

INDIRECT SINUS LIFT

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ABSTRACT

The indirect sinus lift is a procedure to lift the augment/regenerate alveolar bone in atrophied residual maxillary posterior alveolar crest. The posterior maxilla is always considered as difficult site for the placement of implant than the mandible due to the presence of various anatomical land mark such as maxillary sinus. The anatomical structure of maxillary sinus often makes every dental implant surgeons a challenge task in placement of endosteal implants in the chronic atrophic maxilla and difficulty in osseointegration and further functional and aesthetic implant supported prosthesis. Various techniques in sinus lifting procedure enables the additional anchorage and stability in implants placed support in maxillary segments in with atrophic ridges and pneumatic sinuses. Lack of sufficient bone height along maxillary sinus poses significant difficulty for placement of implants in edentulous maxillary jaw. Minimally invasive sinus augmentation is an effective solution for this problem. In 1960 Boyne introduced sinus lift through lateral access which was initially used as a pre-prosthetic procedure for removable complete dentures purpose. In 1980 Boyne and James used the bone created by sinus lift procedures to place implants. In pursuit of less invasive techniques, in 1994 Summer's explained a technique which offers access to sinus floor through residual alveolar crest. Using the elasticity of bone, floor dilatation of sinus was performed to increase the length of implants.

INTRODUCTION

Today, dental implants provide a predictive treatment for prosthetic rehabilitation of edentulous patients. Sufficient volume and density of the alveolar bone for implant integration and load bearing are factors of utmost importance for a good result. Reduced bone height below the maxillary sinus in the posterior maxillary region is a hinderance to successful implant placement. Not only there is bone resorption but also increased pneumatization of the maxillary sinus which renders the ridge inadequate for implant procedures.⁽¹⁾ Thus, the amount of bone beneath the maxillary sinus is often very limited. The technique of sinus floor elevation has expanded prosthetic options by enabling the placement of additional implant support in maxillary segments with atrophic ridges and pneumatized sinuses.

Augmentation of the maxillary sinus was first described by Tatum and published as a clinical study

by Boyne and James.⁽²⁾ In the technique described by Tatum access to sinus was through the crest. This technique was later replaced with lateral sinus osteotomy which was considered to be more versatile and practical. After elevating the sinus lining from the floor, bone graft was placed (autogenous is considered to be a gold standard). Implant can then be installed immediately or at a later stage depending on residual bone height (RBH). Summers described an alternative technique for sinus floor elevation using osteotomes. With this technique, the floor of the maxillary sinus is elevated using access through the alveolar ridge utilizing different osteotomes. Bone graft is added followed by implant placement.

The use of bone grafts for sinus augmentation, irrespective of the technique utilized has been associated with high success rate, although it has certain demerits such as second surgical site for autogenous bone harvesting, increased rate of complications, higher cost, and increased surgical

time. It was a report by Lundgren *et al.* which pointed toward spontaneous bone formation below the sinus floor after the cyst enucleation exhibiting a tendency in the Schneiderian membrane potential for bone formation.⁽³⁾ What followed this were a number of studies, in which successful implant placement and rehabilitation were carried out without using bone grafts. These studies have shown that new bone formation occurs after sinus augmentation due to the creation of void with the presence of blood clot which induces bone deposition based on the principles of guided tissue regeneration. Furthermore, the osteogenic potential of maxillary sinus membrane has come into the picture. Sinus elevation surgery in these days thought of one among the foremost foreseeable pre-prosthetic site development bone augmentation procedures. So the aim of this review is to analyse about the Summers indirect sinus lift procedure and its recent advancements along with the advantages and disadvantages.

ANATOMY OF MAXILLARY SINUS

The sinus may be a pyramid shaped formed cavity with its base adjacent to the nasal wall and apex pointed towards the zygoma. The size of the sinus is insignificant till the eruption of permanent dentition. The typical dimensions of the adult sinus area unit 2.5 to 3.5 cm wide, 3.6 to 4.5 cm tall, and 3.8 to 4.5 cm deep. It has a standard estimated volume of roughly 12 to 15 cm. Anteriorly, it extends up to the canine and premolar space. The sinus floor rarely has its most inferior floor close to the first molar region. The size of the sinus can increase with age if the area is toothless. The extent of pneumatization varies from person to person and from facet to facet. Nonetheless, this method typically leaves the bony lateral and occlusal alveolus paper- skinny within the posterior upper jaw.

The sinus bony cavity is lined with the sinus membrane, additionally referred to as the Schneiderian membrane. This membrane consists of ciliate epithelial tissue just like the remainder of the tract. It's continuous with, and connects to, the nasal epithelial tissue through the ostium within the middle passage way. The membrane includes a thickness of 0.8mm.

The blood offer to the sinus is primarily derived from the posterior superior arteria alveolar is and also the arterial blood vessel, each being branches of

the arteria. There are unit vital anastomoses between these two arteries within the lateral antral wall. The bigger arteria additionally provides the inferior portion of the sinus. However, as a result of the blood provided to the sinus area unit from terminal branches of peripheral vessels, vital haemorrhage throughout the sinus elevate procedure is rare. Nerve connection to the sinus comes from the superior alveolar branch of the jaw (V2) division of the cranial nerve.

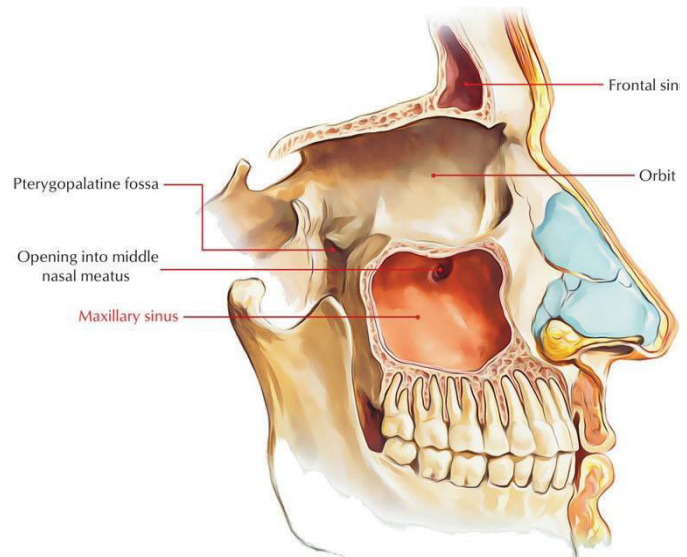


Figure 1- Anatomy of maxillary sinus

In 1987, Misch developed a classification for the treatment of edentulous posterior maxilla based on the amount of bone available below the antrum and the ridge width. Treatment categories ranged from sub antral augmentation category 1 (SA1) to SA4 based on bone height A (>5 mm) and B (2.5-5 mm) based on ridge width.⁽⁴⁾

SA1: It has an adequate vertical bone for implants, that is, 12 mm. No manipulation of sinus is required. Conventional implant placement.

SA2: It has 0-2 mm less than the ideal height of bone and may require surgical correction. Sinus lift and simultaneous implant placement.

SA3: It has just 5-10 mm of bone below sinus. Sinus graft with immediate or delayed endosteal implant placement

SA4: It has less than 5 mm of bone below sinus. Sinus graft healing and extended delay of implant placement.

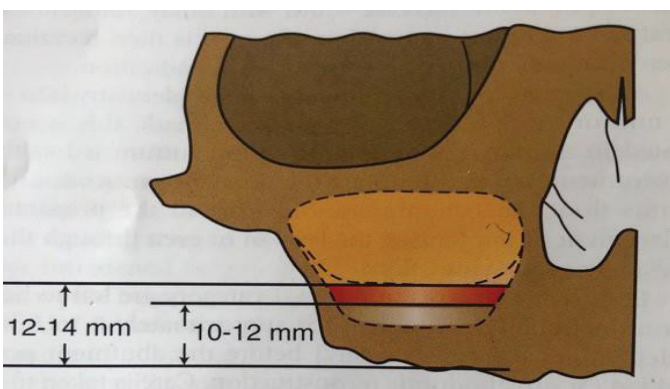
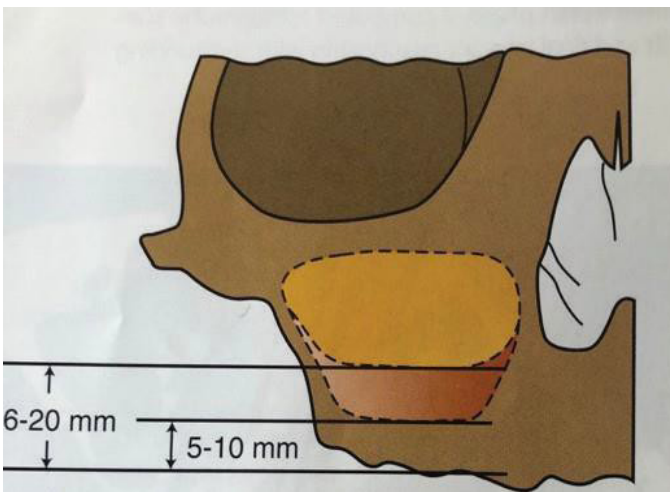
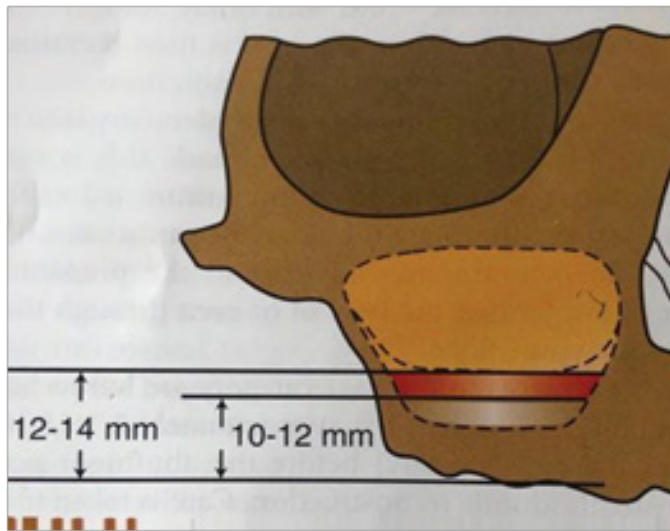
Figure 2: Classification of maxillary sinus on the posterior maxilla based on the bone height

SURGICAL SINUS LIFT PROCEDURES

Lateral Sinus lift is typically meted out with the help of general anaesthesia or local anaesthesia, or through analgesia. After lifting the mucoperiosteum from the front wall of the upper jawbone, a spherical bur is employed to make a window within the skinny bone demarcating the sinus. Antral tissue layer should stay intact. Then the tissue layer is upraised far from the bone employing a special raspatorium to the extent of the alveolar recession and dislocates identical cranially. An area is created at the bottom of the sinus that's stuffed with associate degree acceptable augmentation material.

Currently, 2 main approaches to the sinus floor elevation procedure are found within the literature. The primary approach, lateral antrostomy, is that the classic and therefore the additional normally performed technique originally delineate by Tatum. Additional recently, Summers advocated a second approach: the crestal approach, with the exploitation of osteotomes(5). The crestal approach is taken into account to be an additional conservative technique for sinus floor elevation. Lateral antrostomy is started with a crestal incision created on the outgrowth.

A full-thickness flap is then raised to permit access to the lateral antral wall. Once the flap has been raised to a desired level, antrostomy is performed with a spherical bur to make a formed trapdoor on the lateral buttress of the upper jaw. The sinus membrane is then gently raised from the bony floor by means of associate antral curette. Marx and Garg recommended employing a cottonoid soaked with a capsule of twenty-two local anaesthetic with 1:100,000 adrenaline and left within the house created for 5 minutes therefore on limit and permit for higher mental image for additional dissection. It is necessary to unencumber the sinus membrane in all directions (anteriorly, posteriorly and medially) before making an attempt to intrude the trapdoor medially. An area is formed once the sinus membrane has been elevated by the intruded trapdoor. This house is then grafted with completely different materials to supply the platform for implant placement. Autogenous bone remains the gold customary in bone attachment. Bone crest, chin, anterior bone, and outgrowth have all been mentioned as common self-generated donor sites in sinus elevate. Hydroxyapatite mixed with self-generated bone or used alone are viable alternatives. Care ought to be taken to not make full the recipient website, as a result, it will cause membrane mortification. Implants are placed either at the same time with the graft (one-stage lateral antrostomy) or once a delayed amount of up to twelve months to permit for graft maturation (two-stage lateral



antrostomy). The initial bone thickness at the outgrowth looks to be a reliable indicator to decide between these 2 strategies. If the bone thickness is four millimetres or less, initial implant stability would be jeopardized. Therefore, a two-stage lateral antrostomy ought to be meted out. The reverse holds true for a one-stage procedure. A one-stage procedure is a smaller amount long for each the practitioner and therefore the patient. However, it's a technique-sensitive and its success depends heavily on the quantity of residual bone.

SUMMERS CRESTAL APPROACH SINUS LIFT PROCEDURE

One of the drawbacks of the lateral antrostomy is that it needs the raising of an outsized flap for surgical access. Summers planned a conservative crestral approach exploitation osteotomes for sinus floor elevation in 1994. (6)

This technique begins with a crestral incision. A full-thickness flap is raised to show the outgrowth. An osteotome of the smallest size is then broached into place by a mallet or drill into the bone. Surgical bone height beneath the sinus is measured to see the specified depth for osteotome extension. The goal is to increase the instruments back of the sinus membrane. Osteotomes of accelerating sizes are introduced consecutive to expand the alveolus. With every insertion of a bigger osteotome, bone is compressed, pushed laterally and apically. Summers explicit that the very nature of this system improves the bone density of the posterior jaw wherever kind IV bone is often found. Once the most important osteotome has enlarged the implant site, a ready bone combine is accessorial to the surgical process because the graft material. Summers instructed a twenty fifth autogenous bone with seventy fifth hydroxyapatite mix; but, a spread of graft materials have additionally been used. The ultimate stage of sinus floor elevation is completed by reinserting the most important osteotome to the implant web site with the graft material in situ. This causes the accessorial bone combine to exert pressure onto the sinus membrane and to elevate it. Extra graft material will after be accessorial and broached in to attain the specified quantity of elevation. Once this height is gained, the implant fixture is inserted. The implant fixture ought to be slightly larger in diameter than the surgical process site created by the most important osteotome. It becomes the ultimate osteotome, "tenting" the elevated sinus membrane. The main advantage of the crestral osteotome technique is that it's a less invasive procedure. It improves the density of the jaw bone, that permits larger initial stability of implants. It additionally has the potential for the employment of less autogenous graft material. Summers instructed the crestral incision to be extended distally to the outgrowth

space wherever autogenous bone may be harvested. The disadvantage of the crestral approach is that the initial implant stability is unproved if the residual bone height is a smaller than half dozen metric linear unit. The possibilities of achieving a sufficiently high elevation with the osteotome technique is restricted. With this approach, there might even be a better likelihood of misaligning the long axis of the osteotome throughout the ordered surgical process.⁽⁴⁾

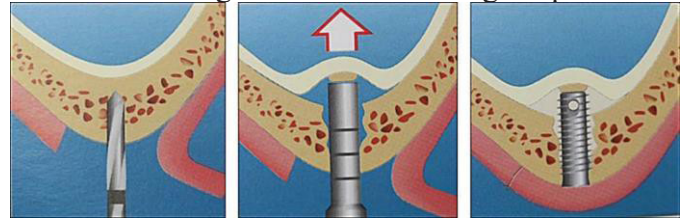


Figure 3: Summers crestral approach

MATERIALS USED FOR SINUS LIFT PROCEDURES

Autogenous bone grafts have been considered as the "gold standard" and most effective material in bone regeneration procedures. Intra-oral donor sites (chin and body-ramus of the mandible) is used to regenerate small and medium defects. Extra-oral donor sites (iliac crest, tibia, ulna, rib and calvarium) increase surgical quality are related to vital (and under-reported) morbidity and scar-ring, thus various graft materials (bone substitutes) are used.⁽⁷⁾ The stem cells capability of survival and proliferation when exposure to changes within the atomic number 8, pH and protein setting is that the main reason behind the reliability of cancellate bone transplant interventions. The incorporation of such kind of transplant is speed, concerning eight weeks.

Allografts comprises 'same species' tissue. Cadaveric bone is harvested and varied techniques (freeze drying and irradiation) cut back antigenicity. The grafts are then sterilised and equipped by specially commissioned tissue banks.

Xenografts comprises 'different species' tissue. An organic bovine and equine bone predominate. Chemical removal of the organic element creates a mineral scaffold.

Alloplasts are artificial bone substitutes. There are

many sorts classified in terms of porousness as dense, macro-porous, micro-porous, and either crystalline or amorphous. The structure influences performance. Some examples are beta-tricalcium phosphate, bio-active glass and calcium sulfate.

All of those grafts are often delivered in varied convenient ways in which resembling bone particles or giant blocks, are often mixed with self-generated bone and might be stable over time or extremely resorbable, reckoning on their chemical characteristics.

Bone formation could also be promoted by the utilization of biologically active molecules resembling bone morphological sequence proteins (BMPs), growth factors, living substance made plasma (PRP) and alternative molecules.

Urist found that acellular, decalcified bone established into extra-skeletal sites stirred new bone formation. The molecules accountable belong to the expansion issue B family and square measure referred to as BMP's.⁽⁸⁾

Some authors have projected sinus augmentation while not the utilization of a graft material, with coagulated blood acting as a scaffold for bone formation. Lundgren projected maintaining an area by sewing the sinus lining to the lateral wall. The implant apex could also be accustomed support the sinus membrane. Some bone regeneration will occur through the particular clinical profit remains doubtful since this methodology has not been compared to applicable management procedures.

The use of Densah burs in densifying mode can breach the sinus floor with autografting without causing any perforation. The simplified minimally invasive antral membrane elevation technique is based on the application of hydraulic pressure by a viscous bone graft that acts as an incompressible fluid to atraumatically elevate the schneiderian membrane. Increased implant stability is achieved due to osseous densification of the Residual Bone by Densah bur. Thus, the proposed technique could be recommended for sites with minimal residual height.

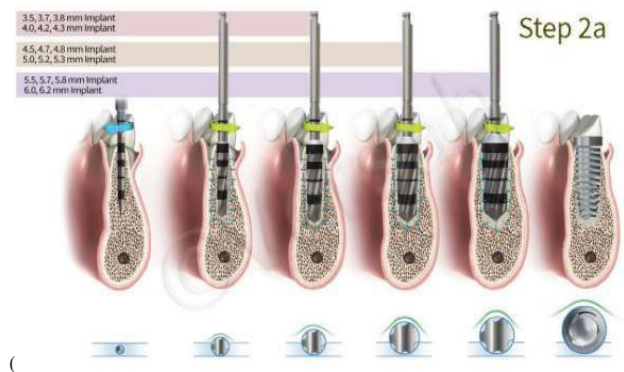


Figure 4: Densah bur

ADVANCEMENTS IN SUMMERS SINUS LIFT PROCEDURES

In the starting, the Osteotome technique was used for congesting the comparatively soft bone tissue of the upper jawbone primarily. This improved the first stability of the implants - a guarantee for achievement. Later on, victimisation the snap of the bone, Summers started floor dilatation of the sinus, therefore increasing the length of his implants. The disadvantages of this system are its restricted indications - the height lack of 1-2 mm and therefore the absence of direct visual management of the state of the membrane. Summers developed his technique, with the help of the broken sinus floor as an osteotome and he put the graft material through the osteotome hole. Later, Summers' technique was changed and therefore the original cup-shaped, cutting osteotomes were replaced by bell-shaped and rounded ones. The main distinction of the changed osteotome technique, is that we have a tendency to not fracture a fraction within the sinus floor. The rounded osteotome allow safely comprimation of bone once getting ready the pilot hole, increasing of the outlet, extrusion of the graft within the sinus cavity and putting of the implant. Another technique with crestal access is that the balloon sinus lift.⁽¹⁰⁾ Forcing saline within the tube, we have a tendency to swell the balloon and obtrude the membrane. Apart from its higher prices this system is accessible and with predictable results. Raising the ground of the sinus throughout extraction may be a two-stage technique. It's borrowed from classic Summers' technique, however it's restricted indications.⁽¹⁰⁾ Raising the floor of the sinus through fracturing the inter-root septum of higher molar once its extraction is feasible, however comparatively risky technique. The Hydropneumatic sinus lift is a crestal access technique, introduced in 2008 by Troedhan, A. Kurrek, M. Wainwright.⁽¹²⁾ The essence of this

method is that when the surgical procedure with the pilot bur, reaching a pair of millimetres from the sinus cavity, the outlet is distended to the sinus floor victimisation mark diamond tips. Then, employing a tip, known as The intralift piezo tips ,“Trumpet” , with a diameter capable of the last instrument that expands the outlet, a cooling resolution is inserted from the piezo surgery unit and its hydraulics pressure pushes out the Schneider membrane. The affixation material is placed within the free area through the osteotome hole with the assistance of the “trumpet” and so the implant.

CONTRAINDICATIONS

Infected exudate within the sinus is that the most often occurring reason of sinus elevate. Empyema, whether or not a symptomatic or not, is an absolute, thorough temporary reason

Inadequate residual bone and crestal bone width will affect the primary stability of the implant

Caldwell-Luc operation sometimes makes the Sinus elevate extremely difficult or not possible. Connective tissue cannot be treated as physiological tissue layer lining.

If the patient reports a history of acute tumour and when the cause is not eliminated, the augmentation might increase the disposition to any attacks of inflammation.

Chronic tumour doesn't complicate the Sinus elevate. On the contrary hyperplastic antral tissue layer is accumulated mechanical resistance, that facilitates the preparation.

Gentle pathology isn't thought of to be reason, whereas moderate kinds of this illness need prolongation of the healing amount up to 12 months. Surgery is rarely performed just in case of severe pathology.

Inhalation or superficial application of corticosteroids has no influence on the results of surgery, because the absorbed dose of the medication is low.

Age itself isn't a reason.

Uncontrolled diabetes, drug or alcohol abuse are also an contraindicated for indirect sinus lift technique. Controlled diabetic mellitus isn't thought of to be a reason, severally of the kind of treatment.

Smoking is an absolute contraindication, Long time smokers often have a skinny secretion lining of the sinus, that is extremely at risk of perforation throughout the surgery.

Local contraindication for sinus floor elevation are acute sinusitis, local aggressive benign tumours and malignant tumours.

COMPLICATIONS

Significant haemorrhage throughout the sinus lift procedure is rare as a result of the blood vessels that offer it are the terminal branches of peripheral vessels

. However, branches of the posterior superior artery, a branch of the arteria, might travel through the world of sinus window preparation . Thus, perforation of those blood vessels will occur.

Intraoperative injury may be controlled by placement of the bone graft, that exerts pressure on the wound. However, important injury could also be difficult to manage because the bone graft particles might wash out.

Operative injury might generally occur within nose bleed. Patients ought to be instructed of this risk and be informed to not blow their nose for a minimum of five days after the operation. Operative injury from the surgical website is rare and might be avoided through adequate primary closure .

Perforations of the Schneiderian membrane are comparatively common. Cone-beam CT scans ought to be obtained ahead.

If perforation will occur, it's necessary to aim to elevate the membrane round the perforation. This could need enlargement of the surgical procedure site. Just in case of an outsized perforation, this could not be potential.

Tiny perforations may be repaired by putting a resorbable scleroprotein membrane over the perforated space when it's been elevated and before the addition of bone graft.

Larger perforations are additionally common in areas of difficult anatomy and are tougher to access. They are sometimes repaired using larger resorbable membranes fastened to the superior facet of the surgical procedure window with bone tacks before bone augmentation or difficult sinus anatomy (i.e., deep, slim sinuses or undulating floors) that will increase the chance of perforation.

The membrane could also be perforated throughout surgical procedure preparation or membrane elevation. Perforation throughout preparation could

also be decreased by exerting care after using a high-speed bur or by employing a electricity unit .

RECENT ADVANCES

Bone augmentation technique by Lateral window technique approach provides access to the lateral sinus wall by raising a full thickness mucoperiosteal flap from the alveolar crest with vertical releasing incisions.⁽¹³⁾

Disadvantages : Involves potential complications such as membrane tear, bleeding, infection, and sinus obstruction, swelling and discomfort.

Advantages : In some instances, a single anterior incision is sufficient to provide access for sinus approach.

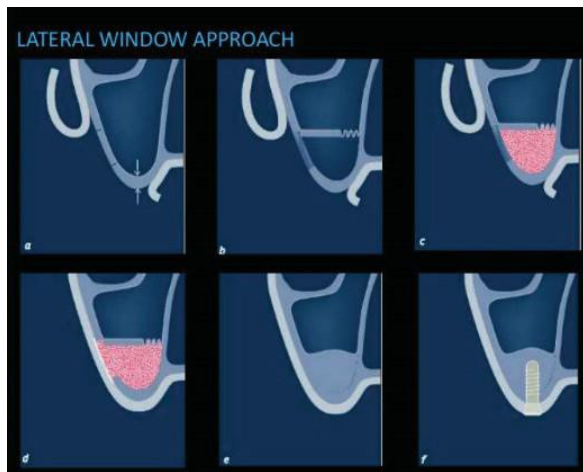


Figure 5: Lateral window approach

HYDRAULIC SINUS LIFT TECHNIQUE (HYSILIFT)

Hydraulic Pressure technique through crestal approach has been used recently for the elevation of sinus membrane. This method facilitates detachment of the Schneiderian membrane through injection of a liquid followed by its spontaneous expulsion or aspiration, to then pass on at the insertion of the graft material in the sub- Schneiderian space created this way.

Advantage : Conceptually simpler to use a graft material in a liquid state that when injected hydraulically raises the mucosa and fills the sub-Schneiderian space at once.

This technique is quite advantageous as it is having

narrow learning curve, minimal invasiveness and greater precision.

Disadvantages : This method uses conventional single-use syringes in which it is not possible to check on the progression of the piston since this depends on individual sensitivity.

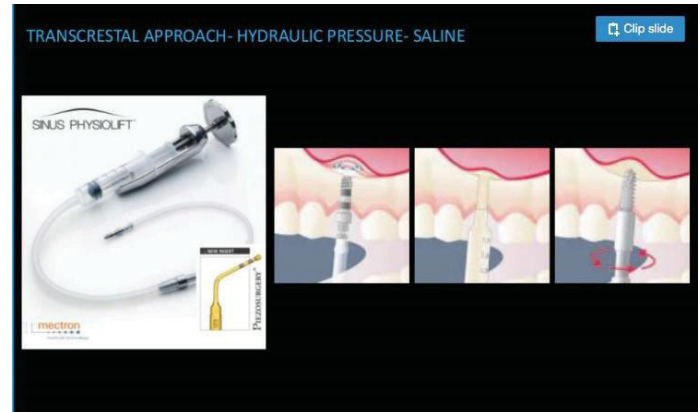


Figure 6: Hydraulic sinus lift technique

BALLOON ELEVATION TECHNIQUE

Minimally invasive antral membrane balloon elevation (MIAMBE) is a modification of the bone-added osteotome sinus floor elevation (BAOSFE) method as the antral membrane elevation is performed through the osteotomy site (3.5 mm) using a specially designed balloon.⁽¹⁴⁾

Advantages : Advantages of using a flapless approach for dental implant placement includes predictability, preservation of crestal bone and mucosal health surrounding the implants.

Disadvantages : The balloon technique yields modest antral membrane elevation and bone augmentation requires considerable skills, and may frequently result in membrane tear, even when selectively applied and endoscopically controlled.

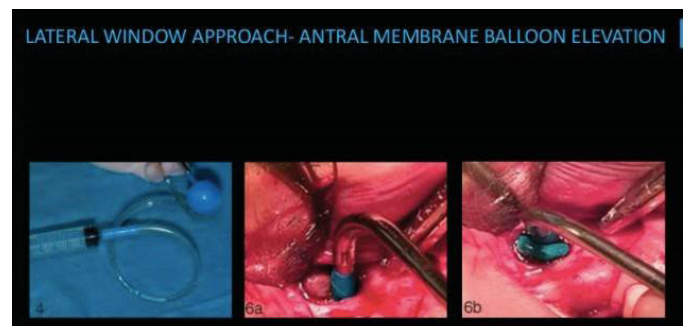


Figure 7: Balloon elevation technique

SUCCESS RATE

According to Necip Fazıl Erdem 57 of 58 implants with their prostheses remained functional with a success rate of 98.28%.⁽¹⁵⁾ None of the implants showed any signs of mobility or periimplantitis. Both apical and cervical bone resorption around the implants were highest by the end of the first year. The success rate of the implants placed with staged approach in augmented maxillary sinuses with the residual alveolar bone height of ≤ 3 mm was high in a 3-year term. Bio-Oss is an acceptable substitute autogenous bone and can be used as an augmentation material during the maxillary sinus lift procedure.

According to Bijan Movahedian Attar after 19 months, results showed 96% success rate. Two out of fifty implants failed due to mobility. The mean depth of implants in sinus, mean height of residual crestal bone before surgery, and the mean rate of crestal bone loss were 3.8, 7.9, and 0.71 mm, respectively. Osteotome sinus lift technique is a non-invasive surgical method for enhancing a desired length. Furthermore, implants insertion was successful after osteotome sinus lift technique in cases with insufficient bone height.⁽¹⁶⁾

CONCLUSION

Restoring edentulism with dental implants needs careful treatment designing. This is often very true with the posterior jaw once pneumatized jaw sinuses may limit the number of alveolar bone for implant placement. Sinus floor elevation offers one amongst the foremost common pre-prosthetic procedures to unravel this drawback. The classic lateral antrotomy and therefore the a lot of conservative crestal approach, was mentioned during this article. sinus elevation mistreatment the osteotome technique may be a foreseeable and effective procedure for correcting restricted bone reabsorption in posterior areas of the jaw, freelance of the bone graft material used. The technique leads to few complications, and therefore the survival rate for implants placed in these areas varies between 93.5% and a 100 %. The question concerning the amount of the attachment material is underneath discussion . In line with many authors, little amount of attachment material mixed with blood from the field is sufficient to take care of the specified volume. There are several other authors UN agency don't advocate the location of

any such material, relying entirely on the blood. The crestal approach is minimally invasive however permits solely a restricted quantity of augmentation. Therefore, practitioners ought to choose the kind of procedure acceptable to the actual clinical desires. In addition, all relevant anatomic structures within the neighbourhood ought to be revered to attenuate surgical complications.

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