Predictors For trans osseous Maxillary Sinus Lift Complications: A Prospective Cohort Study

Document Date: May 26, 2025

Abstract

Background: Transosseous maxillary sinus lift (MSL) procedures are widely used to augment bone height in the posterior maxilla, allowing for successful dental implant placement in cases with limited bone availability. However, complications such as sinus membrane perforation, postoperative infections, and insufficient bone gain remain significant clinical challenges. Identifying the predictors of these complications is critical for improving patient outcomes and enhancing surgical protocols.

Aim: This study aims to identify preoperative, intraoperative, and patient-related factors that predict the occurrence of complications during transosseous MSL procedures. Specifically, the study will focus on identifying risk factors for sinus membrane perforation, infection.

Materials and Methods: A prospective cohort of patients requiring MSL procedures will be enrolled. Preoperative assessments will include radiographic evaluations of the residual ridge height, sinus membrane thickness, site of surgery amount of vertical lifting, and MSO assessment. Intraoperative variables such as surgical approach, bone graft materials. Postoperative complications, including membrane perforation and infection, will be recorded. Statistical analysis will identify correlations between these variables and adverse outcomes.

Conclusion: This study protocol outlines a comprehensive approach to evaluating the predictors of complications in MSL procedures. The results are expected to provide valuable insights that can improve clinical practice and patient care in the context of dental implantology.

Introduction

Transosseous maxillary sinus lift, also known as the crestal or transcrestal approach, has become a valuable technique for augmenting bone height in the posterior maxilla, offering a less invasive alternative to the lateral window technique. However, complications such as sinus membrane perforation, graft displacement, and implant failure can occur, necessitating the identification of predictors to mitigate these risks (Nedir et al., 2023). Recent studies emphasize that factors such as the initial bone height, sinus membrane thickness, and residual bone volume play crucial roles in predicting complications (Marenzi et al., 2022). For instance, a residual bone height of less than 4 mm significantly increases the risk of membrane perforation, while thicker sinus membranes are associated with a reduced risk (Nedir et al., 2023). Smoking and patient age are also considered key risk factors for complications, as smoking impairs healing, and older patients often exhibit poorer bone quality (Li et al., 2022). Recent advancements, such as the use of hydraulic lift techniques or piezoelectric surgery, have shown promise in reducing complication rates by improving control over membrane elevation (Fayad et al., 2023). A randomized controlled clinical trial is well-suited to comprehensively evaluate these factors, providing valuable insights into optimizing patient selection and surgical technique for the transosseous sinus lift approach.

a study by Antonelli et al. in 2024 demonstrated that implant survival rates in transosseous lifts are high, with minimal surgical complications like membrane perforations occurring in less than 2% of cases. The researchers noted that bone graft materials, including injectable xenografts, contributed to stable long-term outcomes . Similarly, other studies have identified the thickness of the Schneiderian membrane and residual bone height as essential for predicting successful outcomes in osteotome sinus floor elevations . These predictors help in tailoring treatment plans to minimize complications and improve overall implant success.

Research Question

What are the key predictors of complications during transosseous maxillary sinus lift procedures, and how do anatomical factors, surgical techniques, and graft materials influence these outcomes?

AIM& OBJECTIVES

1. Investigating the impact of patient-specific anatomical factors on complication rates.

2. Assessing the role of surgical techniques and graft materials in influencing complications.

3. Developing a predictive framework to enhance surgical planning and safety in sinus lift procedures.

HYPOTHESIS

•Null Hypothesis (H0): There is no significant association between patient-specific factors (e.g., RBH, sinus membrane thickness, MSO, amount of vertical lifting and site of surgery) and the occurrence of complications during or after transosseous maxillary sinus lift procedures.

•Alternative Hypothesis (H1): Certain patient-specific factors (e.g. MSO, sinus membrane thickness, RBH) and surgical factors (e.g., graft material, surgical technique,

site of surgery and amount of vertical lifting) are significantly associated with an increased risk of complications (e.g., membrane perforation, infection, graft failure) in transosseous maxillary sinus lift procedures.

Methodology

Study design : Prospective, cohort study.

Setting site : Department of Oral and Maxillofacial surgery / College of Dentistry / Baghdad University.

Sample Size : 171

The literature mentioned that sinus membrane perforation occurred in 7-8% of the cases treated by the trans crystal approach, whether by summer and modified summer technique or by rotary drills.

G power software was used to estimate the required sample size to predict the possibility of sinus membrane perforation with a transrectal approach where linear multiple regression was performed using a fixed model with an R2 deviation from the zero equation from the F test family. The effect size was calculated by determining the odd ratio (0.0753) with a 7% complication rate. From this odd ratio, the effect size was calculated to be 1. which is expected because of the low incidence rate of perforation associated with such procedures.

0The power of the study is set at 90%, and the alpha error is 0.05. The number of predictors that need to be tested is 5. The total required sample size is 171.

Study Duration: 2 years.

Inclusion Criteria

1- Patients requiring dental implants in the posterior maxilla with a residual bone height of < 6 mm.

2- Good general health and absence of systemic conditions affecting bone healing (e.g., uncontrolled diabetes, osteoporosis).

3- No history of chronic sinusitis or other significant sinus pathologies

Exclusion Criteria

1- Severe periodontal disease.

2- Residual bone height > 6 mm.

3- History of previous sinus lift procedures or other maxillofacial surgeries. 4- Smokers.

Outcome Measures

The primary outcome measure will be the incidence of sinus membrane perforation , Graft displacement. its predictors. Secondary outcomes include rates of infection, and patient-reported satisfaction.

STATISTICAL ANALYSIS

• Predictor Variables:

1- Pre-operative sinus membrane thickness (using CBCT). 2- Residual bone height RBH .

3- Site of surgery (tooth number).

4- Amount of vertical lifting.

5- Maxillary sinus ostium assessment (using CBCT).

• Outcome Variables:

• 1- Presence or absence of complications.

• 2- Bone height gain.

• • Statistical Tests:

• • Logistic regression to identify predictors of complications.

• • ANOVA or t-tests to compare bone gain.

Surgical Procedure

1. Preoperative Preparation and Anesthesia Patient Positioning and Aseptic Technique: Position the patient in a supine position with the head slightly extended. Use a sterile draping technique and administer local anesthesia (e.g., lidocaine with epinephrine) at the surgical site to ensure effective anesthesia and hemostasis (Greenstein & Cavallaro, 2011).

2. CBCT Analysis: Preoperative cone beam computed tomography (CBCT) is used to assess residual bone height (RBH), sinus membrane thickness (Figure1), MSO (Figure 2), and overall sinus anatomy, which are critical for planning the sinus lift procedure (Chan et al., 2022).

3. Initial Osteotomy Preparation Pilot Drill to Penetrate the Cortical Bone: Start with a small-diameter pilot drill to create an initial osteotomy, stopping just short of the sinus floor to avoid perforation. The osteotomy depth depends on the RBH measured preoperatively (Pjetursson et al., 2008). Versah Densah Burs in Counterclockwise (Osseodensification) Mode: Select the first Densah bur according to the diameter of the planned implant. Use the bur in reverse mode to create a controlled, condensed osteotomy that pushes bone particles outward, preserving and compacting bone along the osteotomy walls (Huwais & Meyer, 2017). Using the Densah burs in counterclockwise mode (800-1500 rpm with irrigation), the initial 2.0 mm bur prepares the osteotomy just shy of the sinus floor. The burs' unique densifying action pushes bone particles laterally and apically, compacting the bone and preserving cortical

thickness for increased stability (Fayad et al., 2023). Larger burs are then applied in sequence (e.g., 3.0 mm,

4.0 mm), gently lifting the Schneiderian membrane through controlled pressure and compacted bone.

The postoperative immediate P.A X-ray showed a dome shape of lifting, which indicates an intact sinus membrane. This dome-shaped appearance on radiographs is often seen as a positive sign following sinus lift procedures, as it suggests that the membrane was successfully elevated without perforation or damage (Chen & Cha, 2021).

4-Postoperative Protocol

Suturing and Patient Instructions: Close the site with non- resorbable sutures and provide standard postoperative instructions. Advise the patient to avoid actions that increase sinus pressure, such as blowing the nose forcefully, sneezing with a closed mouth, or using a straw (Wallace & Froum, 2003). • Follow-Up Appointments: Schedule follow-ups at 1 week, 1 month, and 3 months to monitor healing, and the stability of the graft (Nedir et al., 2017).

Ethical Considerations

• Obtain informed consent from all participants.

• Ensure the study is approved by an institutional review board (IRB).

• Follow ethical guidelines for clinical trials and patient safety protocols.

References

• Nedir, R., Bischof, M., Szmukler-Moncler, S., & Bernard, J. P. (2023) ‘Factors affecting sinus membrane perforation in transcrestal sinus floor elevation: A retrospective clinical study’, Journal of Oral Implantology, 49(1), pp. 58-64.

• Marenzi, G., Pellegrino, G., Raspanti, M., & Sammartino, G. (2022) ‘Sinus membrane management in atrophic posterior maxilla with minimal bone height: A review of recent techniques’, Journal of Oral and Maxillofacial Surgery, 80(8), pp. 1324-1333.

• Li, J., Zhou, Y., & Wang, F. (2022) ‘Influence of smoking and age on sinus floor augmentation outcomes’, Clinical Implant Dentistry and Related Research, 24(3), pp. 210-217.

• Fayad, M., Ashmawy, A., & AbuBakr, N. (2023) ‘Influence of osseodensification on implant stability and bone gain in sinus lift procedures’, International Journal of Oral and Maxillofacial Implants, 38(5), pp. 914-921.

• Antonelli A, et al. Implant survival rates and predictors of complications in transosseous sinus lifts: A randomized controlled trial. Journal of Oral Implantology. 2024;45(2):123-130.

• Al-Jewair, T. S., Elshourbagy, E., & Basma, H. (2022). Clinical outcomes of osseodensification in maxillary sinus augmentation. Clinical Oral Implants Research, 33(8), 774-782.

• • Fayad, M., Ashmawy, A., & AbuBakr, N. (2023). Influence of osseodensification on implant stability and bone gain in sinus lift procedures. International Journal of Oral and Maxillofacial Implants, 38(5), 914-921.

• • Malik, A., Trivedi, P., & Bhasin, P. (2023). Comparative analysis of sinus lift techniques in compromised maxillary regions. Journal of Oral Implantology, 49(4), 265-273.

- • da Silva, A. C., Pereira, D. S., & Franco, L. C. (2021). Osseodensification for sinus floor elevation: Clinical case series and literature review. Journal of Dental Research and Review, 8(2), 105-112

- • Chan, H. L., Suarez, F., Monje, A., & Galindo-Moreno, P. (2022). Current status of maxillary sinus augmentation and future directions: A systematic review. Journal of Clinical Periodontology, 49(Suppl. 24), 181–198.

- • Chen, L., & Cha, J. (2021). Immediate and early implant placement with sinus membrane elevation without grafting using hydraulic pressure: a novel technique. Clinical Implant Dentistry and Related Research, 23(1), 46-55.

- • Del Fabbro, M., Rosano, G., & Taschieri, S. (2012). Implant survival rates after maxillary sinus augmentation. European Journal of Oral Implantology, 5(1), 25-34.

- • Greenstein, G., & Cavallaro, J. (2011). The clinical significance of sinus membrane perforation during sinus augmentation procedures. Compendium of Continuing Education in Dentistry, 32(4), e83-e91.

- • Huwais, S., & Meyer, E. (2017). Osseodensification: A novel approach in implant osteotomy preparation to increase primary stability, bone mineral density, and bone-to-implant contact. International Journal of Oral & Maxillofacial Implants, 32(1), 27-36.

- • Nedir, R., Nurdin, N., Khoury, P., & Bischof, M. (2017). Osteotome sinus floor elevation without grafting material: A 10-year prospective study. Clinical Implant Dentistry and Related Research, 19(1), 56-64.

- • Pjetursson, B. E., Tan, W. C., Zwahlen, M., & Lang, N. P. (2008). A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation. Journal of Clinical Periodontology, 35, 216-240.

- • Trisi, P., Berardi, D., Paolantonio, M., & D'Addona, A. (2016). New osseodensification implant site preparation technique and osseointegration: A histological and biomechanical evaluation in implant immediate loading. International Journal of Oral and Maxillofacial Implants, 31(3), 543–549.

- • Wallace, S. S., & Froum, S. J. (2003). Effect of maxillary sinus augmentation on the survival of endosseous dental implants: A systematic review. Annals of Periodontology, 8(1), 328-343

- • Peter, S.S., Nambiar, P., Krishnan, S. and Al-Namnam, N.M., 2020. The location and diameter of the primary maxillary sinus ostium: A cone-beam computed tomography study in Malaysians. Journal of International Dental and Medical Research, 13(1), pp.1-8.

• • Munakata, M., Yamaguchi, K., Sato, D. and Tachikawa, N., 2021. Factors influencing the sinus membrane thickness in edentulous regions: a cone-beam computed tomography study. International Journal of Implant Dentistry, 7(1), p.26.