

Different Techniques for Sinus Floor Elevation: A Review

Part I – Direct Techniques

Vivek Jadhav¹, Nitin Kothari², Babita Yeshwante³, Nazish Baig⁴, Snigdha Patil⁵

¹Associate Professor, ²Postgraduate Student, ³Professor and Head, ⁴Professor, ⁵Postgraduate Student, Department Of Prosthodontics, Crown & Bridge And Implantology, C.S.M.S.S. Dental College & Hospital, Aurangabad, Maharashtra

Abstract

Insufficient bone volume is a common problem encountered in the rehabilitation of the edentulous posterior maxilla with implant-supported prostheses. Although adequate bone height can be achieved using various maxillary sinus augmentation techniques, these procedures have been practiced successfully. However, significant complications occur such as perforations or tearing. To maintain the integrity of Schneiderian membrane subsequently increasing the success rate a retrospective analysis is carried out on various techniques with complications which occur during and after treatment. This review will help the readers to understand the intricacies of sinus augmentation by using direct techniques.

Key Words: Sinus lift, direct technique, schneiderian membrane, Bone grafts.

Introduction

The paired maxillary sinuses are air filled spaces lying within the bilateral maxillae, lateral to the nasal cavity, superior to maxillary teeth, inferior to orbital floors and anterior to infratemporal fossa. These sinuses are the largest of paranasal sinuses measuring average of 12.5 ml.⁽¹⁾

The maxillary sinus pneumatization is caused progressively hollowing out of alveolar process of apical aspect mediated by osteoclast and by increasing positive intra antral pressure.²

The primary indication for sinus graft surgery is the planned implant reconstruction of the edentulous posterior maxilla afflicted with post extraction alveolar bone loss and sinus pneumatization resulting in bone too atrophic for said implant.³

There are different techniques which are used for maxillary sinus augmentation. When performing these techniques several types of bone grafts like autogenous bone, allografts, xenografts and alloplastic materials can be used. Graft material chosen must provide adequate

viable bone to stabilize the implant initially and encourage osseointegration.⁴ Autogenous bone is considered the ideal graft for sinus lift technique.⁵ Intraoral sites for graft harvesting are maxillary tuberosity, the symphysis, posterior maxilla, the ramus and mandibular 3rd molar region. The symphysis donor site offers the greatest volume of intraoral bone.

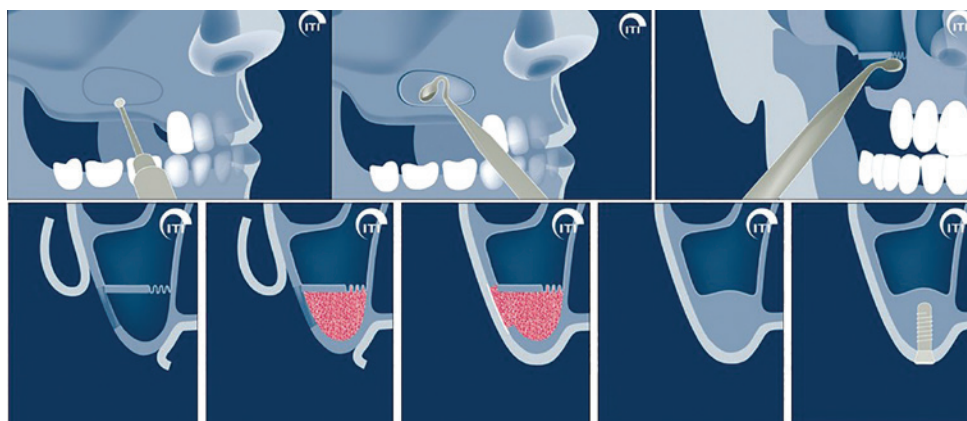
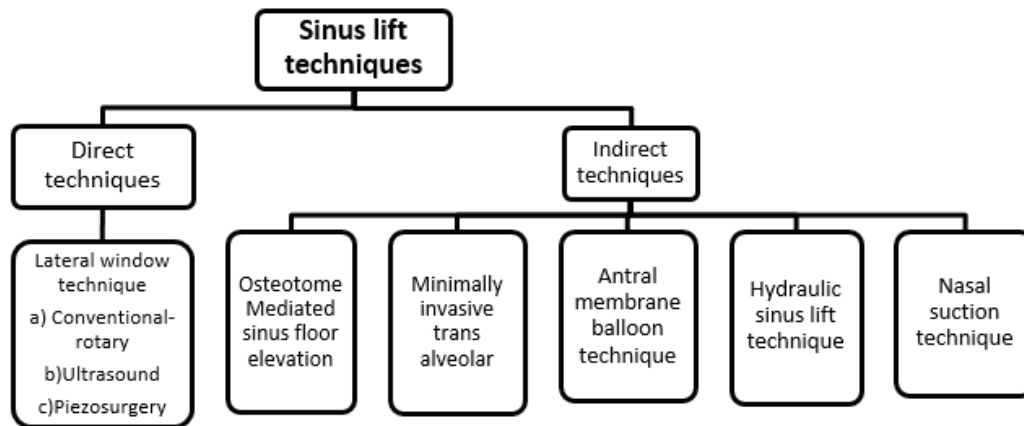
Lateral Window Technique:

The lateral window technique (figure 1) was first demonstrated by Tatum by using a modified Caldwell-Luc approach.⁶ This technique provides access to the lateral sinus wall by raising a full thickness mucoperiosteal flap from the alveolar crest with vertical releasing incisions.⁷ 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.³ To access the schneiderian membrane, high-speed surgical burs are used to prepare a window in the lateral sinus wall. Window in sinus wall can also be made by postage stamp method for minimum invasion.² 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.³ The superior horizontal osteotomy is performed next at the level of the planned augmentation height. The vertical osteotomies are made parallel to the lateral nasal wall and the anterior border of the maxillary tuberosity (or the maxillary buttress), respectively. 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. To make a U-shaped trap-door opening, either the rotary technique or the piezoelectric technique can provide adequate access to the cortical bone and to expose the thin sinus membrane, thereby creating a space for placement of bone graft.⁷ Bone graft material is placed under the membrane in an anterior and inferior direction once the membrane is elevated.³

Perforation of the sinus membrane is a possibility, and may occur. 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.⁽³⁾ Different graft fillers consisting of autogenous bone, bone substitute, or a mixture of these can be placed in the elevated sinus space below the lifted sinus membrane. In general for primary stabilization with minimum 4-5 mm bone height after 9-12 months when bone regeneration has completed implant placement can be done.⁷ It is recommended to place the patient on postoperative antibiotics and decongestants for 2 weeks.³ The LatW offers an average implant survival rate of 91.8 per cent (range, 61.7 per cent –100 per cent)⁸ but involves potential complications such as membrane tear, bleeding, infection, and sinus obstruction, swelling and discomfort.

(Table 1) Classification of sinus lift techniques



(Figure 1) Direct sinus lift technique – Lateral window technique

Rotary and Ultrasound technique:

For sinus graft, perforations of the Schneiderian membrane are the main intraoperative complication occurring in 7% to 35% of the procedures. Generally, this perforation occurs when making the osseous window to access the sinus using a round diamond drill during the rotary osteotomy stage. To reduce this complication, the creation of a vestibular osteotomy using an odontologic ultrasonic generator is proposed since soft tissue cannot be damaged with this method. Thor et al.⁹ reported a mean bone gain of 6.5 mm with the rotary technique. Vercellotti et al.¹⁰ compared the bone regeneration achieved with the ultrasound technique versus the rotary technique. After 56 days of follow-up, greater bone regeneration was noted in the operations performed with ultrasound. Maria et al.¹¹ conducted study and concluded that the bone gain achieved after the operation and 12 months after loading was greater with the ultrasound technique (6.7 mm versus 5.9 mm with the rotary technique) and sinus lift with the ultrasound technique afforded a higher success rate than the rotary technique (98% versus 90%).

Piezoelectric surgery:

In 1988, Thomas Vercellotti developed piezoelectric bone surgery to overcome limitation of traditional instrumented oral bone surgery. Piezosurgery has a wide field of application in dental implantology including sinus lifting, autogenous bone harvesting, bone crest splitting, and removing of failed implants. It provides precise bone cut without much prevents pressure, which helps to prevent excessive heat that would result in bone damage.^{10,12,13} This technique prevents perforation of the “Schneiderian Membrane” and cause minimal postoperative complications. Oscillation frequency used in piezosurgery is designed for acting only on mineralized tissue; therefore, the cutting tip becomes inactive when it comes in contact with soft tissue. Hence, soft tissue damage is not noticed.¹⁴ Piezoelectric osteotomy devices consist of an active tip known as insert and three essential points to be considered precise and clean cutting, selective bone-cutting and surgical field relatively free of blood.¹⁵ As a result, piezoelectric osteotomies are done in a frequency range of 25-30 kHz provide a cut in the bone structure without affecting the integrity of the surrounding soft tissues.¹⁶

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. Vercellotti et al reported a rate of 5% for sinus membrane perforation during Piezosurgery. Barone et al¹² conducted a study that compared conventional drills and Piezoelectric device in maxillary sinus floor elevation. They concluded that the time required for window osteotomy was higher with Piezosurgery, but membrane perforation rate was smaller compared with the conventional method (23% vs 30%).⁸ Piezosurgery has been introduced for sinus membrane elevation for both direct and indirect sinus lifting procedures lately. The lower risk for membrane perforation and enhanced patient comfort enables Piezosurgery to be the preferred device to conventional techniques.^{17,18,19}

Conclusions

Sinus lift procedure performed with piezosurgery in direct technique causes less pain and maintain sinus integrity during surgical approach as compared to conventional techniques. The innate osteogenic potential of the Schneiderian membrane may be a main reason for successful sinus lift technique and piezosurgery has high success rate for maintaining integrity of sinus membrane.

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