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TECHNIQUES OF MAXILLARY SINUS LIFT

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ABSTRACT

Introduction: Osseointegrated implant installation in the maxillary molar region often provides insufficient quality, measurement reduced and density of bone associated with bone loss and pneumatization following tooth loss. Aim: This review article mainly highlights the literature of different sinus lifting procedures, comparison and grafts that are available to carry out the technique. Methodology: A bibliographical research of 52 articles were used to collect the information of various techniques, case reports and different grafting materials used all around to meet the criteria of the article. Results: In view of various research and values, in most cases of the respective articles, there was a necessity to perform a surgery to lift the sinus for increasing the bone height. The techniques were divided based on the use of grafting material. Conclusions: Maxillary sinus lift is a most accepted and safe procedure, provided they adhere strictly to the fundamental principles. The post-operative complications are acquiescent and it can be treated by medications and surgical intervention.

INTRODUCTION:

Bone resorption is a common consequence as a process of repair due to tooth loss since the stimuli of occlusal forces are absent. If this condition persists for a long term, osteoclasts come into play to cause the resorption resulting in decrease in the height of the bone in the maxilla and mandible[1]. The loss of bone in the first few months following the tooth loss is maximum of 40%-62%, which hampers the condition to replace the edentulous area with prosthetic implants without osseous reconstruction[2]. For placing an implant, the amount of bone required circumferentially around the implant is 1.5 mm of the remaining alveolar ridge. Though in some conditions due to continuous resorption, the buccal plates tend to perforate due to the forces that are applied on the long axis of the implant during and after installing the implant[3]. According to published research, the maxillary sinus lift procedure is a great way to treat posterior maxillary edentulism. Additionally, when done correctly, sinus graft procedures generate a sizable amount of bone, which enables the placement of implants in the correct anatomical and proteic position. The amount, quality, and surgical expertise of the remaining bone determine which variation of the approach will be employed; in some circumstances, combinations of these factors may be used. Apart from the sinusal survey, onlay grafts can be used to increase bone height; however, these procedures typically don't result in appreciable modifications[4-6]. The Cadwell-Luc traumatic or access technique involves using autologous bone marrow derived from the iliac crest as graft material

in the affected area. This technique involves creating a lateral bony window to allow access to the interior of the maxillary sinus, elevating Schneider's membrane, and inserting the graft to enable a bone height gain of up to 12mm. When it comes to osseointegrated implants, the process can be completed in two surgical steps (one for sinus elevation and another for implant installation) or in just one stage, with the implant installed concurrently with the maxillary sinus lift[7]. Another method for elevating the maxillary sinus that is thought to be atraumatic is called after its creator, Summers (1994). The available research indicates that this method is less invasive and more conservative than traumatic sinus elevation, which lowers operating expenses. The Summers approach, however, only produces a maximum gain of 4mm in bone height[8]. Based on the aforementioned, this literature review aims to clarify the methods of maxillary sinus survey while taking into account various grafting material possibilities and their applications in the dental surgeon's clinical practice.

METHODOLOGY:

A bibliographical collection of research articles regarding the sinus lifting technique were performed. It covered research conducted in humans as well as laboratory studies, case reports, and systematic reviews. As a result, even non-grafting articles that did not address the rehabilitative techniques of maxillary sinus excision were disqualified.

RESULTS:

During the review process, every manuscript described the method for performing the sinus lifting technique in either an atraumatic or traumatic manner, with or without the use of grafting material. With the knowledge that the methods employed can be both traumatic and atraumatic—using the Summers procedure with or without a bone graft, or accessing Cadwell-Luc while implant installation is happening simultaneously or in two stages during surgery. The amount, quality, and surgical expertise of the remaining bone determine which variation of the approach will be employed; in some circumstances, combinations of these factors may be used.

Ever since the maxillary sinus operation using autologous bone marrow was initially described, a number of materials for sinus grafting have been researched. After reviewing the available data, the Consensus Conference on Bone Graft in the Maxillary Sinus in 1996 came to the conclusion that autogenous, alloplastic, and xenogene grafts—either alone or in combination—may be useful in this surgical procedure. Additionally, they concluded that the simultaneous traumatic technique comprises a modality that is highly predictive and effective for the posterior maxilla's rehabilitation.

It was possible to show that there were no statistically significant differences between the various maxillary sinus sampling and grafting material techniques when compared to panoramic radiographs of the late and immediate implants or when comparing the grafting materials used histomorphometrically. Thus, it can be seen that the maxillary sinus can be safely raised using both the grafting materials that have been researched and the implantation techniques that are currently accessible (immediate or delayed).

The material referred to as the "gold standard" exhibits high success rates and consistent outcomes. Autogenous bone can be sourced from many oral cavity locations, including the mandibular symphysis, maxillary tuberosity, and

edentulous boundary. However, its drawbacks, which include restrictions on the amount of material available, related morbidity, and resorption tendency, should be taken into account when determining indications for sinus grafting. These qualities have spurred the hunt for alternative, more beneficial materials that don't sacrifice its primary benefit—the shortened time frame required for bone repair. The study examined the simultaneous placement of osseointegrated implants utilising multiple extraoral sources of autogenous bone for sinus grafting, including iliac crest, sinus, and parietal bone. Based on the latter, the authors proposed that the breast lift technique Maxillary bone graft by autologous parietal bone graft is dependable, and that immediate implant placement can be accomplished even in cases of severe bone height deficiency (<4mm).

After 4 months following maxillary sinus ectomy, the addition of autogenous bone scrapings at a ratio of 1: 4 to bovine mineral bone (BBM) did not significantly increase the development of new bone compared to BBM alone. However, a review of the literature on the subject of the hypothesis that there is no difference in bone formation in sinuses grafted with Bio-Oss or Bio-Oss associated with autogenous bone as a graft for maxillary sinus lift revealed that a higher percentage of Bio-Oss added to the autogenous graft had a significant impact on the volumetric stability of the graft. In addition to lowering expenses, surgical time, and morbidity, the use of porous hydroxyapatite as a graft in maxillary sinus surgery allowed the procedure to be completed in-office and under local anaesthesia. Because they are abundant, an increasing number of bone replacements are being used for this kind of surgical treatment, either by themselves or in conjunction with autogenous bone.

The stimulation of new bone development in the maxillary sinus solely through surgical sinus membrane elevation, without the need for any grafting material, has been effectively demonstrated in the literature. The Schneider's membrane has a real osteogenic potential and plays a major role in the success of maxillary sinus lift treatments. Stem cell therapy for maxillary sinus lift has yielded encouraging results in recent trials, suggesting that this is a new topic worth investigating. Comparing trunk-mesenchymal cells to other grafting materials on the market, they might be a good substitute when combined with bovine bone mineral for sinusal survey.

DISCUSSION:

When using osseointegrated implants for oral rehabilitation, inadequate bone volume in the posterior maxillary region can lead to a number of issues, particularly when anatomically placed and proteanically unfavourable implants are installed. Severe reabsorption of the posterior maxilla region can also cause abnormalities in speaking, swallowing, and chewing, which can then cause psychological problems[9].

This scenario is frequently observed and is caused by the posterior maxilla's bone remodelling pattern, which loses bone more quickly than any other place. As a result, the alveolar bone resorbs vertically and horizontally due to a lack of stimulation from the periodontal ligament's fibres. In a few months, the lack of maxillary molars causes osteoclastic activity on Schneider's membrane, which results in sinus bone reabsorption. Additionally, substantial bone resorption is brought on by periodontal disease. In edentulous patients, the base of the maxillary sinus tends to extend inferiorly, reducing the height of residual bone over time and impeding or even blocking the insertion of osseointegrated

implants[10]. The preoperative strategy for sinus augmentation and the simultaneous, precisely placed implant fixation at the right position can be made easier with the use of computed tomography data to create three-dimensional models of the maxillary sinus. This claim was made at the close of the 1990s following trials involving computerised tomography scans and acrylic modelling in three patients who had previously been recommended for this kind of surgery[11].

To ascertain the height of the alveolar bone that is accessible, the location of potential septa, and the precise location of the surgical approach, panoramic radiographs of the maxillary sinus and potential CT scans are required. It is also crucial to confirm the absence of diseases like acute sinusitis and polyps, tumours, or cysts in the antral cavity[12]. gathering a thorough medical history and performing a clinical assessment, with a focus on the maxillary sinus. In clinical practice, sinusitis is one of the most frequently ignored conditions, and a possible infection in the maxillary sinus region might have very serious consequences. The patient's medical history and/or clinical examination can be used to diagnose acute, allergy, or chronic maxillary sinusitis[13].

The processes used to assess the amount and quality of bone tissue before implant installation surgery created a need for more exact radiographic examinations that could give professionals the information they needed for accurate planning, precise execution of the surgical procedure, and postoperative control. Periapical, panoramic, postero-anterior maxillary sinus x-rays, as well as computerised tomographies, are useful in this regard because they provide information about the size of the alveolar bone, reveal whether or not the sinus contains septa, pinpoint the precise location of the surgical access, and confirm the existence of sinusitis, residual roots, polyps, or retention cysts in the affected area[14].

The diagnosis, prognosis, and suitable course of treatment are determined by the information gathered from the clinical and radiographic evaluation; as a result, the indication for a maxillary sinus lift differs depending on the surgical approach selected. The panoramic view radiography is recommended for this type of study because it can measure the remaining bone height even with an average magnification of 25%. The most precise image of the position of septa within the sinus is thus provided by computed tomography, which also gives precise information on the thickness of accessible alveolar bone and the real distance between the bone crest and the anatomical sites of interest[15].

All illnesses and drugs that interfere with implant placement are contraindications for maxillary sinus surgery. To avoid complicating or contraindicating the procedure, systemic or sinus disorders or diseases should be looked into in the patient's medical history. Investigations into these changes should focus on the existence of sinus disease, such as acute sinusitis, polyps, cysts, or antral tumours, as well as the use of inhaled steroids and cocaine use[16].

Maxillary sinus lift technique:

Alternatively referred to as the osteotome technique, it preserves more bone in the maxilla by raising the floor, periosteum, and sinus membrane with little damage and without putting the membrane in direct touch with the surgical instruments[17]. Because it can raise the floor by a maximum of 4mm, its execution is made feasible by the low bone density in the posterior part of the maxilla (bones type III

or IV). It can only be indicated when there are bony remnants of 5 to 6mm present. The bone stays on the active tip of the instrument during its movement in the apical direction because osteotomes have a cylindrical shape with a concave cavity. Furthermore, the pressure created while using these tools permits the compression of the bone layers surrounding their area of action, creating a denser contact between the implant and the bone. Although the local increase in bone density caused by this compaction is known to support the immediate implantation of the implant, it is important to remember that the overall success of the procedure also depends on the amount of pre-existing bone between the crest of the alveolar ridge. Additionally, the maxillary sinus floor, as this location is essential for the implant's primary stability[18].

It is possible to use the Summers procedure in conjunction with bone grafts or not. Osteotomes are employed in both operations; they are consecutively introduced and gradually enlarged in order to extend the alveolus and raise the Schneider membrane. By pushing the bone laterally and apically at the insertion of each larger osteotome, the bone density in the posterior portion of the maxilla is improved. Since the sinus floor is already raised, the methods are different. The bone combination that will be used as a graft should consist of 75% hydroxyapatite and 25% autogenous bone. The available literature does, however, suggest a number of materials that can be utilised, separately or in combination, for this goal. Because there may not be sufficient primary stability, it would be dangerous or even impossible to immediately insert implants in regions with less than 6 mm of bone. In such circumstances, the so-called "development of future sites" technique—which involves using the method of atraumatic maxillary sinus elevation with bone graft—is required. In this technique, the bone is refined in the edentulous area and compacted externally to the buccal environment for use as a graft. Thismethod has shown to be intriguing since, in contrast to the traumatic sinus lift approach, graft maturation proceeds more quickly because the trephined bone block contains live cells and bone proteins. This results in a faster healing period[19-20].

Traumatic Maxillary Sinus Surgery Technique:

The trauma technique is recommended in cases when there is less than 5mm and more than 2mm of residual bone positioned between the sinus floor and the crest of the alveolar ridge. It is regarded as a standard procedure for maxillary sinus lift. In addition to palatine infiltrative anaesthesia, the posterior and anterior superior alveolar nerve block is the greatest alternative for local anaesthetic when it comes to execution. Referring to the anterior part of the maxillary sinus, the incision should be made on the alveolar ridge from the palatine tuberosity to the canine pillar. From there, a relaxing vertical incision should be made all the way to the bottomof the buccal groove[21].

The next step is soft tissue detachment for starting the choice osteotomy and preparing the entire flap[22]. It is important to proceed cautiously during this osteotomy procedure to prevent the perforation of Schneider's membrane, which is evident when the vestibular bone thins and appears as a gray or even purple-blue line in the wear area. The patient's breathing movements can be used to confirm that themembrane is intact at the end of the osteotomy, as the bone window will move appropriately if the membrane is intact (Valsalva maneuver). If a perforation is discovered, it is fixed and the graft is either implanted or not, depending on the severity

of the rupture; if not, the graft material is inserted into the cavity to fill it completely[23].

A potential consequence of this kind of surgery is the existence of septum in the maxillary sinus, which is present in about 31% of patients and is most frequently seen in edentulous atrophic maxilla. The septum's existence raises the risk of perforation by preventing the membrane from separating. A precise radiography analysis or, for a clearer image, a computed tomography done before surgery can be used to identify and locate the septum[24].

Traumatic sinus lift can be carried out concurrently with the implant (a surgical stage) or in two surgical stages (first for maxillary sinus lift and posteriorly for osseointegrated implant). When treatment is administered in two phases, it takes longer because the graft must mature (takes about six months) and the implant that is later placed must osseointegrate. Its primary benefit is the elimination of a surgical phase by reducing the time between sinus grafting and implant placement. Simultaneous implantation of the implant requires enough bone height to support stability and primary fixation of the implant (at least 5 mm between the crest of the alveolar ridge and the sinus floor)[25].

Adjustment to the surgical method for sinus inferior wall elevation because of a maxillary antrum septum. Since the membrane is typically firmly adhered to such bone structure, the maxillary septum can divide the sinus into two separate compartments. In these cases, opening only one cavity does not provide adequate access to the bone graft and also hinders the detachment of the membrane without perforations. Following the placement and compacting of the bone graft, the Schneiderian membrane should be raised in both windows. A regenerative membrane should then be inserted at the entry to the bone windows, the flap should be adjusted, and non-resorbable wire should be used to stitch it[26].

Grafting materials in the maxillary sinus:

An autogenous cortical bone graft, bovine bone, and platelet rich plasma (PRP)-based bone graft combination that is reliable and safe for the maxillary sinus lift operation. The following includes all grafting materials which were used by various authors.

Alloplastic Materials:

The use of porous hydroxyapatite as a graft material in maxillary sinuses showed how surgery might be simplified by performing the procedure in an office setting and under local anaesthetic, as well as by cutting down on expenses, recovery time, and morbidity. Because they may be found in infinite quantities, several writers (Haas et al., 2002) have increasingly suggested bone substitutes for sinus lift surgeries through their studies over the years, either alone or in conjunction with autogenous bone[27].

Allogenic Bone:

In a radiographic, histological, and histomorphometric investigation of a novel bone type intended for maxillary sinus grafting. The cryopreservation technique used to create this bone substitute sets it apart from other allogeneic grafts already in use. Histological analyses of bone biopsies taken at the time of implant implantation showed some residual particles in close contact with a neoformed bone that had a well-organised lamellar

structure. The authors may draw the conclusion that this novel bone substitute can be employed with effectiveness in maxillary sinus survey procedures, and that its encouraging outcomes will stimulate more study into the preservation of this radioactively treated bone material in oral and maxillofacial reconstruction.

Xenogen Bone:

A 98.2% implant success rate was achieved in 1998 by lifting 113 maxillary sinuses in conjunction with autogenous bone or lyophilized demineralized bone using the inorganic bovine bone matrix (Osteograf®). After three years of observation, the proportion of vital bone gradually rose and was much higher when autogenous bone or a polytetrafluoroethylene membrane shielding the sinus cavity was added[29]. The majority of the BioOss particles were encircled by dense, mature bone, according to the histological examination of the biopsies that were taken. The contact between the particles and the freshly created bone showed no gaps. Harvesian canals, tiny capillaries, mesenchymal cells, and osteoblasts could be seen on certain images. Osteoclastic resorption of the residual particles, encircled by neoformed bone, was also seen in the specimens taken at a longer follow-up period (18 months to 4 years), indicating that the reabsorption of the material is sluggish in humans.

Stem Cells:

The stem-mesenchymal cells' (CTMs) aptitude for self-renewal, in vitro proliferation, and immunomodulatory abilities are highly promising. It is possible to separate CTMs from a variety of tissues, including adult connective tissue, bone marrow, peripheral blood, umbilical cord blood, the placenta, and tooth pulp. In the fields of reconstructive bone surgery, such as oral, orthopaedic, maxillofacial, and implantology, its osteogenic plasticity is quite beneficial[31-36]. Since its density, mineral content, and three-dimensional characteristics are specifically tailored to the bone's milieu, radiographic assessment of newly formed bone is challenging.

It has been shown that maxillary sinus lift is a useful technique for raising vertical bone height in order to achieve primary stability of the implants in the posterior region of the reabsorbed jaw. An increasing number of artificial bone substitutes are being used by the field's experts in order to prevent the difficulties associated with autogenous transplants. Adult stem-mesenchymal cells for hematopoietic stem cell transplantation and cell therapy are often obtained from bone marrow; however, this process involves surgery, which increases patient morbidity. General anaesthesia is typically required. In this regard, the search for alternative stem cell sources is currently of tremendous interest. Because dental pulp stem cells (DPSCs) are multipotent, have a high capacity for self-renewal and expansion in vitro, and can differentiate into cells of all germ layers, such as ectoderm (nerve cells), mesoderm (myocytes, osteoblasts, chondrocytes, Adipocytes, and cardiomyocytes), and endoderm (hepatic cells), obtaining stem cells from dental pulp is a straightforward and minimally invasive procedure for dental surgeons. Because dental pulp stem cells don't have the same ethical concerns as other forms of stem cells, they could be excellent candidates for reconstructive therapy.

Sinus Surgery and Simultaneous Installation of Implants:

The surgeon can put implants and perform a maxillary sinus lift using two different procedures, depending on the state of the

remaining bone. In a two-stage technique, the implants must be installed once the grafted material in the sinus has reached its maturity phase. In a contemporaneous operation, or in a surgical stage, the implants are installed concurrently with the sinus lift. Reduction of healing time and decreased chance of reabsorption of the grafted bone are two major benefits of the technique during the surgical stage.However, there needs to be a minimum of 5mm of remaining bone between the inferior sinus wall and the bone crest for the insertion of the implant and the sinus graft.

CONCLUSION

As long as the basic guidelines of the procedure are properly followed, maxillary sinus lift surgery is a safe, dependable, and effective surgical treatment. While there is a slight chance of complications following surgery, they can be managed with medicine and/or surgery. For the purpose of a sinus transplant, a variety of materials have been employed, including autogenous bone—which is regarded as the "gold standard" for maxillary sinus surgery—and various synthetic materials generated from bovine bone. Because of its strong osteoconductivity and minimal reliance on bone migration from the sinus wall, this material is the most predictable for bone augmentation treatments. More research is needed to fully establish the extremely promising outcomes of recent studies on the use of stem cells in conjunction with different types of grafting materials for sinus excision.

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