

ANTRAL MEMBRANE BALLOON ELEVATION

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KEY WORDS

Sinus graft
Sinus lift
Sinus floor augmentation
Sinus membrane
Maxillary sinus
Dental implants
Balloon antral augmentation

Many edentulous posterior maxilla are found to be encumbered by alveolar resorption and increased pneumatization of the sinus. These factors limit the quantity and quality of bone necessary for successful implant placement in these areas. One solution is to use shorter implants, but this often results in an unfavorable crown-root ratio. To create an improved environment in such regions, the classic sinus floor elevation with bone augmentation is a well-accepted technique. However, when the edentulous area is limited to a zone between 1 and 2 teeth, lifting the membrane becomes difficult and may subject it to iatrogenic injury. The antral membrane balloon elevation technique, which is introduced in this preliminary report, is a modification of the currently used sinus lift. It elevates the membrane easily and makes the antral floor accessible for augmentation with grafting materials.

INTRODUCTION

The edentulous posterior maxilla presents special challenges to the implant surgeon that are unique compared with other areas in the mouth. After tooth extraction, the initial decrease in bone width is secondary to resorption of the buccal bone plate. As the edentulous area continues to atrophy, there is a continuing loss of bone height and density and an increase in antral pneumatization.^{1,2} The maxilla is primarily trabecular or spongy bone enclosed within thin cortical layers. In addition, the posterior maxilla contains the least dense bone in the oral environment. In some cases, the alveolus may be 2 mm high or shorter and of poor quality. Even if an individual were to have a modicum of bone,

the resulting short endosseous implants would lead to insufficient anchorage, questionable integration, and unfavorable crown-root ratios. It has been written that as much as a minimum of 10 mm of bone height is necessary for successful implant stabilization and integration.

The antral membrane balloon elevation (AMBE) technique lifts the sinus membrane with minimal trauma and is particularly useful in areas that are difficult to reach. It is beneficial when teeth are adjacent to the edentulous area that requires augmentation. The AMBE technique is accomplished with a limited incision, minimal mucoperiosteal flap reflection, and a small window. The membrane is elevated to the medial wall of the sinus cavity avoiding sharp dissection around the roots of adjacent teeth. Thus, morbidity, blood loss, operative

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time, and postoperative pain and complications are reduced when compared with the conventional procedure.

Sinus lift surgery is predictable and is usually not technically demanding. However, it is a more difficult surgical technique when teeth are adjacent to the edentulous area. It presents a far lesser challenge in the totally edentulous posterior maxilla.³⁻¹¹ The AMBE is a modification and combination of surgical techniques that adds sufficient bone height to allow placement of longer implants of up to 16 mm. The balloon operation and graft procedure described herein can be used to augment a severely atrophic ridge and does not depend on the accessible ridge height, as does the crestal approach, which uses trephines and osteotomes.

Numerous approaches to the management of the deficient posterior maxilla have been described. Among them is the 2-stage classic approach with a 4- to 6-month interregnum required before the placement of implants. Fifteen millimeters or more of bone height can be achieved by this operation.

A single-stage procedure following the same protocol as the 2-stage approach also is frequently used. The requirement here is for a beginning bone height of at least 4 to 6 mm.

No lateral osteotomy into the antral cavity is required when using the Summers technique. It uses a number of concave-tipped, tapered osteotomes that are used to both enlarge and deepen the osteotomies while pushing the garnered bone apically beneath the tented membrane.¹²⁻¹⁹ This is not unlike the green stick fracture method, which adds 2 to 3 mm of bone height beneath the elevated but unsullied sinus membrane. A recently published trephine bone-

core sinus elevation graft is a new technique that permits autogenous bone grafting from 5 to 10 mm.²⁰

SURGICAL PROCEDURE

Local anesthesia is obtained with infiltration of the buccal and palatal tissues. A crestal incision is made, extending the length of the edentulous area. If the attached keratinized gingiva is narrow, the incision is made slightly palatal to the crest. At the anterior border of the crestal incision, a vertical, wide-based, relaxing incision is used. It should be angled forward and extended to the vestibule.

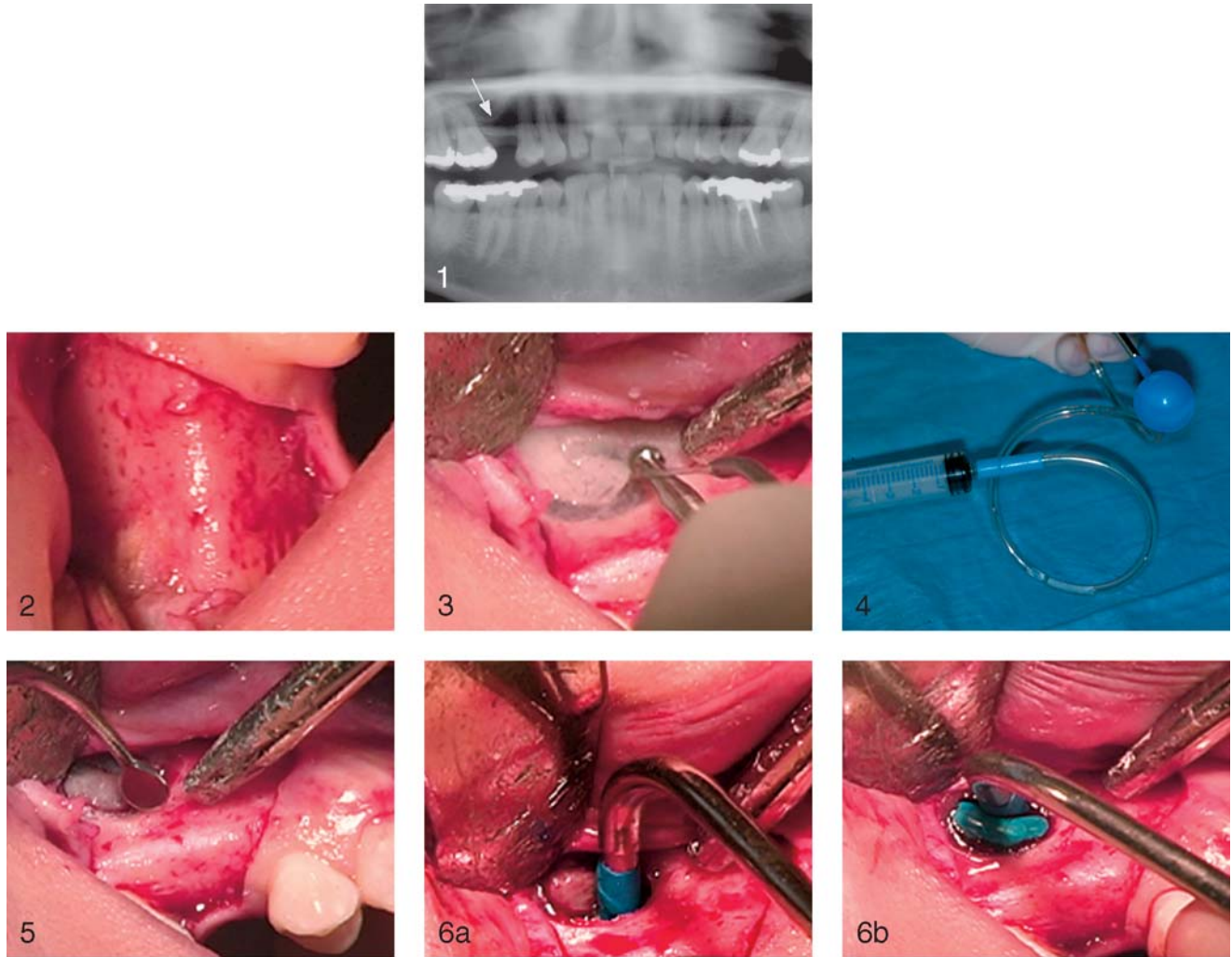
The resulting full-thickness mucoperiosteal flap is elevated around the existing teeth and reflected superiorly, thus exposing the buccal bone beyond the mucogingival attachment and avoiding tension on the interdental tissues. The position of the sinus is determined on the panoramic X ray. Often the outline of the sinus can be seen through the eggshell-thin buccal bone. If the buccal wall is too thick to permit this vision, transillumination of the sinus from the palatal side helps define the antral outline.

An osteotomy of the buccal bone is performed by copious irrigation. A 5-mm trephine or a #8 round diamond serve well in this capacity. The sinus membrane must be preserved during this essential first step. The resulting bony fenestration is gently pressed inward, carrying the underlying membrane along with it. A large spoon curette or modified sharp Freer elevator (G. Hartzell & Son Inc, Concord, Calif) is necessary to elevate the membrane from the antral floor. This dissection should progress

all the way to the medial wall of the sinus.

At this juncture, a balloon (Osseous Technologies of America, Huntington Beach, Calif) made of latex material is used. Before inserting the balloon, it should be inflated with 3 to 4 mL of sterile saline to check for leaks. It is then emptied and placed against the sinus floor midway between the lateral and the medial walls. The balloon is gently inflated with 2 to 4 mL of sterile saline, and as it expands, the membrane is elevated. This technique offers optimal assurance that the fragile epithelium will be subjected to minimal trauma. The procedure at this point results in an antral space bordered superiorly by the reflected buccal bone window and membrane, medially by the medial wall of the sinus, and anteroposteriorly by the nonreflected membrane and the roots of the adjacent teeth. The balloon is then deflated and removed.

A resorbable collagen membrane (Reguarde Membrane, Clinician's Preference, Golden, Colo) is soaked with platelet-rich plasma (PRP) (Harvest Technologies Corp, Conyers, Ga)²¹⁻²⁵ and placed under the elevated sinus membrane.²⁶⁻²⁸ The space created by the expanded balloon is grafted with an appropriate xenograft or allograft combination such as OrthoBlast II (Reguarde Membrane) or C-Graft (Reguarde Membrane) mixed with PRP. The graft is deposited into the antral void and loosely condensed. It should not be overpacked because of potential injury or laceration of the membrane and the limitation of much-needed angiogenesis. Loose compaction is continued until the lateral wall of the sinus is rebuilt. A second guided bone regenerative membrane (Reguarde Membrane) is



FIGURES 1–6. Case 1. FIGURE 1. Six millimeters of bone. FIGURE 2. Crestal and minimal vertical relaxing incisions. FIGURE 3. Buccal wall osteotomy. FIGURE 4. Balloon testing. FIGURE 5. Balloon insertion. FIGURE 6. (a) Balloon insertion along antral floor. (b) Balloon inflation.

trimmed, moistened with PRP or aqueous antibiotic, and placed over the lateral wall window. The mucoperiosteal flap is repositioned and sutured.

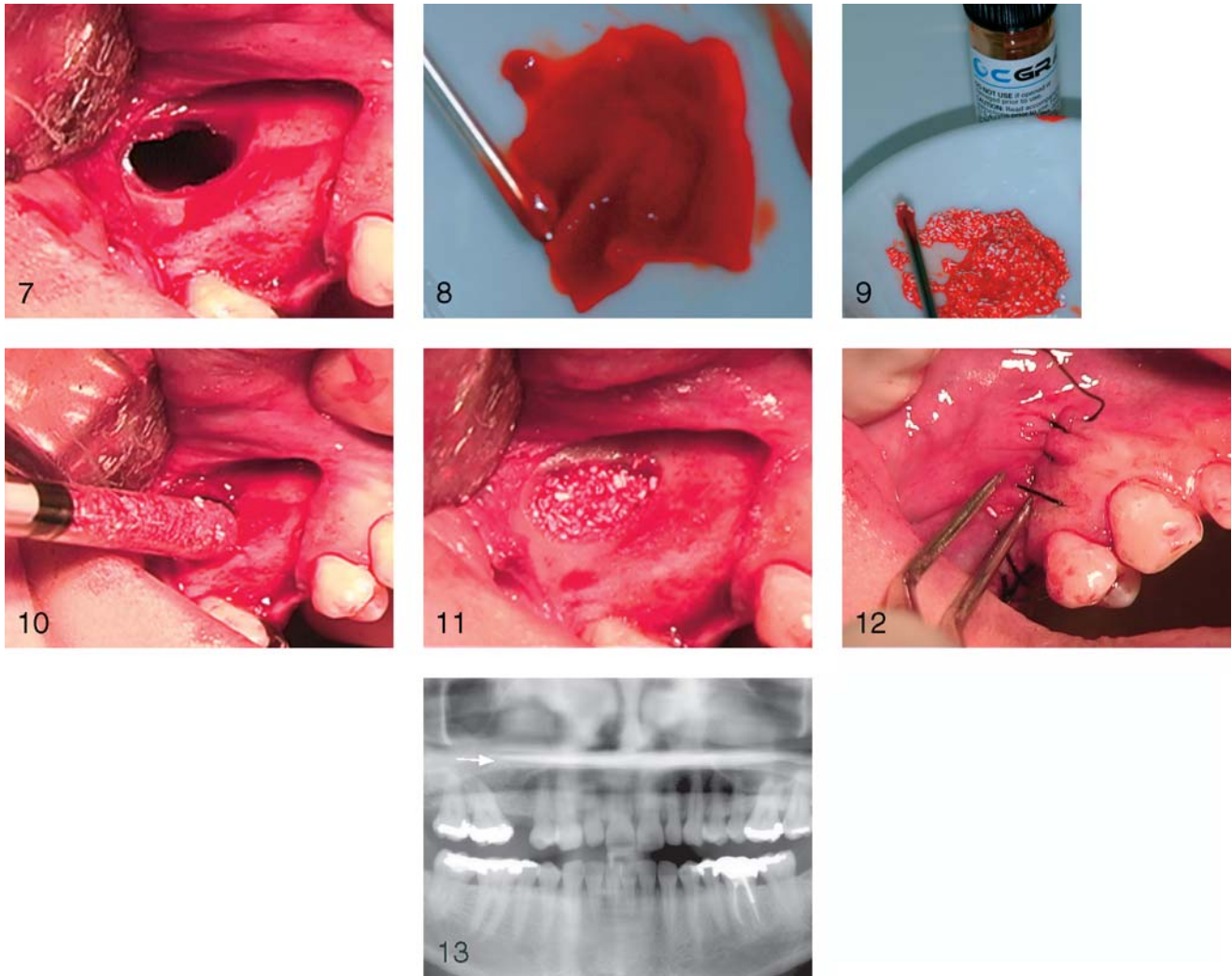
CASE REPORTS

Case 1

J.S., a 42-year-old woman, presented with a missing maxillary right second premolar. Crestal bone was level with the adjacent teeth. An adequate zone of attached, keratinized gingival was present. Six millimeters of bone remained between the crestal and

the floor of the sinus (Figure 1). Crestal and minimal vertical relaxing incisions were made and the mucoperiosteal flap was reflected, exposing the buccal bone of the alveolus and overlying the maxillary sinus (Figure 2). The buccal wall osteotomy was prepared with a #8 round diamond with copious irrigation and gentle pressure (Figure 3). A Freer elevator was used to dissect the membrane along the floor of the sinus to the medial wall. The balloon was tested with 3 to 4 mL of saline (Figure 4). The osseous window and attached membrane were in-

truded and the balloon was inserted (Figure 5). The balloon was inserted along the antral floor to the medial wall (Figure 6a). Then, the balloon was slowly inflated with 2 to 4 mL of saline (Figure 6b). After deflating and removing the balloon, the antral void was evident and ready for placement of the collagen membrane and graft (Figure 7). The resorbable collagen membrane was trimmed and saturated with PRP (Figure 8). Approximately 2 to 3 mL of resorbable hydroxylapatite (C-Graft) was moistened with PRP (Figure 9). The graft extended



FIGURES 7–13. Case 1, continued. FIGURE 7. Antral void. FIGURE 8. Resorbable collagen membrane saturated with platelet-rich plasma (PRP). FIGURE 9. Resorbable hydroxylapatite moistened with PRP. FIGURE 10. Insertion of loosely compacted graft. FIGURE 11. Graft in place. FIGURE 12. Mucoperiosteal flap, repositioned and sutured. FIGURE 13. Postoperative X ray.

from the medial wall along the antral floor and was loosely compacted to rebuild the buccal osteotomy (Figures 10 and 11). The mucoperiosteal flap was repositioned and sutured (Figure 12). The postoperative X ray shows the extent of the membrane elevation and graft (Figure 13).

Case 2

D.S., a 53-year-old woman, presented with a missing maxillary left second premolar and first molar. Less than 2 to 3 mm of

bone remained between the well-pneumatized antrum and the ridge crest (Figure 14). A laterallateral wall osteotomy and membrane elevation permitted insertion of the balloon. Its inflation dissected and lifted the membrane from over the adjacent teeth and the edentulous space that lay between them (Figure 15). Postoperative X rays show the extent of the graft (Figure 16).

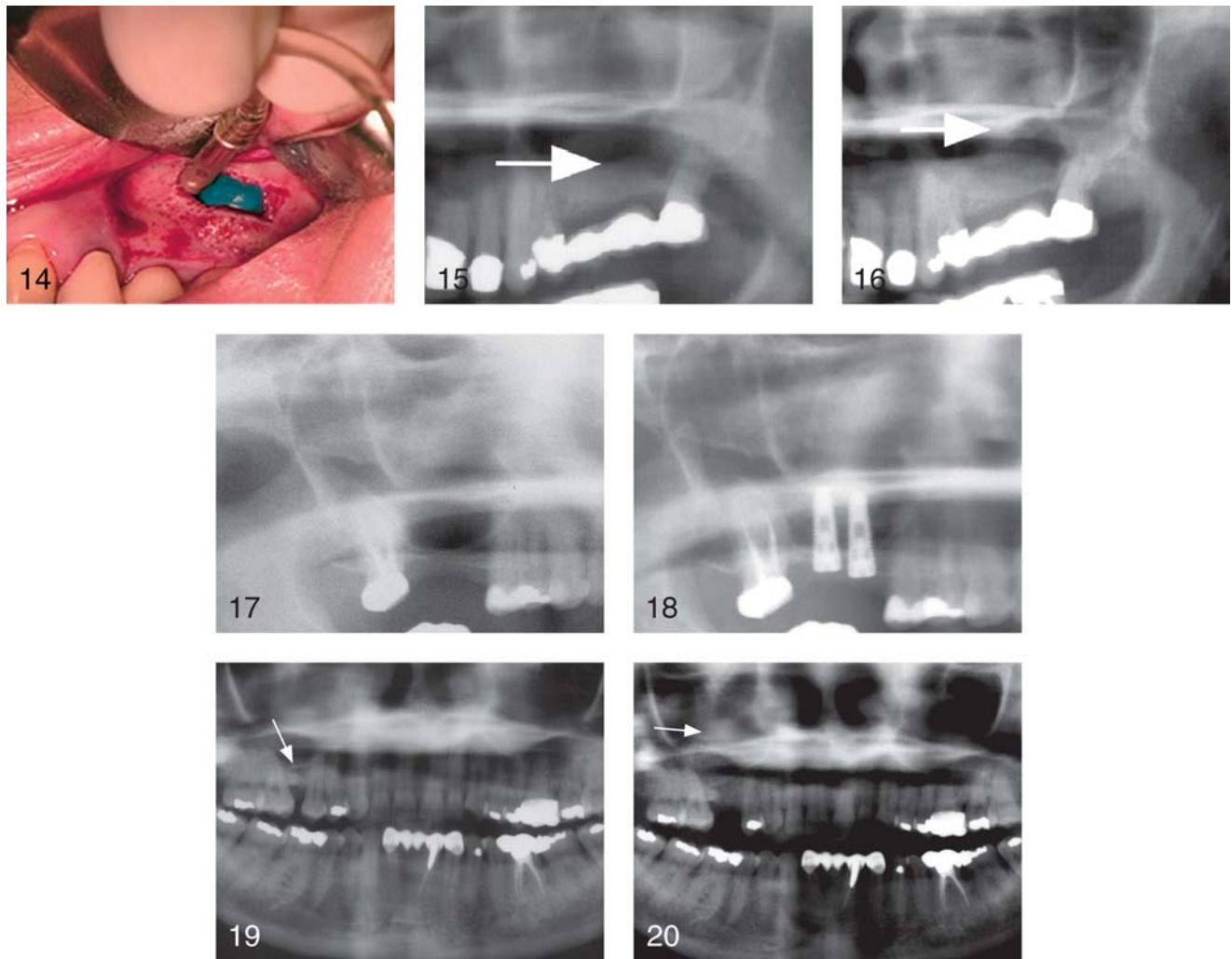
Case 3

V.M., a 51-year-old woman, presented with missing maxillary

right first and second molar teeth. The antral floor approximated the ridge crest so that there was less than 2 mm of alveolar bone (Figure 17). After AMBE, implants were placed simultaneously with the graft (Figure 18).

Case 4

A 45-year-old woman presented with pain in her maxillary right molar region. A 2-mm space was present between the first molar and the second premolar (Figure 19). The second premolar



FIGURES 14–20. FIGURE 14. Preoperative photograph of case 2. FIGURES 15–16. Postoperative X rays of case 2. FIGURE 17. Preoperative X ray of case 3. FIGURE 18. Postoperative X ray of case 3. FIGURE 19. Preoperative X ray of case 4. FIGURE 20. Postoperative X ray of case 4.

had a vertical fracture and was extracted. The AMBE technique with augmentation was accomplished followed by a primary closure (Figure 20).

COMPLICATIONS

On occasion, the membrane will tear either when preparing the osteotomy or reflecting the window. In such instances, the collagen resorbable membrane placed before grafting can be used to repair the defect. If the balloon is inflated too fast or if more than 4 mL of fluid is used to expand it, it may burst. This could rupture the

antral lining. At this juncture, judgment should dictate whether to abort the operation or to repair the damage with a guided regenerative membrane.

Depending on the overall health of the patient, as with any surgical procedure, infection is possible.^{29,30} The graft is most often lost under these circumstances. For this reason, the patient should be premedicated with 2 g of augmentin or 600 mg of clindamycin 2 hours before surgery. Antibiotic coverage is continued for 5 to 7 days.

Another possible complication may be caused by failure to expose the medial wall of the sinus. This wall must be exposed because the viability of the graft will depend on its intimate relationship to the adjacent bone. The postoperative X ray will verify if the balloon-created antral space is filled and properly condensed.

ADVANTAGES OF THE AMBE TECHNIQUE

The use of the AMBE allows the surgeon to elevate the sinus membrane with minimal risk of

tearing and with a conservative, tissue-sparing surgical approach. This reduces postoperative pain, bleeding, possibilities of infection, and the other morbid symptoms often associated with sinus lift procedures. The technique introduced in this article is often completed within 30 minutes. It is especially beneficial when access is difficult and when adjacent teeth are present next to the edentulous area.

DISADVANTAGES OF THE AMBE TECHNIQUE

Unlike some of the currently used techniques, which are performed from a crestal approach, AMBE requires a buccal fenestration and a larger incision than do other alternative operations.

CONCLUSIONS

The AMBE technique with augmentation has been a highly successful and predictable procedure. It facilitates lifting the sinus membrane gently and displacing it upward. The graft material is deposited into the space thus created. Implants may be placed simultaneously with the graft.

NOTE

The authors have no financial interest in any of the products mentioned or used.

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