

Prosthodontic rehabilitation of the posterior atrophic maxilla: Recent trends in sinus augmentation

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The posterior maxilla has been reported as the least predictable area for implant survival. The frontier of bone reconstruction, by sinus augmentation and graft placement, is vast and full of opportunities. Recent trends in sinus augmentation have been discussed in the present article.

Key words: Posterior atrophic maxilla, sinus augmentation

INTRODUCTION

Dental reconstruction in a patient with an atrophic maxilla is often a difficult task. Deficient alveolar bone width increases pneumatization of the maxillary sinus. This results in close approximation of the sinus to the crestal bone. Sinus augmentation helps in providing sufficient quality and quantity of bone in the atrophic maxilla for the placement of a dental implant, which is beneficial in prosthodontic rehabilitation in cases of 'atrophic maxilla'.

Alveolar bone between the sinus floor and crest can be categorized as follows:

- a) Alveolar ridge of 5-10 mm
- b) Alveolar ridge equal to or less than 5 mm
- c) Complete absence of the alveolar bone between the sinus floor and alveolar crest

Treatment of the posterior maxilla: Treatment approaches advocated to restore the posterior maxilla can be categorized as follows:

- Avoid the sinus and place implants anteriorly, posteriorly or medially
- Place implants and perforate the sinus floor
- Use subperiosteal implants
- Perform horizontal osteotomy, interpositional bone grafting and endosteal implants
- Elevate sinuses during implant placement
- Perform lateral wall approach, sinus graft and simultaneous or delayed implant placement
- Antral membrane balloon elevation

Surgical techniques

Closed techniques

i) Classic method: The classic method is preferred when the height of the bone falls short by a few

millimeters. An implant with a smooth rounded apical end and that is 3 mm longer than the host site is gently tapped into place by an implant try-in device. This in-fractures the floor of the antrum without lacerating it, and also elevates the membrane to within its elastic limits.

ii) Summers' method: A sophisticated technique developed by Dr. Robert Summers [Figure 1].

First technique

A 6-mm diameter trephine is used to mallet the selected sites, each 6 mm apart, in ridges sufficiently wide to accommodate it to its full depth. An interval of 6 months is permitted before implant placement.

Second technique

This technique permits immediate implant placement. To accomplish this, an incision is made at the crest

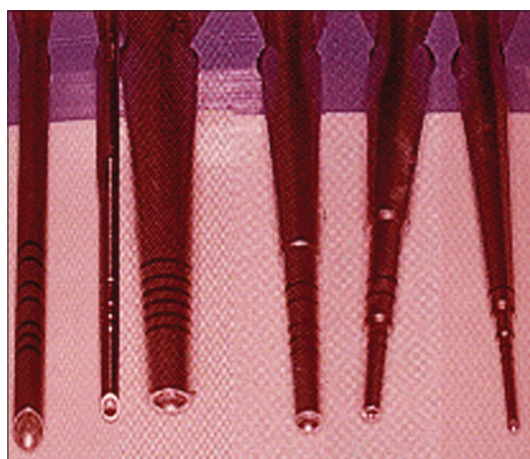


Figure 1: Summers' osteotomes

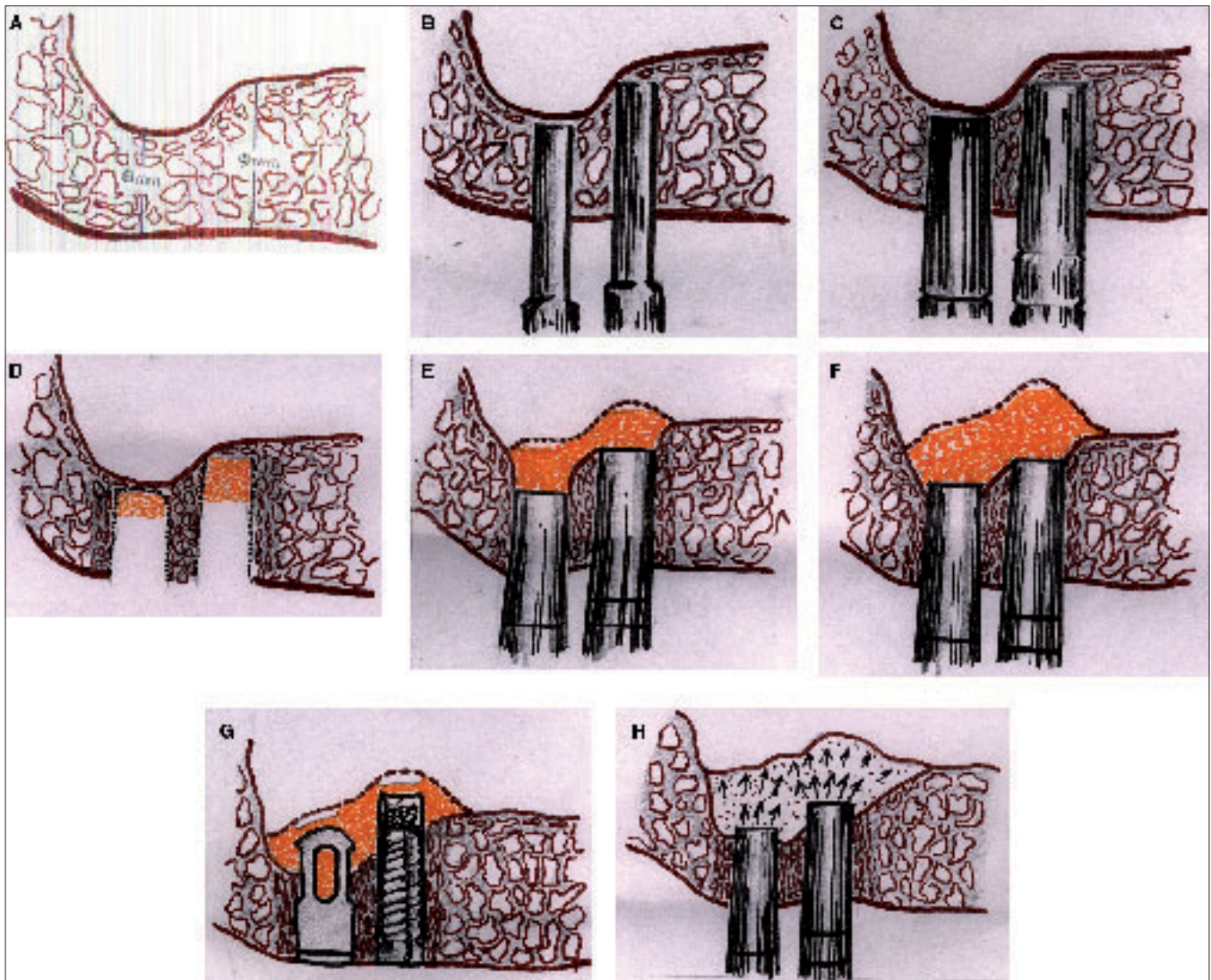


Figure 2: (A) Bone dimensions beneath the sinus floor (preoperative). (B) Small diameter osteotome in position. (C) Larger diameter osteotome in position. (D) Placement of the prepared bone graft mix. (E) The largest osteotome reinserted. (F) Small quantities of bone added. (G) Graft elevating the membrane. (H) Elevating the membranes over an area wider than the osteotomy

of the ridge and each implant site is marked with a number 2 round bur using a surgical template. In cases of soft, compliant bone, an osteotome alone is sufficient. The established sites are reached using the smallest diameter first. Osteotomy is completed 2 mm before the antral floor. Each site is enlarged until its diameter is equal to the size of the intended implant. Small quantities of bone obtained from the adjacent sites are then placed in the concave tip of the last osteotome that had been used; further, gentle tapping permits in-fracture of the antral floor (2-3 mm), elevation of the intact membrane and introduction of the local bone with the addition of the autogenous graft. This process is continued during the subsequent stages of the operation for up to three gentle additions of the bone. The placement of an implant with bone being propelled by its apex

serves as the final osteotome; suturing should then be performed [Figure 2].

Elevation of maxillary sinus floor with hydraulic pressure

Injection of normal saline solution under hydraulic pressure beneath the schneiderian membrane with an appropriately fitted syringe creates simultaneous detachment and elevation of the membrane. Upon administration of 3 ml of normal saline solution, sufficient elevation occurs for the placement of the graft material and implants with a 10-13 mm height.

Advantages

1. Simple and rapid; 2. Avoiding the creation of a buccal bone window; 3. The smaller is the amount of

the remaining residual alveolar crest, the easier it is to perform this method with a successful outcome.

Open technique [Figure 3]

Antroplasty is performed by anesthetizing the area to be grafted from the tuberosity to midline. A full-thickness incision is made along the crest of the maxillary ridge from behind the tuberosity and forward up to the canine area and a vertical releasing incision is made at the anterior end. The flap is reflected to access the canine fossa immediately below the infraorbital foramen to the buttress of the zygomatic arch and lateral maxillary wall posteriorly. A groove is created running along the full anteroposterior dimension of the antrum. The second line is placed parallel to and 15 mm above the first. These two are then connected with vertical incisions at either end. After full bony perforation, the bony plate is gently mobilized inward using the mallet and blunt end of an orangewood stick. Care should be taken so as to not perforate the membrane. Sinus membrane is sutured to the bone using bur holes for fixation. If the original crestal bone height present is less than 4 mm, miniplates can be used as a transitional support mechanism. If more than 5 mm bone height is present, the root form implants can be placed in a similar manner. The floor should then be filled with the graft material up to the upper level of fenestration. A resorbable membrane should be tucked superiorly beneath the mucosal flap to cover the antral window. The buccal flap should be returned to its original presurgical position and closed with a continuous horizontal mattress suture. The patient should be advised not to blow his nose for 2 weeks.

Antral membrane balloon elevation (AMBE)

When the edentulous area is limited to a zone between 1 and 2 teeth, AMBE - a modification of the currently used sinus lift - is the technique indicated.



Figure 3: Tatum membrane elevators

The AMBE is a modification and combination of surgical techniques that adds sufficient bone height to allow the placement of implants up to the length of 16 mm. No lateral osteotomy into the antral cavity is required. 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. A large spoon curette or modified sharp Freer elevator is required to elevate the membrane from the antral floor. The dissection should progress all along the medial wall of the sinus. A balloon made of latex material is used for this purpose.

Advantages: 1. Allows the surgeon to elevate the sinus membrane with a conservative, tissue-sparing surgical approach; 2. The procedure is completed within 30 min; 3. Beneficial when access is difficult and when the adjacent teeth are present next to the edentulous area.

Limitations of lateral maxillary approach (Hinge osteotomy)

- Complications:** (a) Sinus membrane perforation (10-35%); (b) Obstruction of antranasal foramen; (c) Bleeding; (d) Infection and (e) Infra orbital nerve laceration
- Periprocedural discomfort:** (a) Swelling, discoloration, disability and pain and (b) Hematoma and nosebleeding
- Timing:** Delayed (7-8 months) implant fixation
- Skills:** (a) Requires surgical expertise; (b) Demanding learning curve and (c) Time consuming and resource consuming.
- Relative contraindications:** (a) Anatomic-Sinus convolutions, septum or narrow sinus and (b) Previous Sinus surgery (Caldwell-Luc)

Graft used: Xenograft or allograft combination such as OrthoBlast 11 (Reguarde membrane) or C-Graft (Reguarde membrane) mixed with platelet-rich plasma.

Disadvantages: 1. Requires buccal fenestration and 2. Requires larger incision than that in other operations

Graft materials

- Autogenous bone-both osteoinductive and osteoconductive;
- Allogeneic (human) and Xenogeneic (animals, e.g., bovine);
- Demineralized freeze-dried bone allograft and
- Deproteinized, mineralized bovine bone.

DISCUSSION

Each of the abovementioned methods has its own advantages and limitations. The advantages of the closed technique include encouragement of the secondary periapical bone formation and it does not

require any complex manipulation. Summers' method permits the elevation of the membrane over an area wider than the osteotome length. Elevation by hydraulic pressure has advantages such as the following: it is simple and rapid, avoids large flap retraction, has minimal postoperative symptoms, etc.

The advantages of the open technique include minimal risk of tearing the membrane and less postoperative pain. Based on all the discussions thus far, we reveal that we have been unable to bring an ideal sinus augmentation technique to reality.

CONCLUSION

Over the years, various strategies, including the ancient to the recent surgical techniques, autogenous, xenogeneic and allogeneic graft materials and various treatment plans beginning from simple avoidance of the sinus to balloon augmentation of the antral floor have been advocated to reconstruct the posterior atrophic maxilla, to improve the quality and quantity of the bone receiving dental implants and prosthetic restorations. Even though newer graft materials and methods are being suggested, success depends on the adequate case selection, treatment plan and surgical

protocol followed, i.e., the ultimate success of the procedure remains in the dentist's hand.

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