shapes may be needed to allow for complication-free elevation of tissue. This procedure has been well described by Zadeh et al.²³⁻²⁵

Why is a vertical midline incision used rather than a horizontal incision? When a horizontal incision heals, scar contracture can create changes in lip position at rest or during animation. The vertical midline incision within the frenum allows for an esthetic result with

minimal scar formation (Figs 1, 2). The technique is not new. Because of the need for clinicians to re-expose themselves to this technique, this article presents this method as a technical note.

Surgical Technique

The tunnel approach for the anterior maxilla is created through a vertical incision usually in the midline in the unattached mucosa. There are no crestal incisions. A cone beam scan is useful to ascertain where the graft is needed regarding the crestal or apical region. The crestal bone width may be adequate



FIGURE 2 (cont'd). E, Radiograph obtained at 4 years showing implants placed into augmentation through a midline vertical incision within a tunnel. F, View of ridge form at 4 years' follow-up showing maintenance over time.

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with a concave alveolar form in the apical region (Fig 1). Another clinical situation is a narrow crestal portion as well as a concave alveolar form.

Local anesthesia is infiltrated. Hydroptic dissection with the local anesthetic is useful at the junction of the attached and unattached gingiva. Palatal anesthesia may not be necessary.

A No. 15 blade is used to make a vertical incision in the midline, often bisecting the frenum. Sharp dissection is performed to incise the periosteum over the anterior nasal spine. The incision is inferiorly extended to the junction of the attached and unattached gingiva if necessary. The attached gingiva adjacent to the free gingival margin of the central incisor should not be incised.

A small, smooth-tipped periosteal elevator is used to elevate the periosteum from the bone. The tunnel is developed with the guidance of a finger over the mucosa, allowing the clinician to feel where the tunnel's margins are being developed. After the distal and superior aspects of the tunnel have been completed, the clinician very carefully elevates the gingiva at the junction of the unattached and attached gingiva as necessary for a smooth transition along the ridge. For some patients, curved or angled instruments are needed to allow for controlled elevation.

After the tunnel is completed, it is checked to confirm adequate superior tissue elevation. This is critical to avoid trapping periosteum between the graft and bone. A syringe is used to deliver the graft. The opening of the syringe is beveled by use of a blade. The bevel can be placed against the bone to deliver the graft under the periosteum.

The graft is delivered and firmly compacted over the concave portion of the ridge. The incision is closed with resorbable suture. Antibiotics are administered for 1 week (Fig 1).

Discussion

Clinicians choose a surgical approach for ridge augmentation that provides the necessary access and ease of use, minimizes complications, and provides an excellent solution to the osseous problem. The midline anterior maxillary incision, with development of tunnels to allow for hard and soft tissue augmentation, is based on the historical use of tunneling for the edentulous patient. This technical article is presented to re-expose the surgeon to an atraumatic approach, which yields excellent success. Clinicians can appreciate that it is not new. There are multiple uses for this approach.

Vertical incisions can be made in the canine regions and can be made to provide access to the posterior thin ridge and the anterior ridge through a common incision. With the appropriate incision length, access to the premolar region will allow simultaneous sinus graft procedures as well as lateral or vertical augmentation.¹⁵⁻²⁰ Soft tissue grafts also can be placed with or without hard tissue grafting.²³⁻²⁵ This approach is very versatile.

A typical patient for this procedure is a patient who has lost his or her incisors with placement of a 6-unit fixed bridge abutting to the canines. When the canines fail, the patient may benefit from additional implants in the anterior maxilla. However, in such a patient, the alveolar ridge in the incisor locations may be thin. The tunnel approach through a vertical incision will allow placement of augmentation material in thin anterior maxillary regions (Fig 3).

A vertical incision in the unattached maxillary vestibule scars with minimal esthetic consequences. The maintenance of tissue attachments preserves the esthetic borders of restorations and decreases the need for vestibuloplasty procedures because the

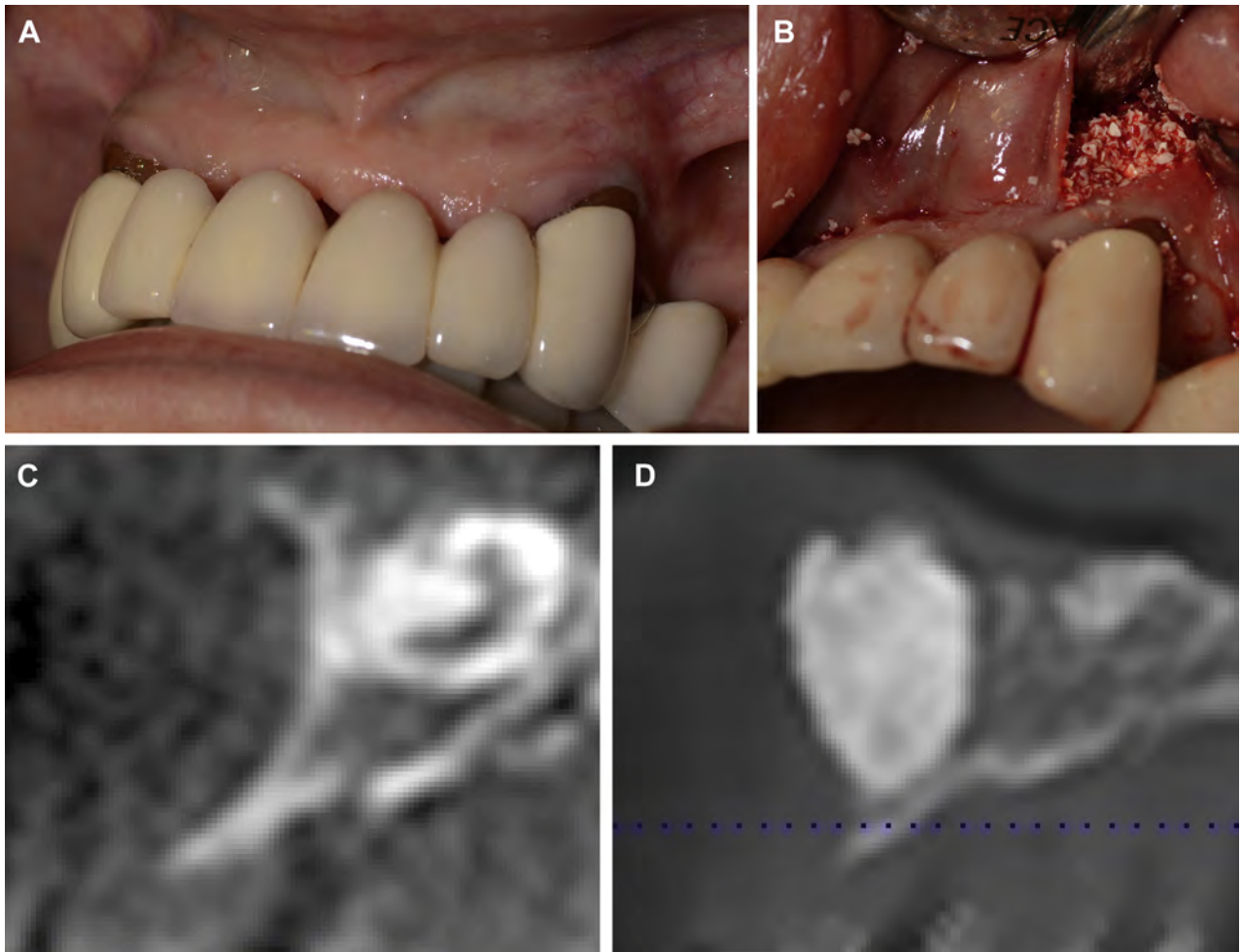


FIGURE 3. A, A 64-year-old female patient with a fixed bridge from canine to canine. She had concave bone anteriorly as well as in the premolar regions. B, A vertical incision was made superior to the canine in the unattached gingiva. Tunnels were created anteriorly and posteriorly, allowing augmentation to be performed through 1 incision. C, Pre-graft cross-sectional image in location of left lateral incisor. D, Cross-sectional image in location of left lateral incisor at 4 months showing ridge augmentation.

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band of keratinized gingiva is not disturbed or moved. Clinicians should add this method to the list of approaches available for augmentation of the thin ridge.

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