

## Case Report

# Minimally invasive maxillary sinus augmentation for single dental implant restoration: a case report

Fahad Ali Alshehri\*

Department of Periodontics and Community Dentistry, College of Dentistry, King Saud University, Riyadh, Saudi Arabia

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### \*Correspondence:

Dr. Fahad Ali Alshehri,

E-mail: [fahalshehri@ksu.edu.sa](mailto:fahalshehri@ksu.edu.sa)

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## ABSTRACT

This clinical case aims to report a minimally invasive approach for maxillary sinus augmentation for first-molar replacement with a dental implant. A 61-year-old male presented to dental clinic with missing upper right first molar. Panoramic x-ray (OPG) showed insufficient posterior maxillary bone with a residual alveolar bone height <4 mm. The patient underwent a minimally invasive sinus floor elevation and augmentation. Three months postoperatively, and a dental implant (Ø 4.1×12 mm, bone level, straumann) was placed successfully. Thereafter, at 3-months post-implantation, the final restoration was accomplished. A 12-months follow-up demonstrated satisfactory clinical outcome. In conclusion, the present case-report demonstrates the advantages of the presented technique for sinus augmentation and dental implant restoration with high precision and promising result, in similar cases with a residual alveolar bone height <5 mm.

**Keywords:** Maxillary sinus augmentation, Dental implant, Case report, Bone graft

## INTRODUCTION

In dentistry, teeth loss is a common oral health problem, which is related to many functional and esthetic issues.<sup>1</sup> Dental caries, periodontal diseases, and trauma are major causes of teeth loss.<sup>2</sup> However, the rate of teeth loss tends to vary among different populations.<sup>3</sup> Therefore, high level of dental care is mandated to assure an optimal replacement of missing teeth. Recently, dental implants represent a reliable treatment option in oral rehabilitation.<sup>4</sup> By evidence, dental implants are able to improve chewing efficiency, esthetics, and patient satisfaction.<sup>5</sup>

Subsequent to teeth loss, the alveolar bone will undergo atrophy. The size of the residual ridge is reduced most rapidly in the first 6 months, especially in the maxillary posterior region.<sup>6</sup> In addition, maxillary sinus enlargement 'pneumatization' after molar-teeth loss has become a significant problem.<sup>7,8</sup> Therefore, sufficient

alveolar bone volume and favorable architecture of the alveolar ridge are essential to obtain optimal dental implant treatment.

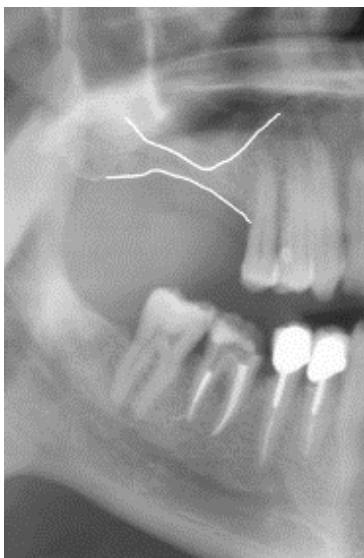
Indeed, pre-implantation sinus augmentation is a requisite for successful and predictable dental implant therapy to replace the upper molar teeth.<sup>9,10</sup> Traditionally, a residual alveolar bone height of less than 5 mm would require maxillary sinus augmentation.<sup>10</sup> Maxillary sinus augmentation is a surgical procedure to increase the vertical height of the alveolar bone followed by dental implant placement.<sup>11</sup> There are many surgical approaches and biomaterials used for this procedure.<sup>11</sup> This was conducted using the lateral window technique that involved an expanded surgical wound and extensive procedures for the bone augmentation.<sup>12</sup> However, the conventional surgical approach often involves several complication issues including the delayed wound healing, sinus infections, and high failure rate in bone augmentation.<sup>13-15</sup> Thus, a minimal invasive technique to

lift/augment maxillary sinus was applied by many oral surgeons. Bone grafting using natural or synthetic bone materials is the most commonly used surgical methods to augment maxillary sinus.<sup>14</sup>

Aim of the present case report is to illustrate the minimally invasive option available for augmenting the maxillary sinus for replacing the 1<sup>st</sup> molar tooth. Moreover, the present technique is a promising solution in cases which have a <5 mm residual alveolar crest height.

## CASE REPORT

A 61-year-old male non-smoker, who was medically fit and had no bruxism, visited the dental clinics with a complaint of a missing upper left and right 1<sup>st</sup> molar. These molars were extracted several years ago due to a periodontal problem. An adequate keratinized gingiva in #16 area was observed clinically. OPG x-ray showed a severe vertical bone loss with a mean residual bone height of less than 4 mm (Figure 1).



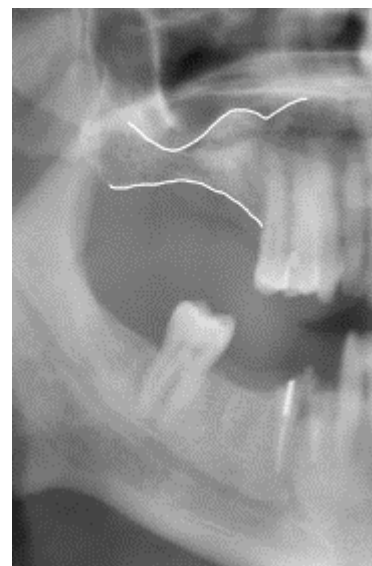
**Figure 1: Pre-operative OPG radiograph showing severe vertical bone loss due to maxillary sinus pneumatization in area of #16 with a mean residual bone height of less than 4 mm.**

### Treatment

Before the surgery, the treatment plan was discussed with the patient. Accordingly, the patient signed an informed consent form. The surgical procedure began by patient rinsing his mouth with 0.12% chlorhexidine mouthwash 3 min per time, for 3 times. Then, local anesthesia with 1:100000 adrenaline was used. Mucoperiosteum flap was released to gain access to the lateral bone side of maxillary sinus.

A precise preparation for an implant bed was established with various osteotomes. The pilot drill was used at a

speed of 800 rpm in combination with the bur's width and depth, leaving approximately 1 mm gap from the maxillary sinus floor boundary. This step was done with special care in order not to perforate the Schneiderian membrane, a thin bilaminar mucoperiosteal membrane that lines the maxillary sinuses. After that, the cortical bone of the sinus floor was up-fractured carefully with a rounded and blunted osteotome to elevate the maxillary sinus membrane to a height of 12 mm. Sinus membrane's integrity was tested by Valsalva maneuver (i.e., performed by a forceful attempt of exhalation against a closed nasal airway), while observing the membrane movement. Following that, bone granules (Puros® Cancellous Particulate Allograft, ZimVie Dental, Florida, USA) were pressed into the maxillary sinus to fill up under the elevated sinus membrane with minimal invasive procedures (Figure 2).



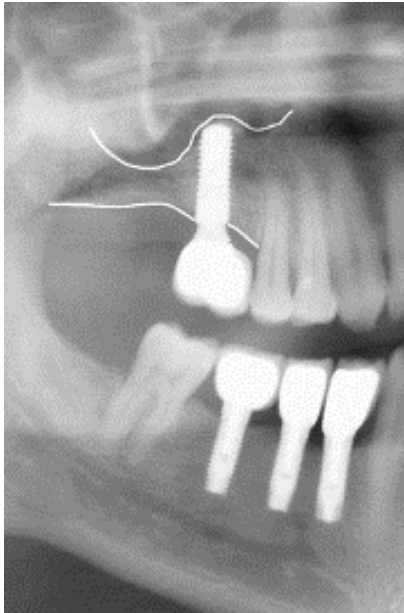
**Figure 2: Post-operative OPG radiograph showing the sinus augmentation was successfully performed with minimal invasive procedures.**

After 3 months of sinus augmentation, implant installation was implemented properly ( $\varnothing$  4.1×12 mm, bone level, straumann, Switzerland) with a torque of 30 N/cm, followed by cover screw placement. All procedures were performed under an assessment with 0.9% saline irrigation and suctioning. Finally, non-tension flaps were approximated with either 4-0 polyglycolic acid (Vicryl) sutures. Postoperatively, the patient was prescribed with a 7-days course of antibiotics (oral amoxicillin 500 mg TID) and Bluem oxygen mouthwash twice a day for 7-days.

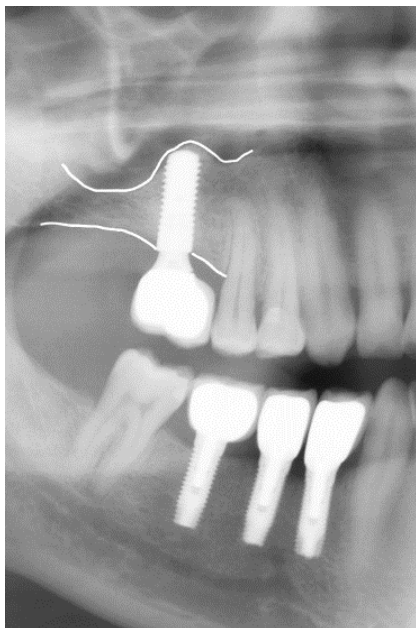
### Outcome and follow-up

After 2 months of the implant placement, X-ray and clinical evaluation revealed a good level of bone-implant healing. Then, implant was surgically exposed and received healing abutment. After two weeks, an impression for the upper arch and a wax-bite registration

were made according to standard procedures for implant-level impression techniques. The prosthetic restoration was able to address the main concern of providing proper occlusion, margins, and embrasures during the fabrication process. Two weeks later, a zirconium-ceramic crown was applied, and fine tuning was conducted at the same visit. The final results were highly satisfactory. Six-month and one year follow-up showed that the bone height remained stable (Figure 3 and 4).



**Figure 3: A 6-months follow-up OPG Radiograph reveals a good level of bone healing in maxillary sinus. The dental implant restoration showed in a stable and successful condition.**



**Figure 4: One-year follow-up OPG radiograph shows sinus augmentation as well as dental implant restoration still in a good and stable condition.**

## DISCUSSION

In this case report, a modified surgical approach for maxillary sinus augmentation is proposed to achieve a sufficient height of bone for proper dental implant placement and restoration. Six-months and one-year follow-ups revealed a good level of bone healing in maxillary sinus. The dental implant restoration showed in a stable and successful condition. Due to the blind nature of this procedure, in the unfortunate event that membrane perforation was observed. In our case, no perforation was monitored during the procedure. There were no postoperative complications. Minimally invasive techniques are often associated with a high success rate, as shown in our case. Follow-up X-ray indicated an increase in the bone formation around the implant. Clinically successful (aesthetically and functionally) crown delivery within 14 weeks of surgery represented a great satisfactory result for both the patient and the clinician.

For dental implants, insufficient alveolar bone in posterior maxilla can present difficulties to support implant fixtures, which necessitates a combined sinus lifting and augmentation procedures.<sup>4</sup> Indeed, various surgical techniques have been proposed for the maxillary sinus lifting and augmentation. However, the indication for surgical procedures is not strictly equivalent and it should be based on a careful evaluation of the individual case. The choice of augmentation modality should be decided to obtain a sufficient bone height for dental implant placement.

Traditionally, lateral window technique is commonly performed to augment the maxillary sinus in cases with an alveolar height <5 mm. This technique was first described in 1980 by Boyne and James.<sup>15</sup> The main clinical advantage of lateral window approach is gaining direct access to the sinus. However, this procedure results in many postoperative complications such as discomfort, swelling, bleeding, infection, exposure of the covering membrane, and occasionally nasal bleeding.<sup>15,16</sup> Consequently, in some cases, minimally invasive surgical procedures for sinus lifting and augmentation are indicated to shorten the treatment period and to optimize the bone volume for implantation.<sup>14</sup>

Understanding the anatomy variations of maxillary sinus is very important to successful the surgical lifting procedures and augmentation. In addition, the ability of Schneiderian membrane to stand intact for a free lifting should be taken into account during the surgical steps.<sup>17</sup> By considering these factors, Aghaloo et al performed a systematic review and found superiority survival rates (91.5%) of dental implants in the augmented sinus floor augmentation.<sup>18</sup>

On other hands, Corbella et al systematically assessed the available data in literature that tested different bone grafting materials.<sup>19</sup> They concluded that bone substitute,

including bovine bone minerals, tri-calcium phosphate, and hydroxyapatite considered as safe and predictable materials. Although autogenous bone is considered a “gold standard”, it counters several limitations, like fast resorption rate, donor site morbidity, and decreased quantity. While non-autogenous biomaterials showed high osteoconductivity, resistance to rapid resorption, and optimal bone housing to accommodate implant site preparation.<sup>19</sup> This was also confirmed by Raghoobar et al in a recent meta-analysis.<sup>20</sup> They analyzed 11 studies (out of 2873) and found no differences in the survival rate of dental implants in regard to native bone vs augmented sinus, immediate vs delayed implant placement in the augmented sinus, and autogenous vs non-autogenous bone materials used to fill the augmented sinus.

## CONCLUSION

This case report illustrates the advantages of minimally invasive surgical procedures for sinus lifting in terms of reduced postoperative complication as compared to lateral approach techniques. And it had promising short and long-term clinical results. Dental implant installation could be followed by final prosthesis within short time <4 months. Therefore, the minimally invasive maxillary sinus lift can be a reliable approach in oral rehabilitation of atrophic posterior maxilla. This technique can be further expanded in view of the successful outcomes.

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## REFERENCES

- Chan AKY, Tamrakar M, Jiang CM, Man Lo EC, Man Leung KC, Chun-Hung C. Common medical and dental problems of older adults: a narrative review. *Geriatrics*. 2021;6(3):76.
- López R, Smith PC, Göstemeyer G, Schwendicke F. Ageing, dental caries and periodontal diseases. *J Clin Periodontol*. 2017;44:S145-52.
- Kassebaum N, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global burden of severe periodontitis in 1990-2010: a systematic review and meta-regression. *J Dental res*. 2014;93(11):1045-53.
- Wennerberg A, Albrektsson T. Current challenges in successful rehabilitation with oral implants. *J Oral Rehabilitation*. 2011;38(4):286-94.
- Cibirka RM, Razzoog M, Lang BR. Critical evaluation of patient responses to dental implant therapy. *J Prosthetic Dent*. 1997;78(6):574-81.
- Burugupalli P, Nair C, Sankara S, Rama AV, Rao DB. Changes in the form and structure of residual ridges: An Overview. *Trends Dent Implantol (Demo)*. 2020;9:20-31.
- Levi I, Halperin-Sternfeld M, Horwitz J, Zigdon-Giladi H, Machtei EE. Dimensional changes of the maxillary sinus following tooth extraction in the posterior maxilla with and without socket preservation. *Clin Implant Dent Related Res*. 2017;19(5):952-8.
- Abdalla MA. Human maxillary sinus development, pneumatization, anatomy, blood supply, innervation and functional theories: An update review. *Siriraj Med J*. 2022;74(7):472-9.
- Mohan N, Wolf J, Dym H. Maxillary sinus augmentation. *Dental Clin*. 2015;59(2):375-88.
- Jivraj S, Chee W. Treatment planning of implants in posterior quadrants. *Br Dent J*. 2006;201(1):13-23.
- Seong WJ, Barczak M, Jung J, Basu S, Olin PS et al. Prevalence of sinus augmentation associated with maxillary posterior implants. *J Oral Implantol*. 2013;39(6):680-88.
- Wallace SS, Tarnow DP, Froum SJ, Sang-Choon C, Zadeh HH, Stoupe J et al. Maxillary sinus elevation by lateral window approach: evolution of technology and technique. *J Evidence Based Dent Pract*. 2012;12(3):161-71.
- Chan HL, Wang HL. Sinus pathology and anatomy in relation to complications in lateral window sinus augmentation. *Implant Dentist*. 2011;20(6):406-12.
- Valentini P, Artzi Z. Sinus augmentation procedure via the lateral window technique-Reducing invasiveness and preventing complications: A narrative review. *Periodontology* 2000. 2023;91(1):167-81.
- Testori T, Weinstein T, Taschieri S, Wallace S. Risk factors in lateral window sinus elevation surgery. *Periodontology* 2000. 2019;81(1): 91-123.
- Lee HW, Lin WS, Morton D. A retrospective study of complications associated with 100 consecutive maxillary sinus augmentations via the lateral window approach. *Int J Oral Maxillofac Implants*. 2013;28(3).
- Valentini P, Artzi Z. Sinus augmentation procedure via the lateral window technique-Reducing invasiveness and preventing complications: A narrative review. *Periodontol* 2000. 2023;91:167-81.
- Aghaloo TL, Misch C, Lin GH, Iacono VJ, Wang HL. Bone augmentation of the edentulous maxilla for implant placement: a systematic review. *Int J Oral Maxillofac Implants*. 2016;31(1):19-30.
- Corbella S, Taschieri S, Weinstein R, Del Fabbro M. Histomorphometric outcomes after lateral sinus floor elevation procedure: a systematic review of the literature and meta-analysis. *Clin Oral Impl Res*. 2015;27:1-17.
- Raghoobar GM, Batenburg RH, Timmenga NM, Vissink A, Reintsema H. Morbidity and complications of bone grafting of the floor of the maxillary sinus for the placement of endosseous implants. *Mund Kiefer Gesichtschir*. 1999;3(1):S65-9.

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