

Exploring the Vital Link: Maxillary Sinus and the Key to Dental Implant Success

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Patients with tooth loss in the posterior maxilla face challenges in appearance, functionality, and psychological well-being. A common solution is maxillary sinus augmentation, a procedure performed before dental implant placement. This procedure addresses bone loss caused by sinus pneumatization, alveolar bone atrophy, or trauma. Clinicians must have extensive knowledge of sinus anatomy, physiology, pathology, and surgical techniques for successful outcomes. Staying updated on bone regeneration advancements and understanding available products is crucial. While research on dental implants in various oral regions exists, limited focus has been given to implants after sinus augmentation. This editorial article provides an overview of the maxillary sinus augmentation technique, including elevation procedures, regenerative materials, potential complications, postoperative instructions, and implant success rates.

Sinus floor elevation, or sinus lift, is a procedure that increases the vertical dimension of the maxillary sinus to allow for dental implant placement in areas with insufficient bone height. It was introduced by Tatum in 1976 and further described by Boyne and James in 1980. The classic sinus lift procedure involves creating a window in the lateral wall of the maxillary sinus and elevating it inward and upward, along with the schneiderian membrane, to form a new sinus floor. Various graft materials are used to fill the space under the membrane. If there is enough bone height for stability, implants can be inserted simultaneously. Otherwise, implant placement is done in a separate procedure after graft remodeling. There are two main approaches for sinus floor elevation: the lateral antrostomy approach and the crestal approach.

Sinus elevation procedures use different types of grafting materials: autografts, xenografts, allografts, or alloplastic grafts. Autogenous bone is the preferred choice due to its properties, but it requires a second surgical site. Allografts can be mineralized or demineralized bone from tissue banks, offering osteoinductive properties but with concerns about cost and disease transmission risk. Xenografts, like deproteinized bovine bone (e.g. Bio-Oss), are commonly used and studied, providing osteoconductivity. Alloplastic grafts, such as calcium phosphate ceramics, are synthetic and cost-effective. Mesenchymal stem cells (MSCs) have shown promise in sinus augmentation, but more research is needed. The choice of grafting material depends on availability, patient factors, technique, and desired outcomes.

Postoperative instructions following sinus augmentation surgery should include the following points:

1. Ice and pressure: Apply ice packs and gentle pressure to control swelling and bleeding.
2. Head elevation: Keep the head elevated, especially when lying down, to reduce swelling and aid drainage.

3. Rest: Avoid strenuous activities to allow for proper healing.
4. Smoking cessation: Quit smoking before, during, and after the procedure to enhance healing and minimize complications.
5. Avoid negative pressure: Refrain from actions like blowing the nose or using a straw that create negative pressure in the sinus during the first week after surgery. If sneezing, keep the mouth open.
6. Caution with incision line: Avoid pulling back the lips to observe the surgical site to prevent disruption of the incision line.
7. Expected symptoms: Inform the patient about normal postoperative symptoms like slight bleeding, soreness, swelling, bruising, and the presence of bone particles or bleeding from the nose.
8. Medication adherence: Provide clear instructions regarding prescribed medications, including anti-inflammatory drugs, antibiotics, and nasal decongestants. Follow the surgeon's instructions for medication intake.

Comprehensive instructions ensure that patients understand how to care for themselves post-surgery, promoting successful healing and recovery.

Several factors can influence the outcome of implantation in maxillary sinus augmentation:

1. Surgical technique: The choice of surgical approach, such as lateral or crestal, as well as the use of specific tools like piezoelectric surgery or rotary diamond burs, can impact the results.
2. Site factors: The bone anatomy and presence of septa in the sinus area can affect the success of implant placement.
3. Timing of implantation: The decision to place implants simultaneously with sinus augmentation or in a delayed manner can impact the outcome.
4. Time of functional loading: Choosing between immediate or delayed loading of the implants after placement can affect their survival rates.
5. Bone grafting materials: The choice of grafting material used in the sinus augmentation procedure can influence implant survival rates.
6. Use of a barrier membrane: The placement of a barrier membrane during the augmentation procedure can provide additional support for implant integration.
7. Implant-related variables: Factors such as the implant's surface type, length, and width can play a role in the success and survival rates of the implants.
8. Patient-related factors: Patient factors like smoking, parafunctional occlusion, systemic conditions (e.g. bone diseases, diabetes), and oral hygiene can also impact the outcome of implantation.

Comparative studies have shown that the lateral window technique can result in greater bone height gain compared to the crestal approach. However, both techniques have similar implant success rates. Rough-surfaced implants with barrier membrane coverage in the lateral window approach have shown favorable outcomes. The choice of grafting material also affects implant survival rates, with particulate grafts generally demonstrating 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. Implant surface, with rough-surfaced implants showing higher survival rates, implant design, oral hygiene, and patient habits like smoking are additional factors that can impact implant success. While diabetes can affect bone formation after sinus floor elevation, further research is needed to understand its influence on the success and survival rates of implants placed following sinus augmentation. Considering these factors and tailoring the treatment approach to individual patients can help achieve optimal outcomes in implant placement following maxillary sinus augmentation.

Sinus augmentation procedures can be associated with complications, including the following:

1. Schneiderian membrane perforation: Occurring in 7% to 35% of cases, perforations are more likely at sharp edges and ridges. Small perforations may not require further management, while larger perforations in unfavorable areas should be closed using a resorbable membrane and surgical adhesive. In cases of very large perforations, further sinus lift may need to be postponed.
2. Bleeding: Small vessel bleeding in the exposed membrane can typically be stopped spontaneously or with light gauze pressure. However, precautions should be taken to avoid massive bleeding from arterial anastomoses of the alveolar antral artery.
3. Implant migration: Implant migration into the maxillary sinus is a potential complication that requires prompt removal once diagnosed.
4. Preexisting antral pathologies: Conditions such as rhinosinusitis, odontogenic sinus diseases, pseudocysts, retention cysts, and mucocoeles can complicate sinus augmentation procedures. Proper recognition and management of these conditions prior to sinus augmentation are essential.

To minimize the risk of complications, careful treatment planning, appropriate patient selection, and adherence to proper techniques are crucial in sinus augmentation procedures.

Presurgical planning is indeed crucial in minimizing complications and addressing anatomical or pathological considerations. Factors such as age, oral hygiene habits, and smoking history should be carefully assessed before proceeding with sinus augmentation surgery.

In terms of future research directions, there are several areas that hold promise for further investigation:

1. Optimal volume for successful augmentation: Understanding the ideal volume of the sinus for successful grafting procedures and implant outcomes would greatly aid treatment planning and improve overall results. Research focusing on volume assessment and its impact on treatment success could provide valuable insights.
2. Mesenchymal stem cells (MSCs) in sinus augmentation: The use of MSCs has shown potential in enhancing bone regeneration. Further studies exploring the efficacy and safety of MSCs in sinus augmentation procedures could contribute to the development of novel approaches for improving bone formation and graft integration.
3. Impact of systemic diseases: Investigating the influence of systemic diseases, such as diabetes and bone diseases, on the success of sinus augmentation, grafting procedures, and long-term implant outcomes is important. Understanding the effects of these diseases on healing processes and developing strategies to mitigate their impact would be valuable for optimizing treatment outcomes in patients with systemic conditions.
4. Smoking and implant outcomes: The relationship between smoking and implant success and survival rates in sinus-grafted sites remains an area of ongoing research. Clarifying the specific effects of smoking on sinus augmentation procedures and implant outcomes would help in developing tailored treatment approaches and improving patient outcomes.

By addressing these research areas, clinicians can continue to refine techniques and treatment protocols, leading to improved outcomes and patient satisfaction in sinus augmentation procedures [1-5].

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