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Case Report

Preparation of the Maxillary Bone Crest for Implant Placement Using Alveolar Preservation and Maxillary Sinus Elevation: A Clinical Case Report

Dania Melina Vega Isaías[1*], Alicia Chacón Moscoso[1], Adriana Elvira Macias Rangel[1]

[1]Universidad Popular Autónoma del Estado de Puebla, Puebla, Puebla, México

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Abstract: This is the case of a 60-year-old patient who required implant rehabilitation in the posterior sector of the maxilla. Given the presence of an atrophic bone ridge, a two-stage surgical approach was chosen. In the first phase, post-extraction alveolar preservation of tooth #16 was performed using the Bartee technique, placing a bone graft in the alveolus and covering it with a non-resorbable polytetrafluoroethylene (PTFE) membrane to maintain graft stability. Closure was achieved with a 5-0 nylon cross suture. Seven months following the preservation and after a computed tomographic evaluation (CBCT), a vertical deficiency of the bone crest was identified that required a maxillary sinus elevation using the lateral window technique. The lateral sinus wall was accessed with piezoelectric instruments, a bony window was created, and the sinus membrane was carefully elevated. Bone graft material covered with a resorbable membrane was placed in the resulting space to facilitate healing and stability of the graft. This case highlights the importance of sequential management of atrophic ridge bone as a key factor in optimizing bone volume and enabling predictable dental implant placement, especially in anatomically compromised posterior maxillary regions.

Keywords: Maxillary Sinus Lift, Alveolar Preservation, Pneumatization, Implants, Rehabilitation, CBCT.

INTRODUCTION

In modern implantology, proper implant placement in three dimensions is essential to ensure its functional and aesthetic stability. Tooth extractions cause changes in the morphology of the alveolar bone, resulting in structural and dimensional adjustments. When a tooth is extracted, the bone surrounding the periodontal ligament and anchoring Sharpey's fibers is resorbed and replaced by woven bone, resulting in a vertical decrease in the alveolar ridge. (Pagni *et al*., 2012). Alveolar preservation is a process designed to prevent or reduce alveolar ridge resorption following extraction for the placement of a dental implant. Tooth loss is considered to promote expansion of the maxillary sinus, which, in severe cases, can lead to direct contact between the sinus floor and the residual bone ridge (Levi *et al*., 2017). A maxillary sinus lift is indicated for implant placement in the posterior maxilla, where there is limited bone available for implant placement. Sinus pneumatization is a constant, naturally occurring physiological phenomenon that leads to an expansion of the paranasal sinuses. This process also commonly occurs after the extraction of a tooth in the posterior maxilla, sometimes referred to as "disuse atrophy." (Sharan & David Madjar, 2008).

Implant placement in the posterior maxilla presents significant challenges due to frequent post-extraction bone resorption and maxillary sinus pneumatization. In many cases, bone height and width are insufficient to accommodate a conventional implant. To address this challenge, surgical techniques have been developed that preserve or augment bone volume, such as immediate alveolar preservation after extraction and maxillary sinus elevation.

This publication describes a clinical case in which both techniques were applied sequentially to prepare an edentulous site for future implant placement, highlighting the importance of three-dimensional planning.

***Corresponding Author:** Dania Melina Vega Isaías
Universidad Popular Autónoma del Estado de Puebla, Puebla, Puebla, México

MATERIALS AND METHODS

A 60-year-old female patient attended the periodontics clinic at the UPAEP postgraduate program for evaluation of tooth #16 (Figure 1).

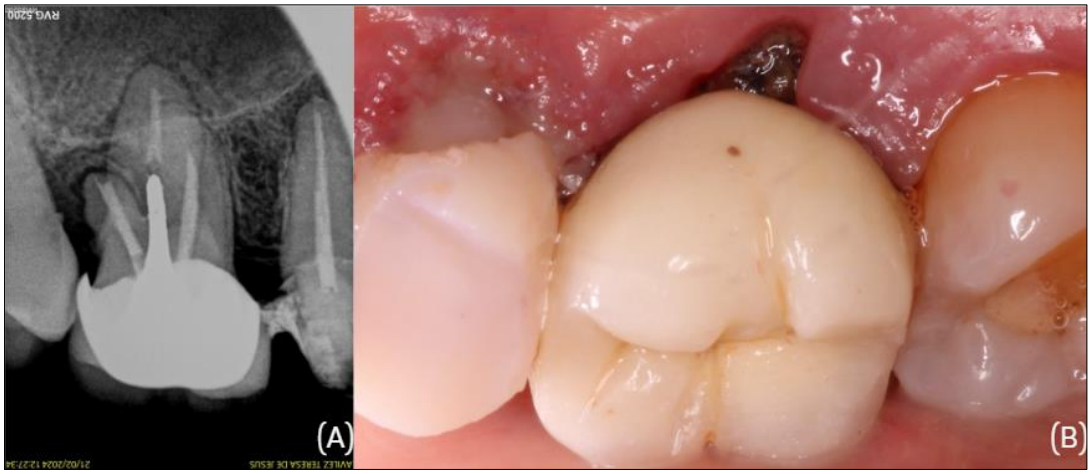

Figure 1: (A) Radiographic image revealing distal root resorption and inadequate endodontic therapy. (B) Image showing the clinical appearance of the tooth, where root caries can be observed on the palatal surface

The prognosis was determined to be hopeless, so the tooth was extracted and a alveolar preservation was performed during the same procedure using the Bartee technique (Figure 2A) (Bartee, 2001) This technique involves performing the extraction in an atraumatic manner, avoiding damage to the vestibular and palatal walls, which are more susceptible to resorption. Particulate bone graft material (either allograft, xenograft, or a mixture of these) was introduced into the alveolus. In the present case, 1 cc of allograft from the Biograft brand was used. This material will act as a scaffold for new bone formation. (Figure 2B)

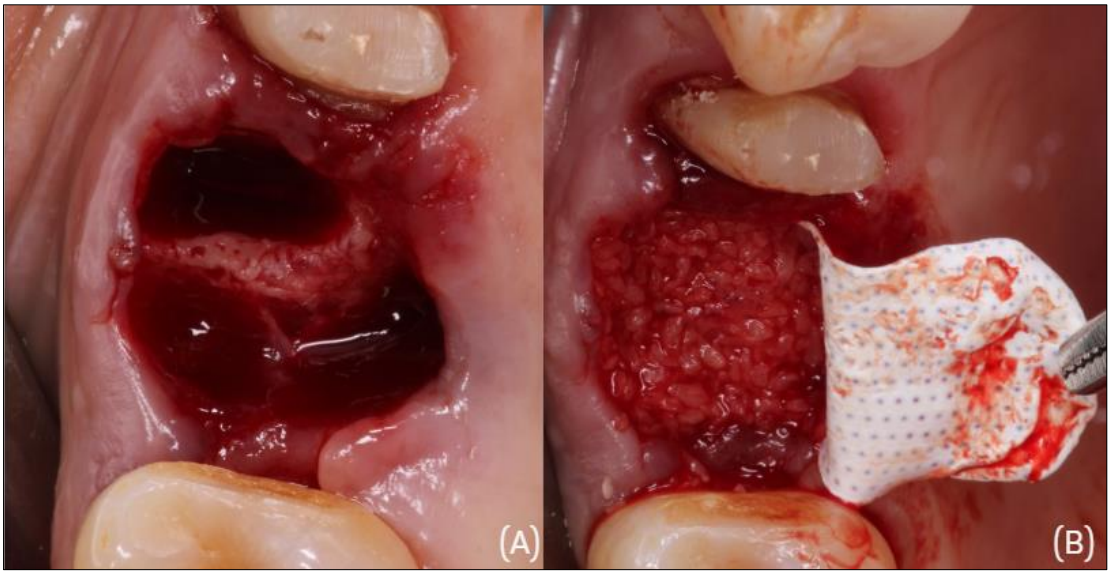

Figure 2: (A) Post-extraction socket showing an intact interdental septum. (B) Bone graft material within the socket and the PTFE membrane placed on the palatal aspect

Finally, a non-resorbable expanded PTFE membrane was placed over the socket, with no primary closure of the soft tissues intended. (Figure 3A). This membrane acts as a physical barrier that holds the graft in place and prevents invasion of the epithelial tissue. A cross-stitch suture was performed with 5-0 nylon thread to stabilize the gingival margins without completely covering the membrane. (Figure 3B). The membrane was left exposed in the oral cavity and was removed after 4 weeks. This procedure is performed during this time to allow the bone graft to stabilize. (Figure 4)

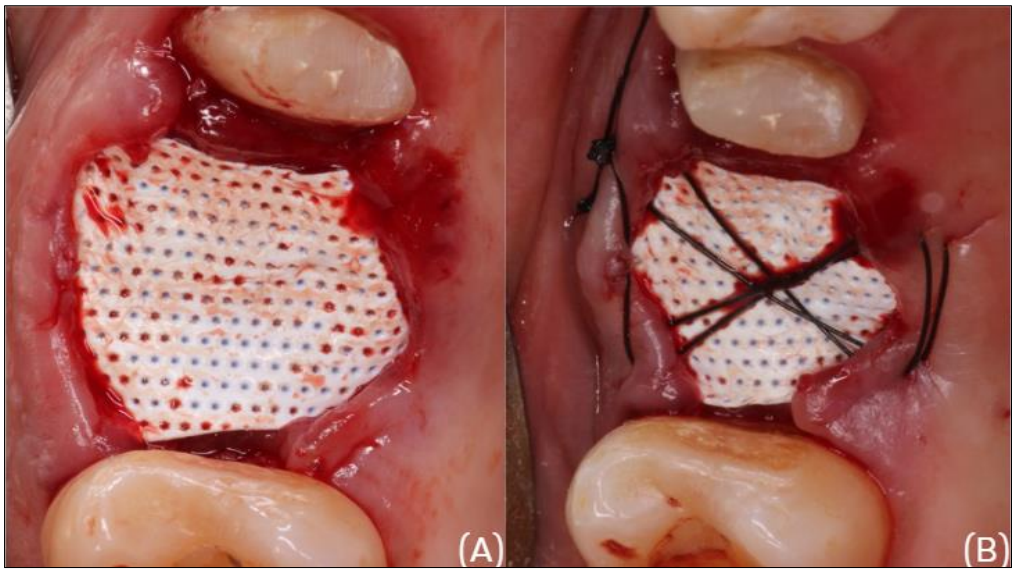

Figure 3: (A) PTFE membrane placed to safeguard the bone graft. (B) A 4-0 nylon suture was placed using a cross-stitch technique

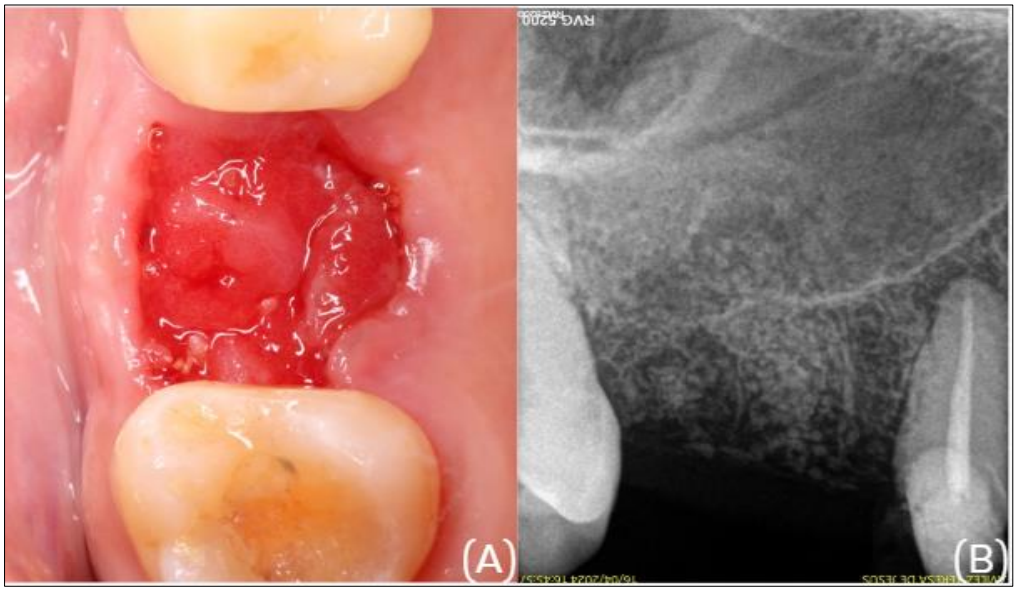

Figure 4: (A) Membrane was removed at four weeks. Favorable epithelialization and ridge volume observed. (B) Radiographic follow-up showing bone fill

In the second stage of surgery, due to the lack of bone height in the posterior portion of the maxilla, a right maxillary sinus lift was performed using the lateral window technique. A crestal incision was made in the edentulous area, extended with vertical mesial and distal incisions, followed by elevation of a mucoperiosteal flap to expose the lateral sinus wall. (Figure 5, A and B) A bony window was then delimited and created using piezoelectric instruments, with the aim of minimizing the risk of perforation of the sinus membrane (Schneider's membrane) and preserving the integrity of the surrounding bone. (Figure 6). Elevation was performed using specialized curette to detach the membrane and allow placement of the bone graft material on the sinus floor (Figure 7, A and B)

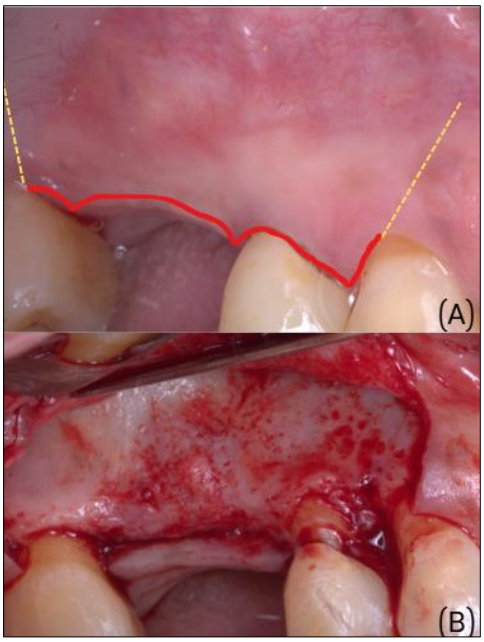

Figure 5: (A) Flap design used in the procedure. (B) The elevated flap revealed the lateral wall of the sinus

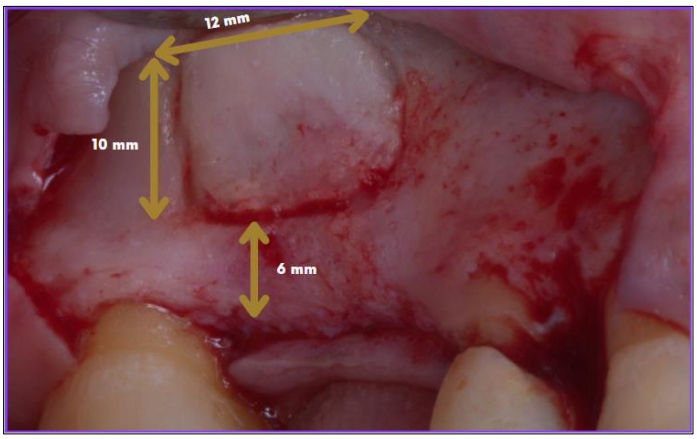

Figure 6: Image showing the outline of the surgical window, including the height, width, and its distance from the alveolar ridge

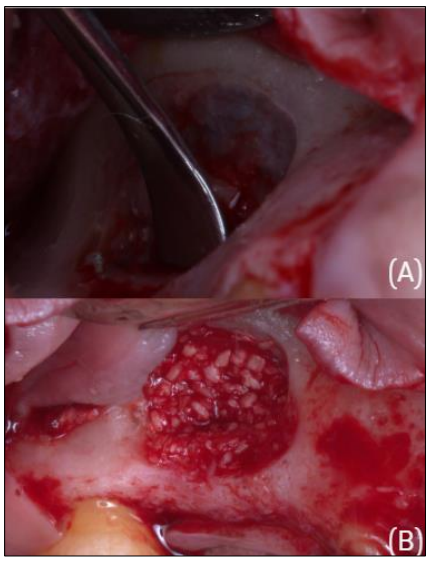

Figure 7: (A) Elevation of the sinus membrane. (B) Bone graft material placed within the newly formed cavity

Finally, the lateral window was covered with a resorbable membrane to stabilize the graft, the flap was repositioned, and surgical closure was performed, ensuring tension-free primary closure. (Figure 8) Antibiotics, analgesics, and antihistamines were prescribed as part of postoperative management.

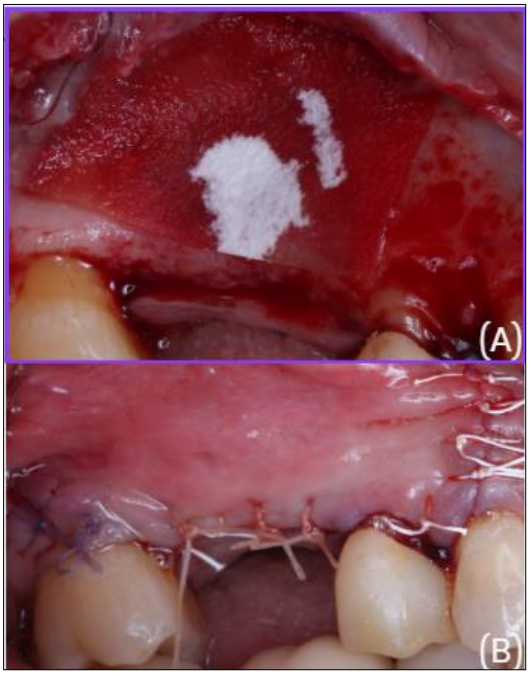

Figure 8: (A) A collagen membrane was placed over the lateral window to stabilize the graft. (B) All incisions were closed with simple sutures to ensure proper flap repositioning

Six months after the elevation procedure, a CT scan was ordered to verify the state of the new bone formation in the grafted space and thus confirm the viability of the site for the predictable placement of a dental implant. (Figure 9. A and B)

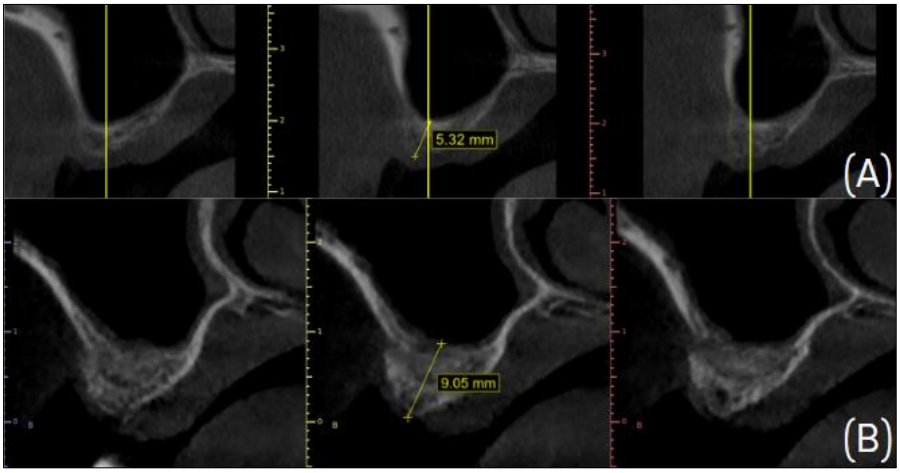

Figure 9: Pre- and post-operative CBCT images

RESULTS AND DISCUSSION

Several procedures have been proposed to reduce alveolar bone loss after tooth extraction, since the greatest amount of bone loss occurs within the first two years; an average of 40% to 60% of the original height and width is expected to be lost (Hansson & Halldin, 2012). Some authors have established that alveolar preservation prevents significant bone resorption after tooth extraction, providing a more favorable environment for subsequent procedures (Wang *et al*., 2004). In the present clinical case, despite good horizontal preservation, as mentioned by these authors, the residual bone height was not sufficient, which made maxillary sinus elevation necessary.

This clinical case highlights the effectiveness of a comprehensive approach combining alveolar preservation and lateral window sinus lift as a sequential strategy for rehabilitating an atrophic bone ridge in the

posterior maxilla. This approach allowed for restoration of bone volume and ensured optimal conditions for implant placement (Papaspyridakos, 2015), as evidenced by the CT scan at six months.

The findings in this case are consistent with the conclusion of a 2018 multicenter clinical study, which showed that alveolar preservation after maxillary posterior extractions reduces both sinus pneumatization (0.69mm vs. 1.04mm) and vertical bone loss (1.62mm vs. 2.01mm), although without reaching statistical significance (Lombardi *et al*., 2018). Likewise, another controlled investigation showed that the group treated with preservation retained significantly more bone height and had a lower incidence of need for sinus elevation than the one without alveolar ridge preservation (ARP) group.

Although a well-executed alveolar graft can mitigate the effects of sinus resorption and expansion, the present case indicates that, due to the magnitude of atrophy, a posterior sinus lift was necessary. This is consistent with the consensus that when the remaining height is less than 5 mm, the lateral window technique remains the gold standard (Lam *et al*., 2024).

In addition to preserving bone structure, the approach applied in this case achieved effective soft tissue management, preserving a healthy band of keratinized gingiva in the edentulous site (Figure 10).

Figure 10: Image illustrating the preserved quantity of keratinized gingiva

This is clinically relevant to ensure good hygiene, peri-implant stability, and long-term mucosal health around the implant. This observation is supported by studies such as the one from Wuhan University (2024), which analyzed the relationship between keratinized tissue dimension and alveolar ridge morphology in molars. They found that sites treated with flapless alveolar preservation showed greater retention of keratinized gingiva compared to those without treatment, especially when vertical buccal bone loss was moderate (Kim *et al*., 2016). This is consistent with our protocol, which assessed the preservation of both tissues through a minimally invasive, wide-flap approach.

Follow-up CT showed homogeneous and sufficient bone formation for implant placement, supporting the claim that combined management significantly increases clinical predictability (Restoy *et al*., 2015). The lateral window technique allowed for safe vertical bone volume augmentation, enabling future placement of an appropriately sized implant. This staged approach, based on accurate 3D assessment, is essential for achieving successful implant rehabilitation outcomes in complex areas (Papaspyridakos, 2015).

Furthermore, the importance of proper diagnosis is emphasized. In this case, it was based on a clinical and radiographic approach that allowed for precise planning of the surgical phases and prediction of treatment outcome. The timely use of CBCT allowed for the identification of significant vertical deficiency, justifying the need for a sinus lift. Likewise, the early diagnosis after extraction justified the application of the alveolar-sparing technique to prevent further bone loss and facilitate the subsequent surgical approach.

These findings align with the results of a comparative study evaluating dimensional changes in the maxillary sinus and alveolar ridge with and without alveolar preservation. The authors observed that, at one year, the group retained significantly more vertical height (0.32 ±0.09mm vs. 1.26 ±0.28mm, $p = 0.0221$) compared to the control group (Levi *et al*., 2017). Furthermore, another investigation using CBCT confirmed that, at six months, only 42.9% of cases treated with alveolar preservation required sinus lift, compared to 100% in the untreated group.

These data support the early application of CBCT and alveolar preservation techniques in this clinical protocol. By mitigating pneumatization and preserving bone height, the magnitude of the sinus lift required is reduced, making it a more predictable and less invasive strategy for implant rehabilitation.

CONCLUSIONS

The clinical management of this case demonstrates that sequential surgical planning, based on a comprehensive diagnosis supported by clinical evaluation and advanced imaging studies such as CBCT, is essential for the successful rehabilitation of atrophic areas of the posterior maxilla. The application of the alveolar preservation technique after extraction minimized bone resorption and limited the extent of sinus pneumatization, optimizing the anatomical conditions for subsequent intervention.

Likewise, maxillary sinus elevation using the lateral window technique was an effective strategy for restoring the necessary bone height in an initially insufficient setting, allowing for safe and predictable future implant placement. The follow-up CT scan confirmed new bone formation in the grafted area, demonstrating the success of the therapeutic sequence implemented.

Overall, this clinical case supports the value of a staged approach in the treatment of atrophic alveolar ridges, highlighting the importance of integrating early diagnosis, regenerative techniques, and reverse restorative planning to achieve successful and long-lasting clinical outcomes in oral implantology.

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