Inverted Periosteal Flap: An Alternative to the Buccal Advancement Flap for Tension-Free, Watertight Closure

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The buccal advancement flap has been universally used in oral and maxillofacial surgery for closure of alveolar ridge incisions. It involves scoring of the buccal periosteum to enhance flap mobility and then stretching the buccal tissues medially (palatally or lingually) to obtain tension-free, watertight closure of a wound. Its applications have included, but have not been limited to, alveolar ridge augmentation procedures and closure of oral–antral communications. However, the buccal advancement flap technique has several major disadvantages. First, because the buccal flap is advanced crestally and medially, this technique invariably results in a significant reduction in vestibular depth. This can cause patients discomfort, such that they have described a sensation that their buccal mucosa has been sutured to their alveolar mucosa. In addition to being uncomfortable, this vestibular shortening can adversely affect patients' options for future prosthetic rehabilitation. Second, because the buccal flap is advanced medially, the mucogingival junction will be obliged to follow; therefore, the width of the keratinized tissue on the buccal aspect of the alveolus will be diminished. Third, if the buccal flap has been advanced a large distance, even with aggressive periosteal scoring and release, true tension-free closure can be very difficult to achieve, increasing the risk of wound dehiscence. The inverted periosteal flap is a new technique for flap design and closure that has several advantages over the buccal advancement flap. In my experience, the inverted periosteal flap will preserve the vestibular depth, maintain the keratinized gingival dimensions, and provide true tension-free closure. Thus, this flap could be ideal for any oral and maxillofacial surgical procedure in which tension-free, watertight closure is desired.

J Oral Maxillofac Surg 72:1244-1250, 2014

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Received February 6 2014
Accepted March 12 2014

0278-2391/14/00315-2$36.00/0
http://dx.doi.org/10.1016/j.joms.2014.03.006

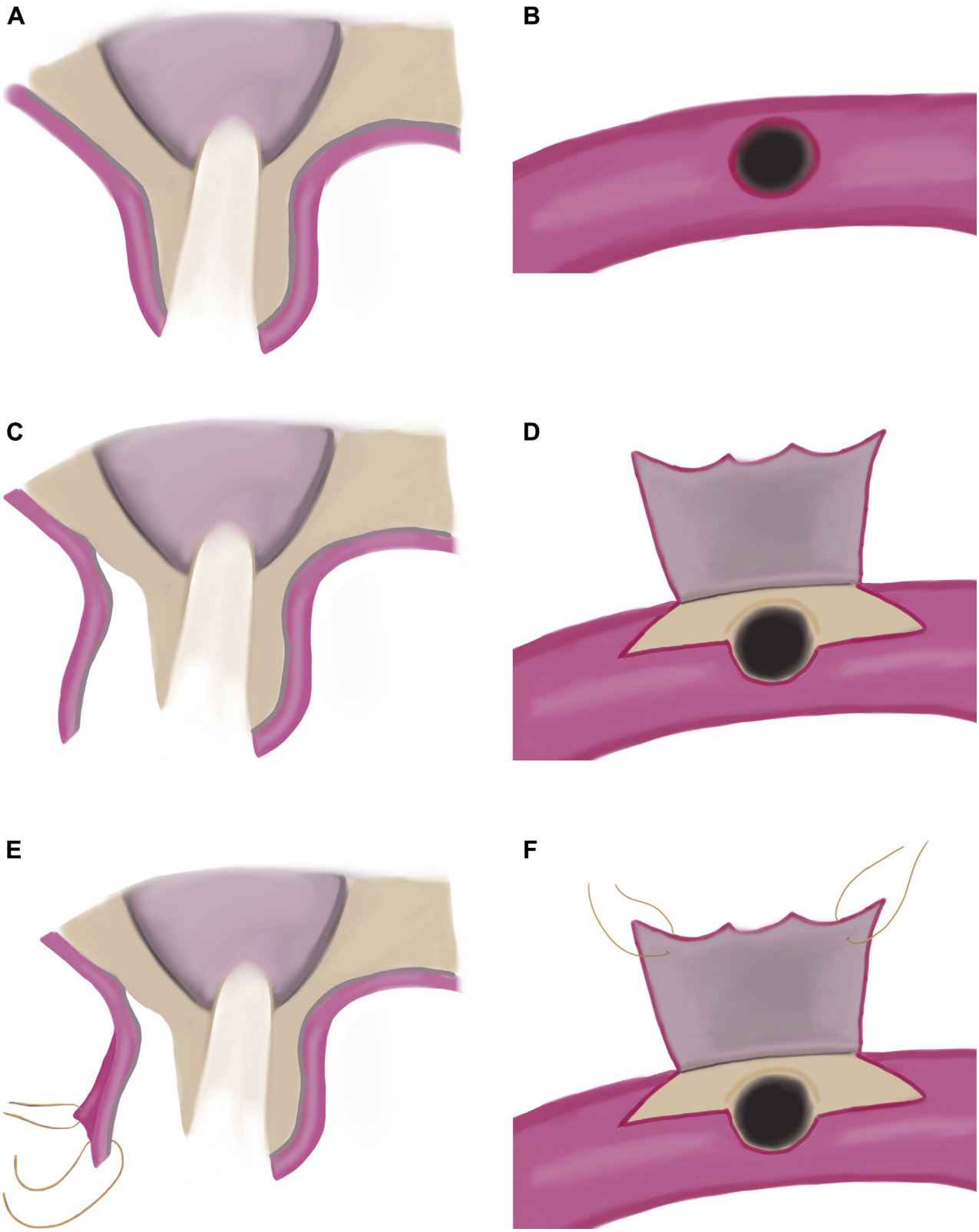

FIGURE 1. Schematic illustrations showing the inverted periosteal flap used in the primary repair of an oral–antral communication after extraction of a maxillary premolar. Each step is shown from a coronal aspect and a worm's eye view. *A,B,* Oral–antral communication after extraction of a maxillary premolar. *C,D,* A full-thickness mucoperiosteal flap is raised, with anterior and posterior vertical releasing incisions. *E,F,* A 4-0 Vicryl suture on a tapered needle is passed through each of the 2 corners of the full-thickness flap at its crestal aspect. They are used for ease of retraction of the flap and will be removed after dissection has been completed. **(Fig 1 continued on next page.)**

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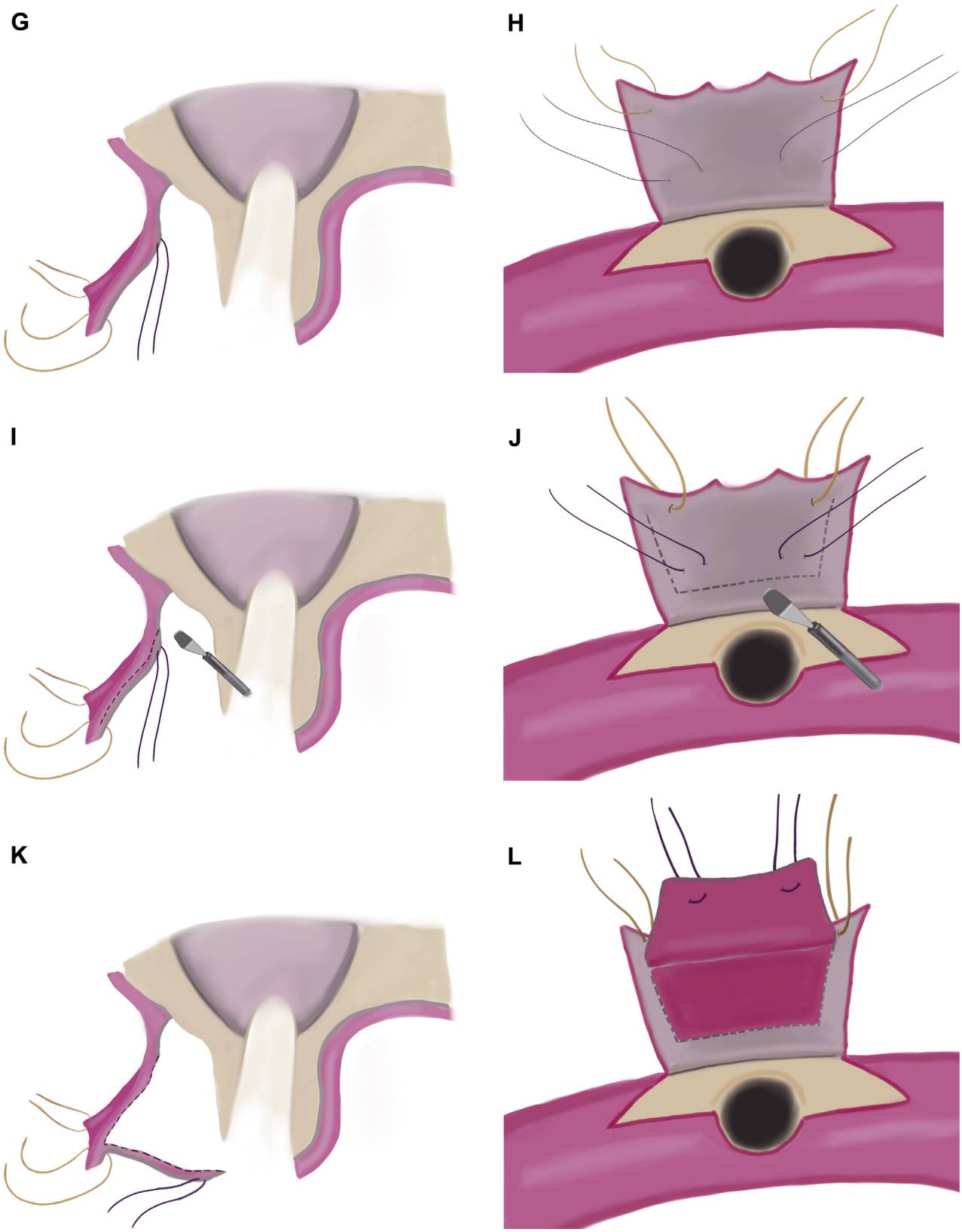

FIGURE 1 (cont'd). *G,H,* A suture is then passed through each of the 2 apical corners of the flap through the periosteal layer only, using a separate needle for each corner. *I,J,* While holding light tension on the hemostats, a Beaver blade is used to dissect the periosteum from the underlying submucosal tissues, in an apical to crestal direction. *K,L,* This dissection must stop approximately 3 mm short of the crestal edge of the flap to avoid unintentional separation of the periosteal layer. **(Fig 1 continued on next page.)**

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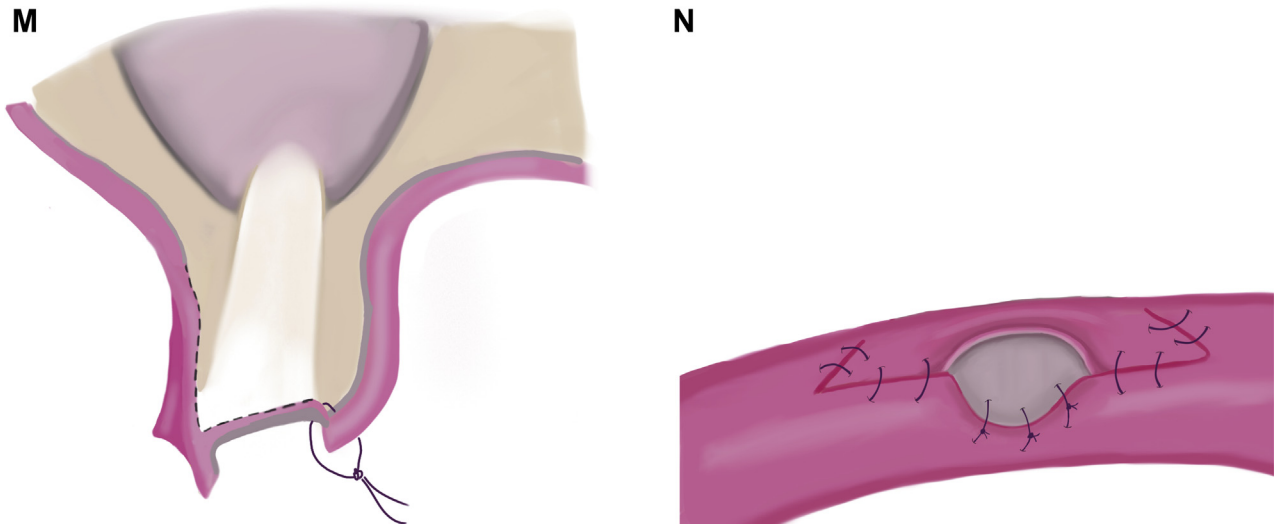

FIGURE 1 (cont'd). *M,N,* The 2 sutures at the apical periosteum are used to approximate this periosteal free edge to the palatal or lingual tissues.

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Surgical Technique

A crestal incision is made with a no. 15 blade, with anterior and posterior releasing incisions. These releasing incisions have 2 purposes. First, they provide access to the periosteal surface of the flap. Second, they allow for adequate retraction of the flap. A full-thickness mucoperiosteal flap is then raised. The flap must now be prepared for closure. A 4-0 Vicryl suture on a tapered needle is passed through each of the 2 corners of the full-thickness flap at its crestal aspect. These sutures should be kept long and tied off. They are used for ease of retraction of the flap and will be removed after the dissection has been completed. A suture is then passed through each of the 2 apical corners of the flap through the periosteal layer only, using a separate needle for each corner. These sutures are not tied; instead, the needles are protected with a small hemostat. These sutures will be used to provide traction while creating a split-thickness dissection through the flap. They will also be used in flap closure. Next, while holding a small amount of tension on the hemostats, a Beaver blade or a fine tissue scissor is used to dissect the periosteum from the underlying submucosal tissues, in an apical to crestal direction. This dissection must stop approximately 3 mm short of the crestal edge of the flap to avoid unintentional separation of the periosteal layer. At this point, the flap is ready for closure. The 2 sutures at the apical periosteum should be used now to approximate this periosteal free edge to the palatal or lingual tissues. After the 2 sutures are tied, it generally will be necessary to place additional sutures at the crest and at the releasing incisions. If any perforations have occurred, in either the periosteal or mucosal layer, they can be coated with a thin layer of a cyanoacrylate tissue adhesive. Tissue adhesive is preferred over small sutures because the periosteal flap is quite delicate; excessive manipulation to suture a perforation could only worsen the problem. Figures 1A-N provide illustrations of these steps. Clinical photographs of the flap design and closure are shown in Figures 2A-H.

Discussion

Oral and maxillofacial surgeons commonly perform procedures that alter the shape of the alveolar ridge. However, careful attention must be paid to incision design and closure, because the final outcome will be affected by the resulting soft tissue characteristics. An oral–antral communication can be closed successfully with a buccal advancement flap; however, the reduction in vestibular depth that results from such procedures can prevent the patient's denture from properly seating. The inverted periosteal flap presented in the present report provides several advantages. First, unlike the buccal

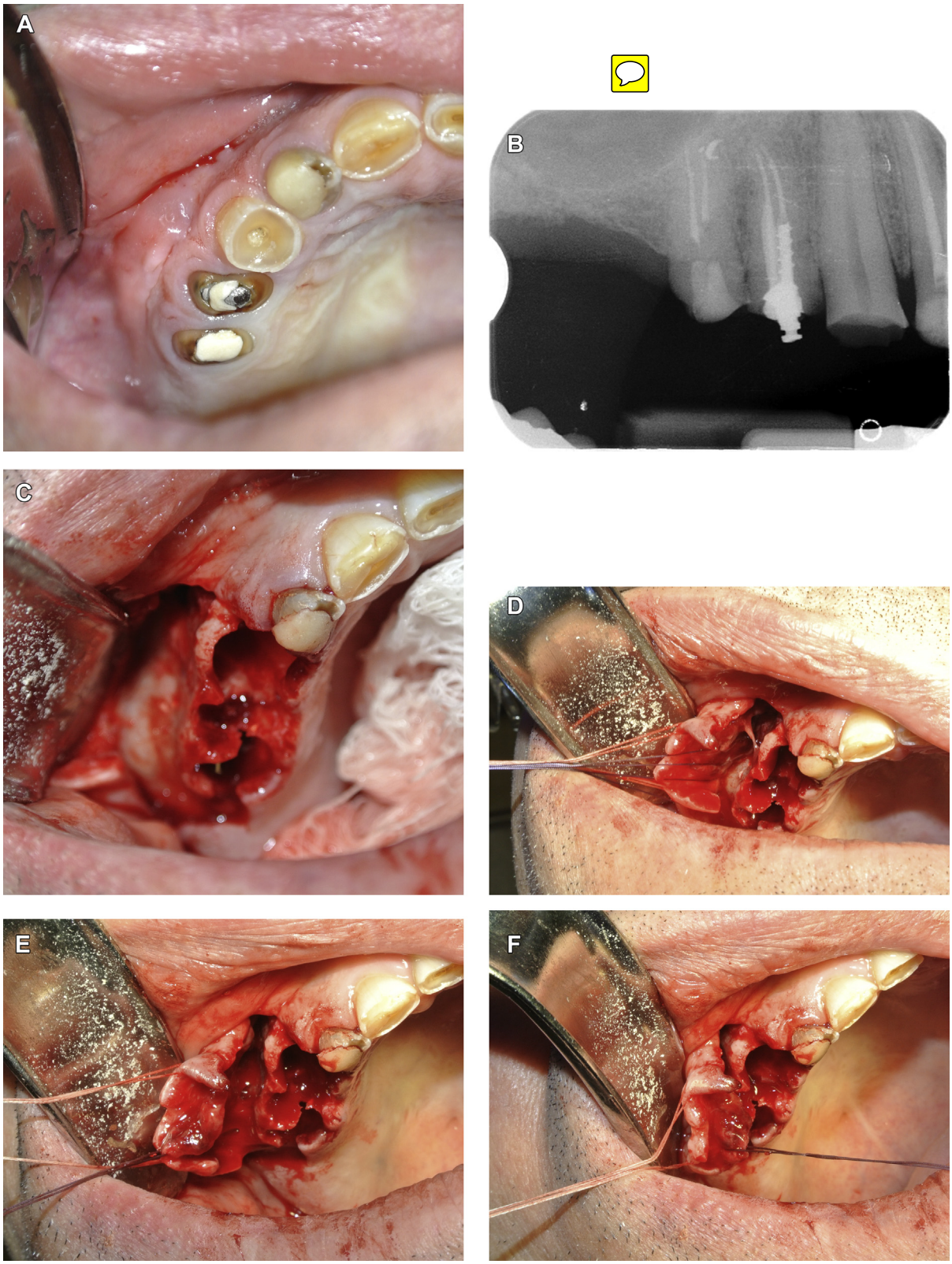

FIGURE 2. Clinical photographs of the inverted periosteal flap used in the primary repair of an oral–antral communication after extraction of a maxillary premolar. *A,* Upper right canine, first premolar, and second premolar planned for extraction. *B,* Periapical radiograph showing root apex of the second premolar proximity to the sinus. *C,* After extraction, a sinus perforation was noted at the apex of the second premolar, and a full-thickness mucoperiosteal flap was raised, with anterior and posterior releasing incisions. *D,* A 4-0 Vicryl suture on a tapered needle was passed through each of the 2 corners of the full-thickness flap at its crestal aspect. Another suture was passed through each of the 2 apical corners of the flap through the periosteal layer only, using a separate needle for each corner. *E,* The periosteum has been dissected from the underlying submucosal tissue, in an apical to crestal direction. The dissection stopped approximately 3 mm short of the crestal edge of the flap. *F,* The inverted periosteal flap was advanced to cover the defect. **(Fig 2 continued on next page.)**

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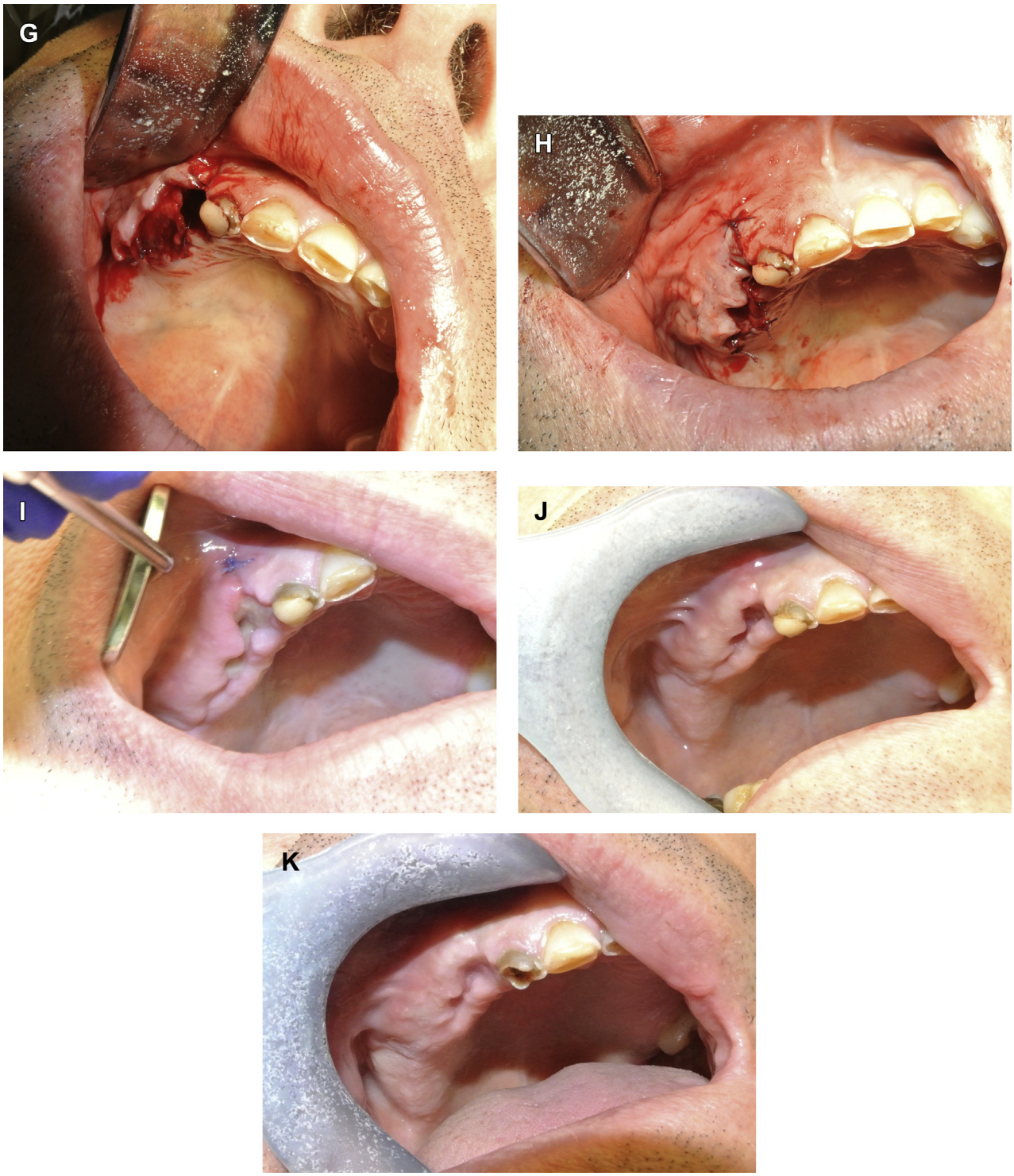

FIGURE 2 (cont'd). *G,* The 2 sutures at the apical periosteum were used to approximate this periosteal free edge to the palatal or lingual tissues. *H,* View showing completed closure. Note preserved vestibular depth and keratinized tissue. *I,* View at 1 week postoperatively. The patient had no signs or symptoms of sinus communication. Note the preserved vestibular depth. *J,* View at 3 weeks postoperatively. *K,* View at 5 weeks, 4 days postoperatively.

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advancement flap, it preserves the vestibular depth. This will be more comfortable for patients postoperatively and will not compromise future prosthetic rehabilitation. A second advantage over the buccal advancement flap is that the inverted periosteal flap maintains the existing dimension of the buccal

keratinized gingiva. The importance of adequate keratinized gingiva for the health of the dentition and the success of prostheses is well recognized.[3] Third, because the technique creates additional length in the flap, it allows for completely tension-free coverage of the bone on closure, which can be difficult to achieve with the buccal advancement flap. Fourth, because it provides tension-free closure, the inverted periosteal flap can eliminate the need for a collagen membrane, which will add considerable cost to a procedure.

In my experience with this technique, I have encountered 2 disadvantages. First, the technique can be technically challenging in the posterior alveolus, specifically when performed posterior to the first molars. In these cases, I have found it helpful to use an angled Beaver blade for the split-thickness dissection of the flap. However, the buccal tissues inevitably will limit visibility and maneuverability of the flap posteriorly. Second, patients will experience a considerable amount of postoperative pain. This might result from the vertical releasing incisions or the increased amount of periosteal stripping and soft tissue dissection. The pain can be controlled adequately with oral narcotic analgesics.

This technique has been used in 15 patients with sinus communication or suspected sinus communication after dental extraction. Of the 15 patients, 11 healed with successful closure of the wound. In 4 patients, inadvertent perforation of the flap had resulted from inadequate visibility and maneuverability during the split-thickness portion of the dissection. In 2 of the 4 cases, the perforation was considered to be small (<3 mm in diameter). In these cases, the dissection was completed, and a slowly resorbing collagen membrane was placed to cover the alveolar defect. The flap was then closed as described; the only difference was that it was performed over the membrane. In the other 2 patients with flap perforations, the perforations were considered too large for the flap to be salvageable; thus, the periosteal layer was placed back in its original position. A collagen membrane was placed over the alveolus, and the buccal and palatal tissues were sutured gently over the membrane to hold it in place. All 4 of these patients with flap perforations and membranes healed without complications. Theoretically, however, if a sinus communication had persisted during follow-up, it is presumable that other, more traditional methods of closure could then have been used (ie, buccal fat pad graft, palatal rotation flap).

In conclusion, the inverted periosteal flap design can be considered for any procedure in which a watertight, tension-free closure of the wound is desired. This can include, but is not limited to, alveolar ridge augmentation procedures and closure of oral–antral communications. Preliminary experience with this technique has yielded favorable outcomes. For the reasons stated, the inverted periosteal flap could be superior to the buccal advancement flap for primary closure of alveolar incisions. However, large-scale, prospective, randomized clinical studies are needed to establish its long-term utility.

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