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Review Article

**AN OVERVIEW OF MAXILLARY SINUS SURGERY  
ELEVATION**Dr. Abdulwahab Alshehri<sup>1</sup>, Dr. Monirah Alfawaz<sup>2</sup><sup>1</sup>Dentist at MOH**Abstract:**

*This review discusses the principles of maxillary sinus repair consisting of anatomy and physiology of the sinus, signs for surgical treatment, preoperative assessment, medical techniques, and management of complications. MEDLINE, AMED, EMBASE, CINAHL, and the Cochrane Library were searched in details (for articles published up to December, 2018) for relevant articles in English language were included in the review. The maxillary sinus lift has, over the last 30 years, been established as an approved standard for treatment of the edentulous maxilla. Alternatives such as short implants, although revealed to be effective in the short term, lack long-lasting researches to sustain regular use. The maxillary sinus elevation treatment making use of a side window approach has been revealed to be one of the most effective bone enhancement procedure that is done as a pre-prosthetic treatment prior to implant placement. When success is measured by patient result (success of the implanting procedure), the superb result rate accomplished is due to the fact that issues are very little and potentially better on avoided through correct situation option, excellent surgical method, and correct and prompt handling of intraoperative and postoperative problems.*

**Keywords:** Maxillary Sinus, Elevation, Implant, Dentistry**Corresponding author:**Dr. Abdulwahab Alshehri,  
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**INTRODUCTION:**

During long-lasting edentulism, resorption of the alveolar process happens. Ever since the maxillary sinus additionally pneumatizes during these scenarios, the remaining bone volume can come to be extremely small and consequently medical professionals and researchers have continuously established methods to overcome this complication [1].

The sinus lift is an operation intending to develop an enhanced bone volume in the maxillary sinus floor in order to enable installment of fixtures in the area. The graft in the sinus base may be entrusted to heal primarily before implants are put in a second surgical treatment (2-stage treatment), or implants may be positioned concurrently with the graft (1-stage procedure). The grafts are, nevertheless, revealed to a rather substantial level of resorption [2].

The method of sinus lift was first orally reported in 1976 by Tatum and initial published in 1980 by Boyne and James and ultimately additionally by Tatum [3-5]. The surgical procedure has actually gone through advancement, and variants exist. Autogenous bone, considered as the preferred choice however with an essential drawback of an uncertain rate of resorption, has actually later been changed by numerous specialists by the use bone substitutes [6]. The series of various materials installed and discovered in the sinus is impressive. Later on works have actually consisted of trials of rhBMP-2 along with using mesenchymal stem cells (MSCs) in combination with inorganic bovine bone [7]. Long-term followup showing gratifying outcomes pertaining to implant survival utilizing two commonly used techniques, the lateral sinus flooring altitude strategy and the osteotome technique, existed in 2010 by Tetsch et al. They followed 983 patients with 2190 implants over an amount of time of 176 months using Kaplan-Meier analysis and revealed a dental implant survival rate of 97,1% [8].

For greater than 30 years the maxillary sinus augmentation graft has actually been a mainstay of implant-directed maxillary restoration. This review discusses the principles of maxillary sinus repair consisting of anatomy and physiology of the sinus, signs for surgical treatment, preoperative assessment, medical techniques, and management of complications.

**METHODOLOGY:**

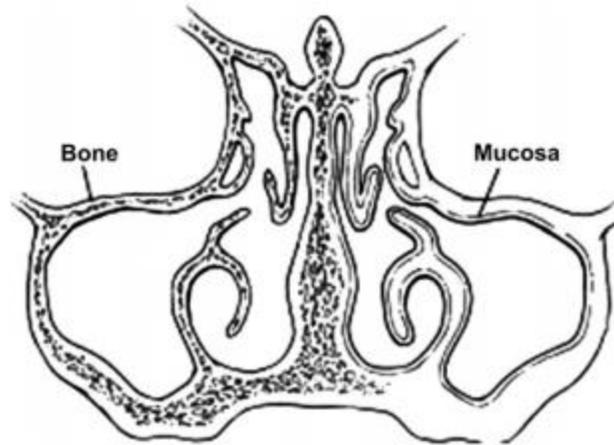
MEDLINE, AMED, EMBASE, CINAHL, and the Cochrane Library were searched in details (for articles published up to December, 2018) for relevant articles in English language were included in the review. Search terms as following “maxillary sinus”, “surgery elevation”. Reference lists of all retrieved articles were scanned for further relevant studies.

**DISCUSSION:**

- **Anatomy Of The Maxillary Sinus**

The maxillary sinus is pyramidal in shape. The base of the pyramid is the medial wall surface of the sinus, which is additionally the side wall of the nasal cavity, and its apex is pointed towards the zygomatic bone (Figure 1). The roofing of the sinus is likewise the flooring of the orbit. The maxillary sinus begins to develop in early youth and continues to raise in size. The typical volume of a totally created sinus is 15 mL. The maxillary sinus is lined with breathing epithelium (pseudostratified columnar epithelium), which covers a loosened and very vascular connective tissue. Beneath this loose connective tissue and instantly beside the bony wall surfaces of the sinus is the periosteum. These structures (the sinus epithelium, connective tissue, referred to as the schneiderian membrane layer. Drain of the maxillary sinus is via the ostium, which is positioned in the exceptional medial element of the sinus and opens into the nasal cavity in between the center and reduced nasal conchae. The fact that the sinus opens up to the nasal cavity is not in the reduced part of the sinus (where the graft is positioned) is important and gives an anatomic rationale to the sinus altitude strategy as the implanting procedure does not interfere with regular sinus function.

The blood supply to the maxillary sinus is obtained mostly from the maxillary artery and, to a minimal level, from the anterior ethmoidal and premium labial arteries. The sensory innervation is derived from the maxillary division of the trigeminal nerve through the former, middle, and posterior premium alveolar nerves. The functions of the maxillary sinus are to warm the aspirated air, to lower the weight of the craniofacial complex, and to offer resonance to the voice [9], [10].



**Figure 1.** Coronal view of the ostiomeatal complex. The uncinate process lies in a sagittal plane. The maxillary sinus ostium drains into the infundibulum [11].

- **Indications For Sinus Reconstruction**

The primary indicator for sinus graft surgery is the planned implant reconstruction of the edentulous posterior maxilla afflicted with postextraction alveolar bone loss and sinus pneumatization, leading to bone also atrophic for stated implant placement (Table 1). Sinus graft surgical treatment is suggested for single-tooth and multiple-teeth repair along with reconstruction of the entirely edentulous posterior maxilla.

- **Preoperative Evaluation**

A comprehensive background and physical checkup must be executed before launching medical therapy. Relevant positives in the history such as recent top

respiratory system infection, chronic sinus illness, chronic sinus/ facial soreness, otitis media, background of nasal/sinus surgery, background of prior efforts at maxillary repair, and history of smoking are important to note. Study has revealed that the complication rate for sinus lift grafts performed on smokers resembles the difficulty rate for the basic populace. Nevertheless, there is proof that smokers with implants put in sinus implanted bone have actually a boosted failing rate when compared to nonsmokers [12], [13]. A preoperative computed tomography (CT) scan is advised to evaluate the existing bone volume, eliminate preexisting sinus disease, and evaluate for the existence of bony septae [14].

**Table 1.** Indications for sinus lift surgery [11].

Condition	Treatment
Edentulous maxilla with severely atrophic maxilla and pneumatized sinus	Open sinus lift via lateral maxilla sinus antrostomy; delayed implant placement
Edentulous maxilla with some remaining alveolar bone (0–4 mm)	Open sinus lift via lateral maxilla sinus antrostomy; delayed implant placement
Edentulous maxilla with some remaining alveolar bone (5–10 mm)	Open sinus lift via lateral maxilla sinus antrostomy; immediate implant placement
Single-tooth edentulous space with 5–7 mm alveolar bone remaining	Open sinus lift via lateral maxilla sinus antrostomy; immediate implant placement
Single-tooth edentulous space with >8 mm bone remaining	Open sinus lift via lateral maxilla sinus antrostomy or closed (crestal approach) osteotome technique; immediate implant placement

- **Surgical Technique**

Sinus altitude surgical procedure can usually be accomplished under local anesthesia; however, when the patient is apprehensive or when a second medical site is utilized for harvesting of an autogenous bone graft, oral sedation, intravenous sedation, or even general anesthesia is in some cases employed. After administration of local anesthetic, the lateral wall surface of the maxillary sinus is subjected by a full-thickness mucoperiosteal flap. The initial incision is typically crestal; it ought to be longer than the future osteotomy in the anteroposterior dimension. To help with visibility, a mesial (and typically a distal) launching incision is executed. All incisions need to be eliminated from the area of the anticipated osteotomy to assist in primary closure. Complying with flap reflection the dimensions of the osteotomy are established based on the professional and radiographic examinations. The reduced border of the osteotomy should be around 3 mm above the sinus floor. The osteotomy should be oval or rectangular, and corners and sharp sides must be stayed clear of to lessen the risk of tearing the sinus membrane. The osteotomy should be executed making use of a round diamond (eg, no. 8 bur) or carbide bur at low speed with copious saline irrigation. When the osteotomy is almost full, the sinus membrane layer, which is bluish purple, can in some cases be observed. After conclusion of the osteotomy, the bony wall surface ought to be mobile and affixed just to the underlying sinus membrane layer. The bony wall surface can now be meticulously gotten rid of and kept for later incorporation into the graft material or used the sinus hinging on its premium margin while still attached to the sinus membrane layer. If the sinus wall surface is tapped into the sinus, it will ultimately work as the new sinus flooring and the roofing of the chamber consisting of the bone graft material. Touching the wall surface right into the sinus or removing it is a matter of medical preference. Some clinicians choose to remove this bony wall surface to boost accessibility and presence. In this instance, the bony wall surface should be delicately released from the underlying sinus membrane layer and meticulously removed to avoid tearing of the membrane. Additionally, the stamina of the attachment of the sinus membrane layer to the bony wall can give a dependable indication of the level of trouble in the reflection of the sinus membrane layer. After the osteotomy is finished, the sinus membrane is gently reflected and elevated making use of special curets to produce space for the graft product. Sinus membrane representation must be to the median wall surface of the sinus and remarkable adequate to prevent pressure on the graft and avoid membrane layer

tearing during graft placement. After ample membrane layer reflection, a cottonoid or gauze soaked with 2% lidocaine with 1:100,000 epinephrine can be placed into the sinus tooth cavity (underneath the reflected membrane layer) to attain vasoconstriction and enhance hemostasis; this improves visualization of the medical area [15]. Ice-cold saline solution can be utilized as well to attain a comparable result. Currently, cautious expedition for membrane perforations must be performed. The graft component of choice is then positioned and packed. A synthetic membrane can be used to cover the window on the lateral wall surface of the sinus and the graft. The placement of a membrane has been identified to raise bone development in the implanted sinus and boost the bony healing [16], [17]. Ultimately, the mucoperiosteal flap is repositioned and sutured. Primary soft tissue closure is important to stop contamination of the graft from the oral environment and, with appropriate flap design, ought to be attained easily.

The existence of septa in the maxillary sinus can complicate the procedure. Septa exist in approximately 31 % of patients and are most typical in the location between the second premolar and initial molar. Septa are identified more frequently in edentulous atrophic maxillas than dentate maxilla [18]. Preoperatively, the very best way to find septa is with CT exam. When a septum is identified, the osteotomy ought to be created to avoid it if possible. In many cases two osteotomies, one anterior and one back to the septum, can be executed.

- **Postoperative Instructions And Management**

The patient should be provided with a printed set of postoperative instructions along with an oral testimonial of the guidelines with the surgeon. Generally, the patient is cautioned against taking in anything hard or harsh that might harm the sutures and bring about wound dehiscence. Sinus safety measures are encouraged as well, and include staying clear of anything that can cause unexpected stress adjustments in the sinus such as nose blowing and sneezing. The patient needs to be instructed to sneeze only with an open mouth to make sure that pressure can be guided far from the sinus. There are several points that the patient should be told to anticipate after surgery. Discomfort is, of course, typical and anticipated for a number of days after surgery. It is typical for some patients to experience some blood loss from the surgical incision for approximately 24 hours after surgical treatment. This bleeding will

seem even worse than it is, due to the blood combining with saliva. The blood needs to be ingested (not expectorated), and if troublesome is controlled with straight wet gauze stress. If after 2 applications of gauze of 1 hour each the blood loss persists or if the volume is of problem, the patient should enlighten the surgeon. Swelling and periodic skin bruising is not uncommon after sinus lift surgery.

Postsurgically, patients ought to relax, use stress on the medical site, and use ice packs. Patients must be instructed to prevent blowing their nose. Coughing and sneezing should be made with an open mouth. Antibiotic coverage with a broad-spectrum bactericidal antibiotic (such as amoxicillin or amoxicillin and clavulanate) need to be started on the day of the surgical procedure and continued for 7 to 10 days postoperatively. An appropriate analgesic (ideally one that is additionally an anti-inflammatory) and a chlorhexidine mouthrinse ought to be recommended. Management of a temporary tapering dose of glucocorticoids (such as dexamethasone) is often utilized to reduce postoperative swelling, trismus, and pain [19]. Systemic and topical nasal decongestants can likewise be made use of to improve ostial drainage.

- **Management Of Complications**

The most typical surgical issue of the maxillary sinus lift is perforation of the Schneiderian membrane (Table 2). In a recent possible empirical unrestrained study, 70 patients undertook 81 sinus lifts and were followed through to filling of a total amount of 212 implants. Forty-four percent of the sinuses were

perforated intraoperatively but were repaired, and the procedure was finished without various other issues. Two percent of the sinuses experienced perforations so serious that the treatment was terminated. Thirty-three percent of the perforations occurred in sinuses that had actually septae kept in mind on preoperative radiographs, and of those sinuses with septae 52% suffered openings. Two of the 36 openings were so serious that the doctor aborted the treatment. Usual methods for handling sinus perforation consist of not doing anything if the perforation is less than 2 mm in size and positioning of a slowly resorbing collagen membrane if larger than 2 mm. Postoperative problems in the research study consisted of graft extrusion into the sinus cavity in one patient presenting as an acute sinus problems after implant positioning. After medical and clinical treatment, the infection resolved and the implants took place to be brought back. Late difficulties included persistent peri-implantitis and a peri-impant cyst. Of importance is that although membrane layer openings were related to postoperative complications such as swelling, pain, and regional infection, there is no association in between intraoperative openings and lasting dental implant survival. In general, this study showed a 95.5% 7-year survival rate for implants positioned in the implanted sinuses. Likewise of note is that of the 9 implants that failed, 5 were positioned in patients who were hefty smokers. Chronic infections causing severe sinus problems and feasible graft direct exposure, extrusion, and/or failure are unusual occasions. Management usually includes therapy based on today symptoms, and can vary from anti-biotics to surgical debridement drain to a Caldwell-Luc procedure [20-22].

**Table 2.** Common sinus lift surgery complications [11].

Complication	Treatment
Graft exposure	Gentle daily normal saline irrigation, allow for creeping epithelialization
No graft present after maturation phase	Assess for possible etiology and retreat
Paresthesia CN V2 distribution immediately postop	Medrol dose pack if no contraindication
Facial swelling 2–3 days post surgery	No treatment, normal postop
Severe facial ecchymosis appearing 1–3 days postop	No treatment, normal postop
Facial pain and swelling, 1 week postop	Clinical examination, CT scan, consider antibiotics
Swelling, acute onset	Possible air-emphysema; antibiotics, reinforce nasal precautions

**CONCLUSION:**

The maxillary sinus lift has, over the last 30 years, been established as an approved standard for treatment of the edentulous maxilla. Alternatives such as short implants, although revealed to be effective in the short term, lack long-lasting researches to sustain regular use. The maxillary sinus elevation treatment making use of a side window approach has been revealed to be one of the most effective bone enhancement procedure that is done as a pre-prosthetic treatment prior to implant placement. When success is measured by patient result (success of the implanting procedure), the superb result rate accomplished is due to the fact that issues are very little and potentially better on avoided through correct situation option, excellent surgical method, and correct and prompt handling of intraoperative and postoperative problems. Appropriately done sinus grafting does not modify neither sinus function nor the qualities of the voice. When determined by implant end result (dental implant survival rate), it has been shown that implant survival rates in the high 90th percentile can be achieved via correct choice making with regard to implant surface areas (textured), graft components (greatest survival with xenografts), and the placement of an obstacle membrane over the window. While there are some relative contraindications for the treatment, there are practically no absolute contraindications. With preparation, education and learning, and experience, the maxillary sinus augmentation/elevation graft is a procedure that greatly benefits the patient, with a foreseeable outcome. Complications are irregular and those that occur after sinus grafting procedures are for the most part local and conveniently resolved. Because prevention is much better than treatment, the professional recommendations given by the panel will help in decreasing the occurrence of the postop infections.

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