Sinus Lift Procedures: An Overview of Current Techniques

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KEYWORDS
- Sinus lift
- Sinus reconstruction
- Bone morphogenic protein
- Osteotomy

For more than 30 years the maxillary sinus augmentation graft has been a mainstay of implant-directed maxillary reconstruction. The purpose of this article is to review the fundamentals of maxillary sinus reconstruction including anatomy and physiology of the sinus, indications for surgery, preoperative evaluation, surgical techniques, and management of complications.

ANATOMY AND PHYSIOLOGY

The paired maxillary sinuses are air-filled spaces lying within the bilateral maxillae, lateral to the nasal cavity, superior to the maxillary teeth, inferior to the orbital floors, and anterior to the infratemporal fossa (Fig. 1). These sinuses are the largest of the paranasal sinuses, measuring an average of 12.5 mL in volume. The maxillary sinuses are lined with a thin bilaminar mucoperiosteal membrane known as the Schneiderian membrane, which comprises ciliated pseudostratified columnar epithelium (respiratory epithelium) on the lumen side and a single-cell osteogenic periosteal layer (cambium layer) on the bone side. The infraorbital nerve runs in a posterior-anterior direction in the middle of the maxillary roof. In most cases the canal floor is composed of thick bone; however, in some cases the canal floor is not present, leaving only a thin layer of mucosa between the nerve and the sinus cavity. The sinus ostium, located in the superior aspect of the medial sinus wall superior to the uncinate process, opens into the ethmoid infundibulum located in the middle meatus along the lateral nasal wall. Thin, bony septae that span from the lateral sinus wall to the medial sinus wall may be present in up to 37% of patients with 22.5% of those in the anterior third of the sinus, 45.9% in the middle, and 31.5% in the posterior. One or two septae are present in 89% of patients with septae. The presence and location of septae may...
affect a treatment plan, and failure to identify them preoperatively may result in perioperative complications, as discussed later.

Of physiologic importance is that the membrane cilia guide mucous discharge and debris toward the ostium so that in normal-functioning sinuses drainage is constantly maintained. Some conditions may predispose certain patients to chronic sinusitis. Allergic rhinitis causes inflammation of the mucosa at the ostium, leading to local swelling and subsequent blockage of the outflowing mucous discharge, resulting in painful sinus pressure as well as infection of the stagnant fluid. Dysfunctional sinus cilia may also lead to accumulation of mucus and debris, resulting in infection due to the inability of the sinus to clear normal discharge and associated debris.5

INDICATIONS AND CONTRAINDICATIONS FOR SINUS RECONSTRUCTION

The primary indication for sinus graft surgery is the planned implant reconstruction of the edentulous posterior maxilla afflicted with postextraction alveolar bone loss and sinus pneumatization, resulting in bone too atrophic for said implant placement (Table 1). Sinus graft surgery is indicated for single-tooth and multiple-teeth reconstruction as well as reconstruction of the completely edentulous posterior maxilla.

PREOPERATIVE EVALUATION

A comprehensive history and physical examination should be performed before initiating surgical treatment. Pertinent positives in the history such as recent upper respiratory infection, chronic sinus disease, chronic sinus/facial pain, otitis media, history of nasal/sinus surgery, history of prior attempts at maxillary reconstruction, and history of smoking are important to note. Research has shown that the complication rate for sinus lift grafts performed on smokers is similar to the complication rate for the general population. However, there is evidence that smokers with implants placed in sinus-grafted bone have an increased failure rate when compared with nonsmokers.6,7 A preoperative computed tomography (CT) scan is recommended to assess the existing bone volume, rule out preexisting sinus disease, and evaluate for the presence of bony septae.8

Fig. 1. Coronal view of the ostiomeatal complex. The uncinate process lies in a sagittal plane. The maxillary sinus ostium drains into the infundibulum. (From Flint PW, Haughey BH, Lund V, et al. Cummings otolaryngology head and neck surgery review. 5th edition. St Louis (MO): Mosby; 2011; with permission.)
As with all surgical procedures, an informed consent discussion must take place before initiation of the procedure. The discussion must include the usual elements of the informed consent process including the risks, benefits, and alternatives to the procedure as well as the risks of the alternatives to the procedure. Typically the risks of maxillary sinus grafting include (but are not limited to) pain, bleeding from the incision site, infection (acute and/or chronic), swelling, graft failure, need for future surgery, hypesthesia, paresthesia, and/or dysesthesia in the distribution of the second branch of cranial nerve V (which includes the lateral nose, lower eyelid, cheek, upper lip, upper teeth and gums), and that this sensation change may be permanent although usually it resolves within 6 months. Smokers should be counseled that although the graft procedure may be successful, they place themselves at higher risk for implant failure with continued smoking. The benefit of the procedure is the ability to eventually reconstruct the edentulous maxilla. Although this benefit is obvious, it must be clearly stated as part of this discussion so that the patient is clear about the indication for the surgery. The most common alternatives to the procedure include a shorter implant, a 3-unit bridge, or a partial denture. Zygomaticus implants and angled implants may also be alternatives. The risks of the alternatives should be discussed as well. In addition, it is important to stress that this surgery is completely elective and that after considering the possible alternatives, the decision to proceed is the patient’s alone. It is also imperative to emphasize that the expected timeframe from this procedure to dental restoration can commonly exceed 1 year, as well as the costs associated with all additional procedures. Patient education videos are available, which provide a multimedia overview of the informed consent process and thus can help solidify difficult concepts. Using other visual aids such as models and radiographs also helps.

**SURGICAL TECHNIQUES**

There are currently two techniques widely used for maxillary sinus augmentation, the lateral window technique and sinus intrusion osteotomy technique. These methods

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<th>Condition</th>
<th>Treatment</th>
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<td>Edentulous maxilla with severely atrophic maxilla and pneumatized sinus</td>
<td>Open sinus lift via lateral maxilla sinus antrostomy; delayed implant placement</td>
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<tr>
<td>Edentulous maxilla with some remaining alveolar bone (0–4 mm)</td>
<td>Open sinus lift via lateral maxilla sinus antrostomy; delayed implant placement</td>
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<td>Edentulous maxilla with some remaining alveolar bone (5–10 mm)</td>
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<td>Single-tooth edentulous space with 5–7 mm alveolar bone remaining</td>
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<td>Single-tooth edentulous space with &gt;8 mm bone remaining</td>
<td>Open sinus lift via lateral maxilla sinus antrostomy or closed (crestal approach) osteotome technique; immediate implant placement</td>
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have been shown to be two of the most stable techniques for vertical augmentation in the oral cavity. When performing these techniques several types of bone graft material can be used including autogenous bone, allograft, xenograft, and alloplastic materials. The graft material chosen must provide adequate viable bone to stabilize the implant initially and encourage osseointegration. Autogenous bone is considered the ideal graft for the sinus lift technique. Although other graft materials can provide adequate bone levels initially, recent studies have shown that autogenous bone grafts have adequate height of alveolar ridge 5 to 10 years after initial placement. Often demineralized freeze-dried bone can be added to autogenous bone to increase the volume of bone placed into the maxillary sinus. Studies have shown that the addition of demineralized freeze-dried bone to autogenous bone slightly lowers the bone level obtained. This lowering was statistically significant, but minimal clinical difference existed due to the implants being still covered with bone.

Autogenous bone grafts are the only graft materials that contain endosteal osteoblasts, giving them osteogenic properties and the ability to directly form bone. In addition to providing osteoblasts for direct bone formation, a corticocancellous graft will provide bone morphogenic proteins (BMPs) and growth factors that will induce bone formation. Many different sites can be used to obtain bone grafts, including the anterior iliac crest, calvarium, proximal tibia, and maxillofacial regions. Most of these techniques are outside the scope of this article, and their individual techniques are not discussed here.

Several sites can be used to harvest bone intraorally. These sites can come from the maxillary tuberosity, the symphysis, the ramus, posterior maxilla, and mandibular third molar site. The maxillary tuberosity offers a small amount of bone (1–2 mL) but should be considered because it is in the same surgical field as the lateral approach to the maxillary sinus. To obtain the graft a crestal incision is made in the posterior maxilla to the area of the hamular notch, with vertical releasing incisions as needed. If the lateral window approach is to be used to access the maxillary sinus, the incision is extended posteriorly to allow access to the tuberosity. A full-thickness mucoperiosteal flap is raised to expose the posterior maxilla. A rongeur can then be used to harvest the bone. When performing this technique care must be taken to avoid the maxillary sinus, pterygoid plates, molar teeth, and the greater palatine canal. The symphysis donor site offers the greatest volume of intraoral bone. To access this region a vestibular incision is made from canine to canine. The incision should be placed at least 3 mm from the mucogingival junction. The periosteum is elevated and the osteotomy is performed 10 mm inferior to the apex of the incisor teeth.

![Fig. 2. Bone harvesting. (From Fonseca RJ, Marciani RD, Turvey TA. Oral and maxillofacial surgery. 2nd edition. Philadelphia: Saunders; 2008. p. 409; with permission.)](image-url)
A trephine with a collecting device placed within the suction line can be used to harvest the bone. If needed, the cortical plate can be removed and the marrow harvested (Fig. 3). Care must be taken to avoid the mental nerve, and the patient should be informed of the increased chance of V3 paresthesia from this procedure. Similar to this procedure, a scraping device with a collection container attached to the suction can be used to obtain bone from the posterior maxilla and mandibular third molar sites.

The lateral window technique was first demonstrated by Tatum by using a modified Caldwell-Luc approach. The surgical technique consists of osteotomies to form a bony window and either the removal or medial rotation of this window without perforating the sinus membrane. Before starting, local anesthetic with epinephrine is administered by performing a posterior superior alveolar nerve block, anterior superior alveolar nerve block, and palatal infiltration. Local anesthesia can be used with intravenous sedation or general anesthesia if indicated. Conventionally, prophylactic antibiotics and steroids are administered before starting the procedure. The surgeon should use his or her discretion when using perioperative steroids and antibiotics. There is no solid evidence to suggest whether the surgeon should use these medications preoperatively, therefore one should weigh the benefits and risks before administering these medications. Before making the incision it is recommended to have the patient rinse and expectorate with 0.12% chlorhexidine rinse. A crestal incision is made from the maxillary tuberosity to a point just anterior to the anterior border of the sinus. Vertical releasing incisions are then made in the anterior and posterior aspect to the depth of the vestibule. The incisions must allow adequate exposure of the sinus and should not be placed in the area of the sinus window. A full-thickness mucoperiosteal flap is then elevated, exposing the lateral wall of the maxilla (Fig. 4). At this point the 4 linear osteotomies are performed with a #6 or #8 round bur. The first to be done is the inferior horizontal osteotomy, which is made as close as possible to the floor of the sinus and no more than 2 to 3 mm above the floor. The osteotomy runs from the area of the first or second molar posteriorly to the anterior extent of the maxillary sinus (Fig. 5). When performing the osteotomies one must take care to do so with a light touch and a brushing stroke so not to tear the Schneiderian membrane. When bicuspid teeth are present, care must be taken not to damage them and one should limit the osteotomy 4 mm from the distal aspect of the tooth. The superior horizontal osteotomy is performed next at the level of the planned augmentation height. The superior and inferior osteotomies are connected with the anterior and posterior vertical osteotomies. The vertical osteotomies are

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**Fig. 3.** The unicortical osteotomies form a rectangular outline in the symphysis. (From Fonseca RJ, Marciani RD, Turvey TA. Oral and maxillofacial surgery. 2nd edition. Philadelphia: Saunders; 2008. p. 410; with permission.)
made parallel to the lateral nasal wall and the anterior border of the maxillary tuberosity (or the maxillary buttress), respectively (Fig. 6). Once the window is created and the membrane exposed, the bone that is adherent is either removed or rotated in medially. If the bony window is rotated inward it then becomes the new floor of the maxillary sinus.

The Schneiderian membrane is then elevated by starting at the edges and then gradually increasing the amount of membrane elevation. If elevation is too excessive in one area, perforation may occur. The elevation can be performed using broad-based freers or curettes. The membrane can and should be elevated higher than the superior osteotomy. It is important to do this to prevent excessive pressure on

Fig. 4. Incision and mucoperiosteal flap reflection. (From Fonseca RJ, Marciani RD, Turvey TA. Oral and maxillofacial Surgery. 2nd edition. Philadelphia: Saunders; 2008. p. 459; with permission.)

Fig. 5. Diagram demonstrating the ideal location of sinus window preparation of the lateral maxillary wall. The inferior ostectomy should be approximately 1 mm superior to or level with the floor of the sinus. The posterior ostectomy should be at the corner of the maxillary buttress. The anterior ostectomy should be adjacent to and parallel with the lateral wall of the nose, and the superior ostectomy should be at the height of the intended graft. (From Block MS. Color atlas of dental implant surgery. 2nd edition. Philadelphia: Saunders; 2007. p. 129; with permission.)
the bone graft material (Fig. 7). Perforation of the sinus membrane is a possibility, and may occur (Fig. 8). Small perforations can be left untreated, but if a large perforation occurs the clinician should either abort the procedure or use a collagen membrane to patch the membrane. If the procedure is aborted, it should not be reattempted for an additional 4 to 6 months. Once the membrane is elevated, the bone graft material is placed under the membrane in an anterior and inferior direction. The graft should contact the medial wall of the maxillary sinus. The graft is placed in the cavity loosely and should not be overpacked. The surgeon should add an additional 20% of bone graft to compensate for loss of graft volume (Fig. 9). After the bone is placed in the sinus, the mucoperiosteal flap is repositioned and sutured. Implants can be placed 6 months after the sinus lift procedure is performed. If there is adequate alveolar bone to stabilize the implants, the implant sites are prepared and the implants are placed before the bone graft, with the bone graft material being packed around the implants (Fig. 10). It is recommended to place the patient on postoperative antibiotics and decongestants for 2 weeks. Patients should also be placed on sinus precautions, should not blow their nose, and should cough or sneeze with their mouth open.

Fig. 6. Complete quadrilateral osteotomy. (From Fonseca RJ, Marciani RD, Turvey TA. Oral and maxillofacial surgery. 2nd edition. Philadelphia: Saunders; 2008. p. 460; with permission.)

Fig. 7. Membrane is carefully elevated and reflected medially into the sinus. (From Block MS. Color atlas of dental implant surgery. 2nd edition. Philadelphia: Saunders; 2007. p. 134; with permission.)
Piezoelectric technology is an ultrasonic device that is used to make the osteotomies. This system has been shown to help avoid perforating the sinus membrane. The piezoelectric surgery systems have been designed to use a specific power that is higher than traditional ultrasonic instruments. This higher power allows the osteotomies to be made even in thicker, more compact cortical bone. The real advantage of this system is that it does not cut soft tissue and helps to reduce the chance of perforating the membrane. The surgical instrument can even be used to assist in the elevation of the sinus membrane. This instrument is helpful with robust areas of bone and thin membranes. The piezoelectric surgery systems come with many different inserts, from osteotomes, to diamond-cutting inserts, to inserts to help elevate the sinus membrane. Once the window is made the lifting of the membrane is accomplished by separating the endosteum from bone, and a hydropneumatic pressure of the physiologic saline solution is subjected to the piezoelectric cavitation (Fig. 11). A study by Vercellotti and colleagues was performed on 15 patients, creating 21 bony window

Fig. 8. Crestal incision is combined with anterior and posterior vertical release incisions to allow for exposure of lateral wall of the maxilla. Lateral wall of the sinus is rotated medially with membrane reflection. A small perforation is present. (From Block MS. Color atlas of dental implant surgery. 2nd edition. Philadelphia: Saunders; 2007. p. 145; with permission.)

Fig. 9. Bone graft composite is packed into the sinus site. After approximately 6 months, implants are placed; after an additional 6 months, the final restoration is completed. (From Block MS. Color atlas of dental implant surgery. 2nd edition. Philadelphia: Saunders; 2007. p. 135; with permission.)
osteotomies with a Mectron Piezosurgery System (Mectron Medical Technology, Mectron SPA, Carasco, Italy). The inserts were used with a vibration between 60 and 210 μm with a power exceeding 5 W. All osteotomies are made under irrigation provided by a pump in the surgical system. After reflection of the flap the piezoelectric scalpel is used to make the bony window. The membrane elevator tip is then used beginning at the apical position, then moving to the mesial and distal aspects. Then attention is drawn to the floor of the sinus, a common place to find adhesions, where the membrane is elevated and the risk of perforation reduced. All sinus augmentations in this study were performed with autogenous bone grafts and platelet-rich plasma. Of the 21 cases, only 1 resulted in perforation of the membrane and there was a 95% success rate.

The sinus intrusion osteotomy is indicated when at least 5 to 6 mm of alveolar bone is present. This approach has been shown to add 4 to 8 mm of bone height, but is best indicated when minimal bone height is needed and there is sufficient bone for

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Fig. 10. Diagram showing the lateral wall of the maxilla rotated medially into the sinus, which is optional. Bone graft material is placed into the sinus, either in particulate material or block form, to support the implant. Ideally, the block grafts should engage the superior surface of the implant. (From Block MS. Color atlas of dental implant surgery. 2nd edition. Philadelphia: Saunders; 2007. p. 130; with permission.)

Fig. 11. Incision and mucoperiosteal flap reflection. (From Fonseca RJ, Marciani RD, Turvey TA. Oral and maxillofacial surgery, vol. 1. 2nd edition. Philadelphia: Saunders; 2008. p. 462; with permission.)
stabilization of an implant. This technique was developed in 1994 by Summers, and consisted of a crestal incision, preparation of the bone, and elevation of the sinus by several millimeters. When performing this technique one will not only compact bone apically and elevate the sinus but also compact bone laterally by using osteotomes of progressively increasing diameter (Fig. 12). Summers performed this procedure in 46 patients, placing 143 implants, and showed a 96% success rate 5 years postoperatively. When performing this procedure a crestal incision is made and the implant drills are used to create an osteotomy, leaving 1 mm of bone between the site and the sinus membrane. After preparing the site with the implant drills, sequential osteotomes are used to the depth of desired implant length; this compacts bone lateral and apical, and elevates the sinus membrane. Once at the desired length and diameter, bone graft material is placed in the apical portion of the prepared site (Fig. 13). The implant is placed next to the desired length, and care is taken to ensure that the implant is stable. A coverscrew is placed and primary closure is achieved. After 4 to 6 months of healing the implant can be uncovered and the healing abutment placed. Komarnycky and London performed this procedure in 16 patients and placed 43 implants, showing a 95.3% success rate. This study had a follow-up that ranged from 9 to 47 months and showed a mean bone gain of 3.25 mm.

An alternative to bone graft material is bone morphogenic protein (BMP), which is becoming more and more popular. BMPs are transforming growth factors that contain bone-inductive properties. There are two recombinant human proteins that are currently available: rhBMP-2 and rhBMP-7. This material is used in place of bone graft material for spinal fusion, treatment of bone defects, fracture repair, and reconstruction of the maxillofacial region. Advantages of using this material include no harvest-site morbidity, enhanced soft-tissue healing, ease of use, and possible use in patients who are not autogenous graft candidates. BMP comes in the form of a powder that is reconstituted with sterile water and applied to a carrier at the time of the surgery. The carrier material is resorbed over time, and its purpose is to maintain the rhBMP at the treatment site and to act as a temporary scaffold for osteogenesis. The most commonly used carrier for maxillary sinus augmentation is the collagen carrier. This carrier is adequate for maxillary sinus augmentation, but does not have any mechanical strength and must be used in an area that has borders in all dimensions. The following discussion describes the use of BMP-2 on a collagen sponge. When using

![Fig. 12. Trephined bone core partially intruded into sinus cavity. (From Fonseca RJ, Marciani RD, Turvey TA. Oral and maxillofacial surgery. 2nd edition. Philadelphia: Saunders; 2008. p. 465; with permission.)](image)
BMP-2 for maxillary sinus augmentation the lateral window method is preferred, and there are very few data to show success through the sinus intrusion osteotomy. Local anesthetic is administered, an incision is made, full-thickness mucoperiosteal flap is raised, bony osteotomies are made, and sinus membrane is elevated as previously described. If a membrane perforation is encountered it is not necessary to repair this when using BMP, but it may be done if the surgeon prefers to.

The BMP comes packaged as a lyophilized powder and is reconstituted into the sterile water as per the manufacturer’s recommendations. The reconstituted BMP is then placed in a sterile syringe and applied to the collagen sponge (Fig. 14). When placing the liquid on the sponge, drops are applied equally along the sponge and allowed to sit for at least 15 minutes. This period of time allows the BMP to adhere to the collagen sponge. The sponge can then be cut into 15-mm strips and placed into the sinus between the bony floor and membrane (Fig. 15). Primary closure is then achieved with chromic gut sutures. Antibiotics are given for 1 week and the

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**Fig. 13.** Graft placed through implant receptor site into sinus cavity. (From Fonseca RJ, Marciani RD, Turvey TA. Oral and maxillofacial surgery. 2nd edition. Philadelphia: Saunders; 2008. p. 468; with permission.)

**Fig. 14.** BMP is placed onto collagen sponge and the sponge is cut into five or six strips. (From Block MS. Color atlas of dental implant surgery. Philadelphia: Saunders; 2007. p. 147; with permission.)
patient is placed on sinus precautions. One should advise the patient that significant swelling is likely to occur. After 4 months a postoperative panoramic radiograph can be obtained showing bone formation, and implants can be placed 6 months after the procedure. One of the earliest studies showing the successful use of rhBMP-2 was done by Boyne and colleagues,\textsuperscript{21} in which 12 patients had rhBMP-2 placed into their maxillary sinus. The mean height of bone was 8.51 mm. The most significant postoperative side effects were facial edema, erythema, pain, and rhinitis. In another study rhBMP-2 was compared with anterior iliac crest grafts in 30 rabbits.\textsuperscript{22} Implants were placed in the augmented sinuses 12 weeks later and allowed to integrate for 3 months. The mean vertical bone gain was greatest in the rhBMP-2 group, and showed that the bone between both groups was of similar quality. Recombinant BMP is contraindicated in patients with hypersensitivity to the protein, carrier, or any other components of the formulation. It should not be used in patients with an active malignancy or being treated for a malignancy, in areas of existing or resected tumors, in skeletally immature patients, in pregnant women, or in areas of active infection. BMP is an excellent alternative for patients who do not wish to undergo a separate procedure to obtain bone graft material, and should be considered.

**POSTOPERATIVE INSTRUCTIONS AND MANAGEMENT**

The patient should be provided with a printed set of postoperative instructions as well as an oral review of the instructions with the surgeon. Typically the patient is cautioned against consuming anything hard or rough that may damage the sutures and lead to wound dehiscence. Sinus precautions are advised as well, and include avoiding anything that can cause sudden pressure changes in the sinus such as nose blowing and sneezing. The patient should be instructed to sneeze only with an open mouth so that pressure can be directed away from the sinus. There are several things that the patient should be told to expect after surgery. Soreness is, of course, normal and expected for several days after surgery. It is normal for some patients to experience some bleeding from the surgical incision for up to 24 hours after surgery. This bleeding will appear to be worse than it is, due to the blood mixing with saliva. The blood should

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**Fig. 15.** BMP impregnated collagen membrane is placed into the sinus with no membranes used to cover the sinus graft site. (From Block MS. Color atlas of dental implant surgery. Philadelphia: Saunders; 2007. p. 147; with permission.)
be swallowed (not expectorated), and if bothersome is controllable with direct wet gauze pressure. If after 2 applications of gauze of 1 hour each the bleeding persists or if the volume is of concern, the patient should inform the surgeon. Swelling and occasional skin bruising is not uncommon after sinus lift surgery.

**MANAGEMENT OF COMPLICATIONS**

The most common surgical complication of the maxillary sinus lift is perforation of the Schneiderian membrane (Table 2). In a recent prospective observational uncontrolled study, 70 patients underwent 81 sinus lifts and were followed through to loading of a total of 212 implants. Forty-four percent of the sinuses were perforated intraoperatively but were repaired, and the procedure was completed without other complications. Two percent of the sinuses suffered perforations so severe that the procedure was aborted. Thirty-three percent of the perforations occurred in sinuses that had septae noted on preoperative radiographs, and of those sinuses with septae 52% suffered perforations. Two of the 36 perforations were so severe that the surgeon aborted the procedure. Common modalities for dealing with sinus perforation include doing nothing if the perforation is less than 2 mm in diameter and placement of a slowly resorbing collagen membrane if larger than 2 mm. Postoperative complications in the study included graft extrusion into the sinus cavity in one patient presenting as an acute sinusitis after implant placement. After surgical and medical treatment, the infection resolved and the implants went on to be restored. Late complications included persistent peri-implantitis and a peri-implant cyst. Of importance is that although membrane perforations were associated with postoperative complications such as swelling, pain, and local infection, there is no association between intraoperative perforations and long-term implant survival. Overall, this study demonstrated a 95.5% 7-year survival rate for implants placed in the grafted sinuses. Also of note is that of the 9 implants that failed, 5 were placed in patients who were heavy smokers. Chronic infections leading to severe sinusitis and possible graft exposure, extrusion, and/or failure are rare events. Management typically involves treatment based on the presenting symptoms, and can range from antibiotics to surgical debridement drainage to a Caldwell-Luc procedure.23–25

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<td><strong>Common sinus lift surgery complications</strong></td>
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<tr>
<td><strong>Complication</strong></td>
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<tr>
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<tr>
<td>No graft present after maturation phase</td>
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<td>Paresthesia CN V2 distribution immediately postop</td>
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<td>Severe facial ecchymosis appearing 1–3 days postop</td>
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<td>Facial pain and swelling, 1 week postop</td>
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<td>Swelling, acute onset</td>
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SUMMARY

The maxillary sinus lift has, over the last 30 years, been established as an accepted standard for treatment of the edentulous maxilla. Alternatives such as short implants, although shown to be effective in the short term, lack long-term studies to support routine use. While there are some relative contraindications for the procedure, there are almost no absolute contraindications. With preparation, education, and experience, the maxillary sinus augmentation/elevation graft is a procedure that greatly benefits the patient, with a predictable outcome.

REFERENCES


