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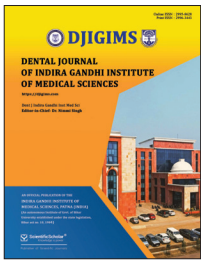

Review Article

Exploring the Crucial Role of Maxillary Sinus in the Success of Dental Implants: A Comprehensive Review

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Received: 22 August 2023

Accepted: 17 October 2023

EPub Ahead of Print: 20 February 2024

Published: 06 April 2024

DOI
10.25259/DJIGIMS_16_2023

Quick Response Code

ABSTRACT

The procedure known as maxillary sinus augmentation has been increasingly embraced by dental professionals, who are recognizing its value and efficacy. This comprehensive review article's goal is to give a complete and current examination of several important features relating to the anatomy, physiology, and common clinical problems of the maxillary sinus in light of this expanding acceptance. Moreover, the review intends to highlight the clinical significance of these key elements in connection to the sinus augmentation operation and the subsequent placement of dental implants.

Keywords: Dental implants, Maxillary sinus, Maxillary sinus complications, Maxillary sinus graft materials, Maxillary sinus pathology

INTRODUCTION

Patients who suffer from tooth loss in the back upper jaw often encounter difficulties related to their physical appearance, oral function and emotional well-being. To tackle these challenges, a widely performed procedure called maxillary sinus augmentation or sinus lift is conducted prior to the placement of dental implants in the posterior maxilla.[1] This region commonly experiences significant bone loss caused by factors such as sinus pneumatization, alveolar bone atrophy or trauma.[2] Healthcare practitioners need to have a thorough understanding of sinus anatomy, physiology, pathology, and surgical methods in order to perform the surgery properly.[3] Additionally, it is important to keep up with developments in bone regeneration techniques and be knowledgeable about the materials that are now on the market and their limits.[4] Despite the fact that numerous clinical trials and reviews have examined the effectiveness and durability of dental implants in various oral locations, there is a dearth of studies that concentrate especially on implants placed after sinus augmentation. In order to provide a comprehensive understanding of the maxillary sinus, this article will cover topics including sinus development, anatomy, physiology and disease. The sinus augmentation technique will also be covered, along with elevation techniques, regeneration materials, probable risks, postoperative instructions and the success rates of implants inserted after sinus augmentation.

Development, anatomy and physiology of the maxillary sinus

The largest paranasal sinus in the human body, the maxillary sinus, has a variety of uses, including cooling, pressure relief, vocal resonance and lowering the weight of the skull or facial development. It is present in the majority of placental mammals and archosaurs.[5] The maxillary sinus joins the nasal cavity through a channel known as an ostium that is located inside the maxillary bone on both sides of the nasal cavity. This ostium is elevated on the medial wall of the nasal cavity and connects to the middle nasal meatus' semilunar hiatus on the lateral side.[6]

By invagination of the mucosa and extension from the primitive ethmoid infundibulum, the maxillary sinus begins to develop as early as the tenth week of pregnancy. The maxillary sinus grows quickly during childhood, going through two development spurts between the ages of 7 and 12 and between birth and 3 years of age.[7] The height of the sinus floor rises until it reaches the level of the nasal floor at about 9–12 years of age, which is determined by its growth pattern from head to tail.[8] Adults with teeth may have a sinus floor that dips about a centimeter below the nasal floor.[9] The maxillary sinus develops a pyramidal shape as a person ages due to the pneumatization process, with the base facing the nasal wall and the lateral tip projecting into the zygomatic process of the maxillary bone, or the zygoma. The canine and premolar regions are reached by the anterior extension of the sinus, and the first molar region is reached by the floor's most inferior point. The infraorbital nerve that leaves the body by the infraorbital foramen, crosses the orbital floor, thus with forming the ceiling of the sinus. The larger palatine nerve, internal maxillary artery, and sphenopalatine ganglion are all located in the pterygomaxillary fossa that is located behind the posterior wall of the sinus. Particularly above the canine in the canine fossa, pneumatization frequently results in thin bone in the occlusal and lateral walls of the posterior maxilla.[10]

The maxillary sinus has an average volume of 15 mL and dimensions of 33 mm in height, 23–25 mm in width and 34 mm along the anteroposterior axis.[11] The posterior superior alveolar and infraorbital arteries that meet in the lateral wall of the sinus, are the main branches of the maxillary artery that give blood to the maxillary sinus. The bottom portion of the sinus may receive additional blood flow from the larger palatine artery. Through the superior alveolar nerve, the second division of the trigeminal nerve (maxillary nerve V2) supplies the sinus with nerves. Through the dural sinus system, venous drainage takes place anteriorly into the facial vein, posteriorly into the maxillary vein, and finally into the jugular vein. Through the ostium and infraorbital foramen, lymph outflow occurs.

The maxillary sinus is divided into several recesses by bony barriers called maxillary sinus septa, which were initially discovered by Underwood in 1910.[12] These septa can be divided into primary septa that form during the growth of the maxilla and the eruption of teeth, and secondary septa that occur during the pneumatization of the maxillary sinus after tooth loss.

The inside of the maxillary sinus is lined with a thin respiratory ciliated epithelium that originates from the epithelium of the nasal mucosa. The sinus mucosa is less vascular and slightly thinner (around 1-mm thick).[13]

Pathological conditions

Inflammatory illnesses, mucoceles, odontogenic sinusitis, neoplastic conditions and granulomatous vasculitis are some of the numerous forms of maxillary sinus diseases that can be categorized.[14]

The majority of pathogenic illnesses that affect the maxillary sinus are inflammatory diseases. Usually caused by viral upper respiratory tract infections, they exhibit signs and symptoms that include discomfort and discharge. The most common cause of chronic sinus inflammation is bacteria, and other than when it flares up, it usually goes unnoticed.[15]

The epithelium-lined cystic masses, known as mucoceles, form when the sinus ostia are obstructed. They may exert pressure and entirely fill the sinus, which would cause the bone to grow.[16]

Odontogenic sinusitis makes up 10%–12% of instances of maxillary sinusitis. It happens when the Schneiderian membrane is torn open by dental problems in the maxillary bone, infections in the maxillary teeth, trauma to the maxillary teeth, or iatrogenic reasons such as dental extractions, incorrect dental implant implantation, or maxillary osteotomies during orthognathic surgery.[17]

The most frequent radiographic findings for maxillary sinus pathology, according to research comparing diagnostic techniques, were mucosal thickening, mucous cysts and full sinus occupation. For maxillary sinus pathology, conventional computed tomography (CT) was thought to be a reliable diagnostic technique. Cone-beam CT in three dimensions, magnetic resonance imaging and panoramic radiography are other diagnostic techniques.[18]

A higher likelihood of sinus outflow blockage is linked to irregular mucosal thickening exceeding 5 mm, circumferential mucosal thickening and total mucosal thickening. It is advised to speak with an ENT (ear, nose and throat) expert in such circumstances. However, there is no risk of sinus obstruction associated with any degree of thickening of rounded mucosa.[19]

Sinus pathological lesions can have a variety of radiological features. In contrast to benign illnesses, which can sometimes reveal sinus walls with a thin, continuous white line, soft tissue lesions are typically radiopaque without a clearly defined boundary. A discontinuous corticated outline on the reabsorbed sinus walls is a symptom of malignant, infectious or expansile illnesses. The roots of the maxillary teeth may appear resorbed in cases of malignant or quickly spreading illnesses.

Sinus elevation procedure

A surgical technique called sinus floor elevation, commonly known as a sinus lift, is carried out on the maxillary sinus to enhance the lateral maxilla's vertical dimension. The purpose of this surgery is to raise the alveolar bone height enough to allow for the implantation of dental implants in those regions. Boyne & James expanded on Tatum's first 1976 introduction, which was first introduced.[20]

In the traditional sinus lift technique, a window is made in the lateral wall of the maxillary sinus. The Schneiderian membrane and this window are then raised inward and upward to a horizontal position, thus forming a new sinus floor. Depending on the circumstances, different graft materials are used to fill the area beneath the membrane. Dental implants can be placed simultaneously if there is sufficient bone height to establish primary stability (about 4 mm). However, implant placement is carried out in a future treatment if the grafted bone needs more time to go through remodeling.

The lateral antrostomy route and the crestal approach are the two basic methods for elevating the maxillary sinus floor.

A crestal incision is made in the alveolar ridge, slightly palatal to the midcrest, to start the lateral antrostomy approach. To access the lateral wall of the sinus, a full-thickness flap is raised. Using a circular bur, a U-shaped trapdoor is made on the lateral wall. A CT scan can establish whether the height of the trapdoor does not surpass the sinus' width, which is an important consideration. To relieve pressure on the membrane, the sinus membrane is gently elevated with an antral curette in three directions: medially, posteriorly and anteriorly. Graft material is then used to fill the space. Implants can be inserted either simultaneously (1-stage) or after a delay of up to 12 months (2-stage), depending on the necessity for graft maturation. Overfilling the recipient site must be avoided, as it may cause membrane necrosis. Although the 1-stage process takes less time, it requires precise expertise and significantly depends on the amount of bone that is still present. For surgical access, a bigger flap is also necessary.

Crestal approach

A crestal incision and elevation of a full-thickness flap are the first steps in the crestal approach procedure for sinus augmentation. Augmentation exposing the alveolar ridge. Subsequently, an osteotomy is carried out utilizing increasingly larger osteotomes. To widen the alveolus and condense the bone, the osteotomes are gently tapped into the bone with a mallet or drill. The osteotomy is filled with prepared bone grafting material that presses against the sinus membrane and raises it. The desired elevation may be achieved by adding more grafting material. The site is then filled with an implant that is only a little bit bigger in diameter than the osteotomy.

The maxillary bone density may be improved by using the crestal approach technique, which is less intrusive. Less autogenous grafting material might be needed. The greater likelihood of osteotome misalignment during sequential osteotomy is a negative, though.

Different alternative sinus augmentation methods have been developed over time.[21] These include rotating devices like surgical handpieces or high-speed handpieces that have been designed to raise the sinuses. The hinge osteotomy approach, the piezoelectric technique and the Dentium Advanced Sinus Kit technique are just a few examples of the several variations that have been discussed.

During the piezoelectric osteotomy technique, specialized bone scalpels that use ultrasonic modulating vibrations are used to cut a window in the alveolar bone. This method lowers the possibility of membrane perforation while providing simplicity and accuracy. When the piezoelectric tool comes into contact with nonmineralized tissue, it automatically ceases its surgical operation. Ultrasonic vibrations and the hydropneumatic pressure of the physiological fluid utilized during piezoelectric cavitation work together to separate the membrane. Piezoelectric devices cause less intraoperative bleeding and membrane perforation than rotational diamond bursts do.[22]

Specialized safe-cutting drills and diamonds, hydraulic pressure techniques and balloon elevation techniques are among the recent developments in piezoelectric technology. These developments enhance the procedure's overall effectiveness and safety.

Surgical procedure and anatomical considerations

Flap design

The blood supply must be disrupted as little as possible, and the surgical site must be adequately covered while creating the flap for sinus augmentation. The incision is often performed through the keratinized, connected mucosa, either mid-crestal or paracrestal manner. When making the osteotomy

and retracting the flap, extra care must be taken to avoid the infraorbital foramen and guard against any harm to the neurovascular bundle.

The optimum osteotomy door shape should resemble the frequently curved internal surface of the maxillary sinus. Radiographic and clinical assessments can help with door-form planning. It can be necessary to thin out the entire sinus lateral wall if it has a thick lateral wall. To reduce the possibility of membrane injury when dealing with rounded corners, it is best to design a wide cranial hinge base. It is advisable to use finger pressure rather than sharp objects while luxating the door. This helps the surgeon prevent any complications and enables them to feel any resistance.[23]

Schneiderian membrane

During the sinus lift surgery, maintaining the integrity of the thin Schneiderian membrane is crucial to preventing graft material leakage into the sinus and maintaining a sufficient blood supply. Various factors, including smoking, chronic sinusitis, allergies and prior sinus surgery, can affect how the membrane is feeling.

The membrane may appear atrophic, brittle and thin in smokers. On the other side, a thicker membrane might result from allergies and persistent sinusitis. These disorders must be addressed at the preoperative planning stage, as they are considered contraindications to the sinus lift procedure. Previous sinus procedures can also be a contraindication since the preparation of healthy, undamaged mucosal tissue may be hampered by scar tissue.[24]

A delicate procedure, the separation of the Schneiderian membrane necessitates the use of specialized tools with blades of various shapes and angles. Although the distal side of the sinus may stretch far, the membrane must be entirely removed from the caudal area in order to elevate the sinus. A sinus that is overfilled may develop sinusitis, membrane necrosis and graft loss. When the membrane is separated from the septa and longitudinal rims, navigating the sinus floor's convolutions and avoiding root tip expressions might be difficult.

In a study by Aimetti *et al*.,[25] it was discovered that people with thick and thin gingival tissues, respectively, had sinus mucosa with thicknesses of 1.26 +/– 0.14 mm and 0.61 +/– 0.15 mm. This implies that the thickness of the gingival tissue might be used as a metric to forecast the thickness of the sinus membrane. However, additional study is needed to confirm these preliminary results.

Maxillary sinus septa

A bony division that separates the maxillary sinus into several recesses and smaller accessory sinuses is referred to as an antral septum. The incidence of this typical anatomical variation in the maxillary sinus ranges from 16% to 58% in the general population. Multiple septa are less frequent than a single septum.[26]

Sinus augmentation treatments can be complicated by the presence of septa, unless they are in the caudal (lower) region of the sinus. A normal augmentation procedure is possible in these circumstances. However, clinicians have a number of alternatives if a septum is located higher than the caudal region. The septum can be partially removed after raising the membrane, or it can be partially removed after creating two trapdoors, a door on one side of the septum (usually the mesial side), or a W-shaped window by following the outlines of the sinus.

Studies have looked at the frequency, distribution, size, shape, orientation and morphology of maxillary sinus septa. For instance, research by Park *et al*.[27] using CT scans discovered that 37% of the individuals, or 27.7% of 400 maxillary sinuses, had septa. The anterior region had 22.5% of the septa, the middle region had 45.9%, and the posterior region had 31.5%. The majority of septa (87.6%) were buccopalatal, while only a tiny proportion were sagittal (11.1%) or transverse (1.3%).[27]

2534 of the 8923 sinuses examined in a meta-analysis by Pommer *et al*.[28] that used data from 1995 to 2011 had septa. However, there was a 29% error rate in the diagnosis when panoramic radiographs were employed. The septal height was 7.5 mm on average. In comparison to dentate maxillae, the incidence of septa was substantially higher in atrophic sinuses. The transverse septa made up 87.6% of all septa, whereas sagittal septa made up 11.1% and horizontal septa made up 1.3%. It was uncommon (0.3%) to find a complete septum separating the sinus into two distinct chambers. 4.2% of patients had multiple septa, while 17.2% of patients had bilateral septa.

According to a review by Rossetti *et al*.,[29] the use of a removable prosthesis in the past was a risk factor for posterior maxillary resorption, with flabby tissues being linked to the degree of resorption. The incidence of septa was likewise higher in atrophic maxillae. Compared to male patients, female patients typically had reduced medullary connection and quantity.

It is crucial to remember that these conclusions may not be applicable to all situations because they are based on research done with particular groups.

Sinus volume and dimensions

Using CT images, Kirmeier *et al*.'s study [30] showed the accuracy and repeatability of a semi-automatic virtual volumetric analysis technique for calculating maxillary

sinus volume. The method's validation revealed a mean relative error of 0.364%, demonstrating that CT scans are a trustworthy source for determining a patient's maxillary sinus volume.

CT scans were used by Jun *et al*.[31] to assess how age and gender affected changes in maxillary sinus volume. They discovered that the development of the maxillary sinuses lasts until the third decade in men and the second decade in women. Males and females were found to have considerably varying maxillary sinus volumes, with young adults having significantly different mean maxillary sinus volumes between the sexes. The scientists came to a conclusion that maxillary sinus procedures carried out before the sinus' complete growth might have a negative effect on it, and this fact should be taken into account before surgery.

In the study by Kawarai *et al*.,[32] CT scans were employed to measure the size of the maxillary sinus and other paranasal cavities in a sample of healthy Japanese participants. They discovered that males and females had different volumes for the maxillary sinus, with males having somewhat greater volumes than females.

In "normal" children and those with bilateral chronic sinusitis, the maxillary sinus volume was measured using CT scans by Ikeda *et al*.[33] The outcomes were contrasted with those of patients who were adults. Inflammation widened the ethmoid infundibulum and middle meatus in kids with bilateral chronic sinusitis that impeded maxillary sinus pneumatization.

These studies demonstrate the value of CT scans in determining the volume of the maxillary sinus, comprehending its patterns of development, and recognizing potential surgical consequences.

Augmentation materials

A variety of grafting materials, including autografts, xenografts, allografts and alloplastic grafts, may be used during sinus elevation treatments. Due to its osteogenetic, osteoinductive, and osteoconductive qualities, autogenous bone, taken from the patient's own body, is regarded as the gold standard graft material for sinus augmentation. The need for a second surgical site, which can result in donor site morbidity and complications,[34] is its primary downside.

1. Autografts: The best type of graft material is autogenous bone, which is taken from the patient's own body. It has characteristics that are osteogenetic, osteoinductive and osteoconductive. However, the requirement for a second surgical site may result in morbidity and problems at the donor site.
2. Allografts: Allogeneic graft materials are sourced from tissue banks and are available as mineralized or demineralized bone. Demineralized bone contains bone morphogenetic protein that stimulates osteoinduction. Cost and potential disease transmission risks are concerns associated with allografts.
3. Xenografts: One kind of often-used xenograft material is deproteinized bovine bone, such as Bio-Oss. It has osteoconductivity and can be applied either on its own or in conjunction with other grafting materials. Bio-Oss goes through a process to get rid of the organic material while keeping the bone structure.
4. Alloplastic grafts: Alloplastic grafting materials, such as hydroxyapatite-based products like calcium phosphate ceramics, provide synthetic scaffolds for bone formation. They are easy to use and relatively less expensive compared to harvesting bone.
5. Mesenchymal stem cells (MSCs): Recent studies have investigated the use of MSCs in the augmentation of the maxillary sinus. Early research has produced encouraging findings that point to the possible advantages of cell-based strategies. To prove their efficacy, more randomized controlled trials are required.[35]

The choice of grafting material depends on various factors, including availability, patient-specific considerations, surgical technique and desired outcomes. Surgeons carefully consider these factors to determine the most suitable graft material for each case.

Postoperative instructions

It is critical to give the patient written and verbal postoperative instructions after sinus augmentation surgery. Several areas of care and precaution must be covered in these guidelines:[36]

1. Application of ice and pressure: Apply ice packs to reduce swelling and apply gentle pressure to control bleeding.
2. Elevation of the head: Keep the head elevated, especially when lying down, to minimize swelling and promote drainage.
3. Rest: Avoid strenuous activities and get plenty of rest to facilitate healing.
4. Smoking cessation: It is highly recommended to discontinue smoking before, during, and after the procedure to promote healing and reduce complications.
5. Prevent negative pressure: During the first week following surgery, prevent negative pressure in the sinuses by not blowing your nose or sipping from a straw. Sneezing with the mouth open is advised.
6. Exercise caution when examining the surgical site by not pulling back the lips to reveal the incision line.

7. Expected symptoms: Let the patient know about typical postoperative side effects such as bleeding, discomfort, oedema, bruising and the presence of tiny bone fragments or granules.
8. Medication compliance: As directed by the surgeon, take all recommended medications, including anti-inflammatory drugs, antibiotics and nasal decongestants.

By providing clear and comprehensive instructions, patients can properly care for themselves after surgery and contribute to successful healing and recovery.

Outcomes

Implant success rate, survival rate and risk evaluation

The outcome of implantation in maxillary sinus augmentation can be influenced by various factors.[37]

1. Surgical technique: The choice of surgical approach (lateral or crestal) and the tools used (piezoelectric surgery or rotary diamond burs) can impact the outcome of maxillary sinus augmentation. The lateral window technique has shown greater bone height gain, but both techniques have similar implant success rates.
2. Site factors: Bone anatomy and the presence of septa in the sinus can influence the success of implantation. A careful evaluation of these factors are necessary for determining the appropriate surgical approach and technique.
3. Timing of implantation: Implants can be placed simultaneously with sinus augmentation or in a delayed fashion. The timing of functional loading (immediate or delayed) also affects the outcome. Proper consideration of these factors are important for achieving successful results.
4. Bone grafting materials: The choice of grafting material can impact implant survival rates. Particulate grafts have shown higher survival rates compared to block grafts. The use of autogenous bone or a combination of autogenous and other graft materials does not significantly affect implant survival.
5. Barrier membrane: The use of a barrier membrane with rough-surfaced implants in the lateral window approach has shown favorable outcomes.
6. Implant-related factors: The type, length and width of the implant surface can affect the survival and success rates of implants inserted into grafted sinuses. Compared to machine-surfaced implants, rough-surfaced implants typically have higher survival rates.
7. Patient-related variables: Systemic disorders (such as bone diseases, diabetes and dental hygiene) and patient-related factors (such as smoking, parafunctional occlusion and oral hygiene) can all have an impact on the effectiveness of implantation. For best results, these aspects need to be carefully evaluated and managed.

To completely understand the impact of these parameters on the success and survival rates of implants inserted after sinus augmentation, more research is necessary, as different studies may report diverse outcomes.

Complications

Complications can arise during or after sinus augmentation procedures.[38]

1. Schneiderian membrane perforation: This is the most common surgical complication, occurring in 7–35% of cases. Perforations are more likely to occur at sharp edges and ridges, such as spines or maxillary sinus septa. Small perforations may not require further management, but larger perforations in unfavorable areas must be closed and covered to prevent graft loss. Techniques such as using a resorbable membrane and surgical adhesive can be employed for closure. In cases of very large perforations, further sinus lifts may need to be postponed.
2. Prevalence of sinus membrane perforations: Studies have reported varying prevalence rates of sinus membrane perforations, with sizes ranging from less than 5 mm to larger than 10 mm.
3. Bleeding: Bleeding from small vessels in the exposed membrane can usually be controlled spontaneously or with light gauze pressure. Care must be taken to avoid massive bleeding due to arterial anastomoses of the alveolar antral artery. Precautions during osteotomy should be taken to avoid damage to these vessels.
4. Implant migration into the maxillary sinus: This is a potential complication that may occur at different stages, including several days post-implantation, during abutment connection surgery or even years later. Prompt removal of the migrated implant is necessary once diagnosed.
5. Pre-existing antral pathologies: Procedures for sinus augmentation might be complicated by conditions including rhinosinusitis, odontogenic sinus disorders, pseudocysts, retention cysts and mucoceles. Before beginning sinus augmentation, it is crucial to recognize and treat these disorders appropriately.

It is crucial to carefully plan the treatment, select suitable patients and adhere to appropriate techniques to minimize the risk of complications during sinus augmentation procedures. Additionally, regular follow-up and prompt management of any complications that may arise are essential for achieving successful outcomes.

Changes in maxillary sinus physiology following augmentation

Maxillary sinus floor augmentation treatments do not appear to have a negative long-term impact on sinus function, according to research. It was discovered in a prospective trial employing endoscopic, histological, and microbiological evaluations with a 9-month follow-up that patients without previous maxillary sinusitis did not have any clinical repercussions from the surgery using autogenous bone grafts.[39]

In a different study by Griffa *et al*,[40] mucociliary function was evaluated in individuals undergoing maxillary sinus augmentation who had no preoperative symptoms of maxillary sinusitis. Methylene blue was employed during the operation to assess the mucociliary function in the maxillary sinus' ostium. The findings demonstrated that, with the exception of the Schneiderian membrane's detached portion, mucociliary function was maintained during the surgical process.

These findings suggest that sinus augmentation procedures with autogenous bone grafts, in patients without pre-existing maxillary sinusitis, do not appear to have adverse effects on sinus function or mucociliary clearance. However, it is important to note that these studies have limited sample sizes, and further research with larger cohorts and longer follow-up periods would be beneficial to validate these findings.

CONCLUSION

To reduce problems and resolve any anatomical or pathological issues, presurgical planning is essential. Before performing the procedure, a patient's age, oral hygiene practices and smoking history must be considered.

There are various areas that need more inquiry in terms of future research directions. The volume of the sinus and its effect on grafting techniques and implant results are one area of research. Knowing the right volume for a successful augmentation can aid with treatment planning and result in better results.

Another potential area of research is the use of mesenchymal stem cells (MSCs) for sinus augmentation. MSCs may be useful in sinus augmentation treatments and have the potential to improve bone repair. Additional research on the application of MSCs in this setting may yield insightful results.

Future studies must focus on how systemic illnesses affect the effectiveness of sinus augmentation, grafting techniques and implant outcomes. Diabetes and bone problems, for example, can affect how quickly the wound heals and how successfully the surgery will go in the long run. Optimizing treatment outcomes would benefit from research on the effects of systemic disorders and the creation of mitigation techniques.

Last but not least, more research is needed to determine how smoking affects the success and survival rates of implants inserted in sinus grafted sites. More research is required to establish the association and pinpoint the precise impacts of smoking on sinus augmentation procedures, even though there are inconsistent results about the influence of smoking on implant outcomes.

Clinicians can continue to hone and improve the methods and effects of sinus augmentation operations by focusing on these research areas, which will ultimately help patients who need this kind of treatment.

Ethical approval

The Institutional Ethics Committee approval is not required.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

Dr. Nimmi Singh is on the editorial board of the Journal.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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How to cite this article: Sikri A, Sikri J, Pathak C, Jain N, Somanna MK, Singh N. Exploring the Crucial Role of Maxillary Sinus in the Success of Dental Implants: A Comprehensive Review. Dent J Indira Gandhi Int Med Sci. 2024;3:36–43. doi: 10.25259/DJIGIMS_16_2023