Simplified Sinus Lift Surgery

Authored by
Karl R. Koerner, DDS, MS, and David Chong, DDS

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LEARNING OBJECTIVES
After participating in this CE activity, the individual will learn:
• Background information on surgical considerations for sinus displacement/bone graft procedures.
• A modified and less traumatic version of the Summers Technique.

ABOUT THE AUTHORS

Dr. Koerner has a private general practice in Utah that is limited to oral surgery including implants, and he performs the procedure described in this article on a routine basis. He is past president of the Utah Dental Association and Utah AGD. He has coauthored 4 books, published many articles, and is featured in several Practical Clinical Courses DVDs on oral surgery. Dr. Koerner is on the editorial boards of several dental journals and contributes to the Clinician's Report Newsletter (Provo, Utah). He presents courses internationally on oral surgery for the general dentist. He can be reached at karlrkoerner@comcast.net.

Disclosure: Dr. Koerner occasionally teaches courses for HIOSSEN Dental Implants on “Extracting Teeth in Preparation for Dental Implants” for which he is compensated. He has no other financial relationship with that company.

Dr. Chong maintains a general practice emphasizing implants and sinus grafts in Flushing, NY, and has successfully performed the procedure described in this article more than 150 times. He completed a 2-year surgical and prosthetic implantology residency program at New York University and currently is a clinical advisor at Far Rockaway Hospital in Queens, NY. He is also a consultant for the State Board of Dentistry in New Jersey. Dr. Chong is a Fellow of the International Congress of Oral Implantology and an active member of the Academy of Osseointegration. He can be reached at jehyunchong@yahoo.com.

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INTRODUCTION
Dental implants for edentulous areas of the mouth have become the standard of care in the United States, and the number of dentists, particularly general dentists, placing them is increasing. One challenging location for these implants, however, is the posterior maxilla. Even with adequate crestal bone width, implant placement may be limited by a lack of vertical bone height.

In the past, surgical techniques to overcome this obstacle were daunting, and the thought of approximating the maxillary sinus was out of the question for more conservative clinicians. With the development of new innovative surgical instrumentation and careful case selection, more dentists are now using new protocols and performing at least some of these implant-associated surgeries on a regular basis. This article presents brief background information and describes the surgical procedure for a crestal approach sinus graft using a predictable, minimally invasive technique.

TYPES OF SINUS GRAFTS
Sinus displacement/bone graft surgery in dentistry via a window made on the lateral wall of the sinus was described in the 1980s by Boyne and James, Misch, and Tatum. They suggested methods to increase the amount of intra-alveolar bone in the posterior maxilla necessary for implants that would be long enough to support dental prostheses. A less invasive way to increase vertical bone height for implants when several millimeters of intra-alveolar bone is already present was proposed by Summers in 1994: the osteotome sinus floor elevation technique. This article presents a modified and less traumatic version of the Summers technique.
NATURE OF THE MAXILLARY SINUS

The maxillary sinus is a pyramid with its base facing medially (toward the nose). Its volume is approximately 15 to 20 cc. It is 28 to 37 mm high (vertically), 32 to 34 mm from anterior to posterior, and 23 to 25 mm wide (buccolingually). The sinus often pneumatizes with age and grows larger to be in close proximity to the roots of premolar and molar teeth. If teeth are extracted, there is not only alveolar ridge resorption, but in addition, the sinus commonly pneumatizes or expands closer to the oral cavity. Septa can be found about one third of the time in edentulous patients and one fourth of the time when the dentition is present. Such septa are reported to have a mean height of 4.78 ± 1.76 mm in length and are located 60% in the middle region of the maxillary sinus, 22.5% in the posterior region, and 17.5% in the anterior region. The ostium or drainage orifice for the sinus is located at the extreme upper extent of the medial wall and averages about 2.4 mm in diameter.

CHARACTERISTICS OF THE SUMMERS TECHNIQUE

The Summers technique as originally described required a minimum existing ridge width of 3 mm that could be widened with progressively larger osteotomes. A transalveolar sinus floor elevation using twist drills (without ridge expansion) instead of osteotomes would, of necessity, require more bone width than 3 mm to allow for the osteotomy plus additional bone on the buccal and lingual of an implant (at least one mm on each side). The original Summers technique required between 7 and 10 mm of bone between the bone crest and floor of the sinus. Later, Rosen et al reported the implant success rate to be highest in cases where the preoperative vertical bone height was greater than 5 mm. Disadvantages of this technique, however, can include: perforation of the sinus membrane, ridge fracture (especially if the ridge is narrow), patient discomfort and even vertigo from malleting with osteotomes, complications from treating patients with an oblique sinus floor, and fracturing of bony trabeculae.

MOVING BEYOND THE SUMMERS TECHNIQUE—LESS TRAUMA, FEWER COMPLICATIONS

Other, newer nonosteotome sinus elevation/bone augmentation devices and techniques are now available to more safely accomplish this procedure and lessen the problems listed above. Included in the various brands currently available are HIOSSEN’s Crestal Approach Sinus (CAS) Kit (shown in Figures 1a and 1b and described in the paragraphs below), Zimmer Dental’s Sinus Crestal Approach Kit, and Neobio tech’s SCA Kit, which despite their differences in design, all provide a minimally invasive transalveolar osteotomy and bone grafting technique for implant placement that can be accomplished in a short period of time.

Prerequisites to be able to use these kits are that a clinician should: (1) be trained and experienced in implant placement, (2) understand principles of bone regeneration, and (3) have completed training that provides necessary expertise in doing procedures that involve the maxillary sinus, including knowing how to manage potential complications. There are available programs that meet these criteria.

This procedure should not be performed if there is any disease, condition, or medication that might compromise healing or osseointegration. A consultation with a specialist can be obtained if needed. There should be sufficient bone buccal and lingual to the proposed osteotomy and at least 5 mm of vertical bone height (Figures 2a and 2b). With this system, the sinus floor does not have to be completely flat, but septa are avoided if possible as they can increase the chance of membrane perforation.
**CASE REPORT**

A surgical case is presented that demonstrates an intra-alveolar sinus lift procedure with photographs and radiographs from start to finish—pre-operatively to 5 months post-operatively (Figures 3a to 3j).

**Surgical Procedure, Step-by-Step**

As with any implant surgery, diagnostic radiographs are of critical importance. Panoramic radiographs have been commonly used in the past with most clinicians now opting in favor of cone beam computed tomography with its clarity, contrast, and image accuracy. Intraoperatively, periodic periapical x-rays can be taken with drill in place to confirm preoperative measurements and guide the progress of the procedure.

This sinus surgery is exposed to a wide range of bacteria, so a broad-spectrum antibiotic along with an antibacterial rinse is recommended. A common protocol is: (1) amoxicillin 500 mg 3 times a day starting at least one hour prior to surgery with a loading dose and continuing for 5 days post-op, and (2) chlorhexidine gluconate (0.12%), rinsing twice a day starting 2 days before surgery and continuing for 7 days.

The first surgical step is to create a full-thickness mucoperiosteal flap exposing crestal bone. Using a No. 6 round bur, a “divot” is made about half the diameter of the bur so that the 2 mm diameter pilot drill does not “wander” before starting to penetrate bone. Set the stopper from the kit on the pilot drill so that penetration is approximately 2 mm from the sinus. The speed at this point is approximately 1,000 rpm. All burs used are latch-type in a contra-angle handpiece. Irrigation during use of the drills is required. Using round-ended sinus drills and still staying 2 mm away from the sinus (as enabled by using stoppers), the clinician progressively widens the osteotomy with the CAS Kit drills (available sizes: Ø2.8, Ø3.1, Ø3.3, Ø3.6, Ø3.8, Ø4.1), being careful not to use a diameter that is larger than the implant to be placed. There are a total of 11 stoppers labeled 2 to 12 mm. The 2-mm stopper is the longest one, indicating the usable length of the drill from its tip to the apical edge of the stopper as 2 mm. Again, the speed can be about 1,000 rpm until closer proximity to the sinus is achieved.

Next, the stopper is set to drill (1) one mm away from the sinus and (2) drill to width (same size as the implant or the next drill size smaller than the implant) by going up the progressively wider sizes of drills. Note, in softer bone, some drills can often be skipped. When this close to the sinus, the speed should be slowed to between 400 to 600 rpm (the less experienced the operator, the slower the speed).

Finally, the stopper is set so that the appropriate drill (in width and length) will penetrate the last remaining millimeter of bone. At this point the speed should only be 400 rpm to maximize tactile feel, even slowing to 50 to 100 rpm as the drill goes through the last few tenths of a millimeter, past the bony wall of the sinus into the sinus cavity proper. The rounded and concave end of the drill creates a circular conical bone lid that safely pushes the sinus membrane away from the drill without tearing it (Figures 1b, 4a, and 4b).

The depth gauge in the CAS Kit (Figure 5) measures the vertical length of the osteotomy in bone. Along with periodic radiographs, it can be used at any time to confirm depth and to verify that the membrane has been lifted with the last drill. For safety, the stoppers can also be used with the depth gauge but with the caution of not letting it penetrate beyond one mm into the sinus itself. There is quite a bit of variability in the thickness of the sinus membrane. The thickest mean values range from 2.16 to 3.11 mm in the midsagittal (vertical-
center) area of the sinus but it can be as thin as 0.16 mm. Sinus perforation is infrequent with this system. However, to test for membrane integrity, the patient can be asked to gently blow through the nose with the mouth open while pinching the nostrils with the fingers to block air passage. If there is a perforation, air bubbles will appear in the osteotomy. On the other hand, if done too forcefully, this maneuver can actually cause a perforation. If a hole into the sinus is detected, graft and implant placement should be aborted. The patient can be rescheduled in 6 to 8 weeks, after the membrane has healed. It should be noted that the maneuver described above is not 100% reliable.

Sterile saline under gentle hydraulic pressure may now be pushed through the osteotomy in order to carefully lift the sinus membrane away from bone. It is recommended in most single implant cases to use 1.5 cc of saline; however, up to 3 cc of saline can be used if desired, especially with multiple implants in more advanced cases. This process delicately separates the membrane from the bone using a system that includes a 3-cc syringe, plastic tubing, and the soft green hydraulic lifter nozzle. The lifter nozzle creates a seal at the entrance to the osteotomy and is held in place with a curved hemostat as the saline is very slowly injected. These materials can all be autoclaved and reused (Figures 3e and 3f). There will be some variability in the size of the “dome” of bone at the apical end of the osteotomy according to (1) the amount of saline used, (2) how much bone graft material is inserted, and (3) the width of the sinus.

Once the sinus membrane has been cleanly disengaged from the sinus wall, bone graft can be tunneled through the osteotomy. Bone graft material is deposited into the osteotomy with a bone carrier (amalgam carrier) and then pushed beyond the osteotomy into the newly created subantral compartment using the bone condenser with stopper attached. The bone condenser is a double-ended...

Figures 3a to 3j. Radiograph of tooth area No. 3 showing approximately 6 mm of vertical (residual) bone height. During the procedure, however, penetration of the inferior bony wall of the sinus was actually determined to be at 7 mm (a). Clinical view of area No. 3 (b). Creating the implant osteotomy with a drill from the CAS Kit. A stopper is attached to prevent the drill from cutting too deeply which could cause membrane perforation (c). Completed osteotomy. The lowest area of the sinus floor was penetrated without membrane perforation (d). View of the Hydraulic Lifter System which lifts the membrane away from the bone (e). Clinical application of the Lifter System. The size of the space created initially (between sinus membrane and bone) depends on the volume of saline injected (f). Use of the bone spreader. At this point in the case, the bone graft has already been inserted into the space (see technique described in this article) and a bone spreader (with stopper attached) is shown, to be used to uniformly distribute bone graft material on the sinus side of the osteotomy. The apical end of the implant will be inserted into this bone graft material (g). Radiograph of the just-inserted subantral bone graft resting underneath the sinus membrane (h). Radiograph of the completed bone graft/implant placement procedure (i). Same site at 5 months post-op showing remodeling of the bone graft (j).
instrument with a different diameter on each end to accommodate different widths of osteotomies. The stopper prevents the condenser from going beyond the sinus floor level (Figures 6a and 6b).

The Table is a guide to show how much graft material is needed to lift the membrane various heights. The amount of bone graft material required is dependent on the amount of augmented bone height the clinician wants to obtain. This height is usually from one to 6 mm. More experienced dentists may be able to gain slightly more—either in the one-step (implant placed at the same appointment) or 2-step (implant placed subsequently) approach.

Various sources of bone graft material can safely and predictably be used: autogenous bone, allografts, xenografts, or alloplastic materials. Autogenous bone can sometimes be harvested from drilling the osteotomy preparation (slow drill speed, < 500 rpm, wiping bone from the drill flutes); it is usually not of sufficient quantity for the procedure but can be used to supplement other graft materials. Allograft is commonly used, but one disadvantage is that it is not as visible radiographically. Xenografts, alloplasts, and “cortical” mineralized allograft materials or combinations of these with mineralized cancellous allografts or autogenous bone usually provide more radiopacity. Bone selected for use should not include large, sharp particles that might inadvertently cause tears in the membrane. Instead, they should be smaller, more rounded particulates or putty-type materials.

The step prior to actual implant placement is to use the bone spreaders to distribute the previously inserted bone graft material more widely and evenly—360° around the soon-to-be-placed implant (Figure 3g). There are 2 lengths of spreader extensions: 2 mm and 3 mm. These instruments, as with others, must be kept confined and not allowed to get too close to the membrane. To that end, stoppers are again utilized. It should be noted that these bone spreaders are 2.5 mm longer than all the other instruments in the kit. This must be taken into account when setting a stopper on them. The reason for this is that by this time in the

Table. Amount of Graft Needed*

<table>
<thead>
<tr>
<th>Lift Height</th>
<th>Bone Graft</th>
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<tbody>
<tr>
<td>3 mm</td>
<td>0.4 cc</td>
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<tr>
<td>4 mm</td>
<td>0.5 cc</td>
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<tr>
<td>5 mm</td>
<td>0.7 cc</td>
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<tr>
<td>6 mm</td>
<td>0.9 cc</td>
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*Amount will vary according to sinus size. Confirm with radiograph.
procedure, the membrane has already been lifted several millimeters away from the sinus floor.

A periapical radiograph will show the “dome” of bone graft created between the membrane and the lower wall of the sinus and will confirm the length of implant that can be placed. The upper outline of the graft should have a rounded appearance indicating confinement of bone particles between the membrane and inferior bony floor of the sinus (Figures 2b and 3h). After implant placement, another radiograph is taken.

Postoperative instructions include use of the above-mentioned antibiotic and twice daily antimicrobial rinses. In the authors’ practices, postoperative pain is usually addressed with dosing of nonsteroidal anti-inflammatory drugs, acetaminophen, or their combinations as optimized for patients. A commercially available combination product containing opioid and acetaminophen may also be an option and is easy to prescribe. Patients should be advised to follow typical implant placement postoperative protocol, such as soft diet, warm saline rinses, and not chewing for several days at the surgical site. Sinus precautions should be given (mouth slightly open if there is a need to cough, sneeze, or blow the nose).

CONCLUSION
As with most surgical procedures, innovation and improvement come with time. This article presents a minimally invasive crestal approach sinus grafting technique that allows implants to be more easily and safely placed in the posterior maxilla when there is an inadequate amount of intra-alveolar bone.

REFERENCES
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1. The vertical height of the maxillary sinus is:
   a. 10 to 17 mm.
   b. 18 to 27 mm.
   c. 28 to 37 mm.
   d. 38 to 45 mm.

2. The distance from anterior to posterior of the maxillary sinus is:
   a. 20 to 25 mm.
   b. 26 to 32 mm.
   c. 32 to 34 mm.
   d. 35 to 39 mm.

3. In an edentulous patient, how frequently can septa be found in the maxillary sinus?
   a. One tenth of the time.
   b. One third of the time.
   c. One half of the time.
   d. Three quarters of the time.

4. The ostium or drainage orifice for the maxillary sinus is located at the extreme upper extent of the medial wall.
   a. True.
   b. False.

5. The original Summers technique required a minimum existing ridge width of:
   a. One mm.
   b. 3 mm.
   c. 5 mm.
   d. 6 mm.

6. A disadvantage(s) of the original Summers technique is/are:
   a. Performance of the sinus membrane.
   b. Ridge fracture.
   c. Fracturing of bony trabeculae.
   d. All of the above.

7. In the modified Summers technique described in this article, there should be at least ______ of existing vertical bone height.
   a. 3 mm.
   b. 5 mm.
   c. 7 mm.
   d. 8 mm.
8. In the technique described in this article, during the first surgical step, the speed of the pilot drill is approximately:
   a. 100 rpm.
   b. 600 rpm.
   c. 1,000 rpm.
   d. 1,500 rpm.

9. The following type of bone graft material has the disadvantage of not being as visible radiographically compared to certain other types:
   a. Allograft.
   b. Xenograft.
   c. Alloplast.
   d. Autogenous bone.

10. The “dome” of bone created at the apical end of the osteotomy during the described technique will vary in size according to:
    a. Amount of saline used.
    b. Amount of bone graft material inserted.
    c. Width of the sinus.
    d. All of the above.
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2.  a  b  c  d
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8.  a  b  c  d
9.  a  b  c  d
10. a  b  c  d

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