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## **CASE REPORT**

# **Maxillary Implant Placement in a Limited Residual Bone Height**

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## **ABSTRACT**

The limitation of residual bone height (RBH) and vital structures such as sinuses in the maxillary often make the implant placement procedure becomes complicated. Clinicians may perform sinus elevation prior to implant placement to accommodate the length of the implant fixture. Sinus elevation is an invasive procedure and complication may occur during the surgery including the most frequent complication is perforation of Schneiderian membrane. **Objectives:** To discuss a comprehensive management of implant placement and its complication step by step from surgical procedures to crown placement **Case Report:** 67-year-old female patient with partial edentulism in the right maxillary region, presence of sinus septum, and RBH was 4mm. The patient was planned to do sinus elevation surgery prior to implant placement, perforation of the Schneiderian membrane occurred while surgery performed and pericardium membrane was attached around the perforation site. Sinus re-entry and implant placement were performed after 3 months followed by prosthetics procedures in the next 6 month. **Conclusion:** Dental implant is a complicated treatment and complication may occur during the placement, thus a comprehensive management is very essential to minimize the risk of complications.

**Key words:** sinus floor elevation, lateral window, dental implant, membrane perforation, residual bone height

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## **INTRODUCTION**

Alveolar bone insufficiency poses challenges during implant placement; the bone dimension may be reduced in both the horizontal and vertical directions following tooth extraction because of interference of blood supply, absence of occlusal loads and positive pressure inside the sinuses (called sinus pneumatisation).<sup>1</sup> Sinus pneumatisation in the maxilla, which contains the maxillary sinuses and lies above the alveolar bone, should concern clinicians because it makes the sinus floor become closer to the alveolar ridge, thus minimising the amount of vertical bone available for implant placement. Inadequacy of the alveolar bone makes implant placement more challenging, and other surgical techniques may be needed.<sup>1</sup> Guided bone regeneration (GBR), autogenous bone grafting and distraction osteogenesis are surgical techniques that can be used to increase bone volume in the vertical direction, but these techniques are sensitive and have high morbidity; thus, sinus floor elevation (SFE) is the preferred surgical technique for insufficiency in the vertical direction.<sup>2</sup>

SFE, which increases the amount of vertical bone, was initially developed by Tatum in 1977. The SFE technique is divided into the crestal (transalveolar), lateral and palatal approaches. These methods have been developing rapidly, especially in terms of surgical techniques, instruments and use of grafting material. There are many considerations for technique selection, including blood, nerve supply, Schneiderian membrane, residual bone height (RBH), anatomy of the maxillary sinuses, and presence of sinus septum.<sup>3</sup> The crestal approach can be considered if the RBH is at least 5 mm, whereas the lateral window approach might be preferable for an RBH below 5 mm.<sup>4</sup> SFE can cause intraoperative and postoperative complications. Intraoperative complications include membrane perforation, intraoperative haemorrhage, bone fracture, nerve injury, inadequate primary stability and implant displacement into the sinus cavity. The incidence of membrane perforation is quite high, ranging from 20 to 44%. Postoperative complications could be haemorrhage, graft leakage, wound opening, infection,

graft osteitis and benign paroxysmal positional vertigo (BPPV).<sup>1,5,6</sup>

Management of membrane perforation depends on the size of the perforation. In a small perforation (<1mm), the membrane may fold by itself and form a clot. In a medium perforation (<5mm), fibrin glue, collagen tape or bioabsorbable membrane can be used, or the membrane can be sutured. A perforation larger than 5 mm can be treated with a bioabsorbable membrane, lamellar bone plate or suturing combined with fibrin glue, or the implant placement can be delayed.<sup>5</sup> In a large perforation, management is more challenging, and the use of a larger resorbable membrane may be needed. Sinus re-entry is planned three months after the management.<sup>1,7</sup>

Implant placement following SFE is determined by the available RBH. An RBH <sup>3</sup>5mm is sufficient for achieving primary implant stability; thus, one-stage or simultaneous implant placement is possible.<sup>1</sup> A recent study revealed that one-stage implant placement with RBH <4mm has a greater risk of implant failure.<sup>8</sup> Bone quality should also be considered by clinicians in one-stage implant placement, as this plays an important role in achieving primary implant stability.<sup>9</sup>

## OBJECTIVE

The objectives of this case report are to provide an overview of implant placement with limited residual bone through SFE and explain the management of complications.

## CASE REPORT

A 67-year-old female patient with partial edentulism in the right maxillary region came for implant treatment. cone beam computed tomography (CBCT) imaging was indicated because of the proximity of the alveolar crest to the maxillary sinus. A diagnostic cast was created to evaluate the placement prosthodontically, and a simple surgical guide was made. Following the CBCT results, the team placed three individual implants, and SFE was indicated. Coronal-view CBCT imaging revealed bone heights of 10.03 mm (14), 4.38 mm (15) and 6.08 mm (16). Axial view showed bone widths (buccal-palatal) of 6.44 mm (14), 5.23 mm (15) and 7.78 mm (16). There was also a sinus septum (around 16) with an irregular sinus floor. Hence, lateral SFE was preferred.

Schneiderian membrane perforation occurred during the SFE procedure. A small perforation emerged near the sinus septum, and the perforation site was covered with pericardium membrane. A thin septum in the buccal window was removed, and pericardium

membrane was also placed around the window to prevent soft tissue invasion. The site healed after three months, and the implant was placed simultaneously. A sinus window was created using the thin-out approach by using dome-shaped diamond sinus drills with internal irrigation at 800–1200rpm. The instruments were soaked in NaCl 0.9% before elevating the Schneiderian membrane to minimise stickiness to the membrane. The membrane was then carefully detached from the adjacent structure.

Osteotomy sites for implant placement were made using a Lindemann drill at 1200rpm. From initial to final drill, a 40 Ncm torque at 20rpm was used as a drilling system capable of harvesting bone at low speeds. Between the drilling steps, parallel pins were used to confirm the angulation among the osteotomy sites. Fixtures inserted at the bone level and b-TCP bone grafting material were used to fill the gap between the lifted Schneiderian membrane and the sinus floor. The implant fixtures were placed afterward. Bone grafting material was also used to cover the exposed buccal area (14). Pericardium membrane was placed over the lateral windows to cover the grafting area. As two-stage placement was indicated in this case; the fixtures were covered by cover screws, and 5-0 nylon suture was used for flap closure.

The prosthetics were done six months after fixture placement. First, the patient underwent a second surgery for healing abutment placement. The patient returned after a two-week healing period, and an emergence profile was created; thus, an impression could be made. Fixture level-closed tray impression was used in this case, and the final prosthetics were screwed afterward.



Figure 1. Multiplanar reformation (MPR) view

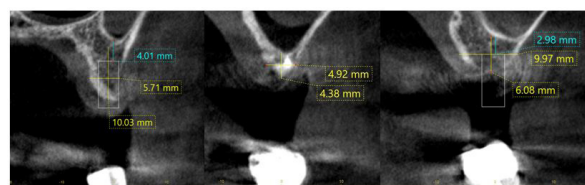


Figure 2. Coronal view 14, 15, and 16

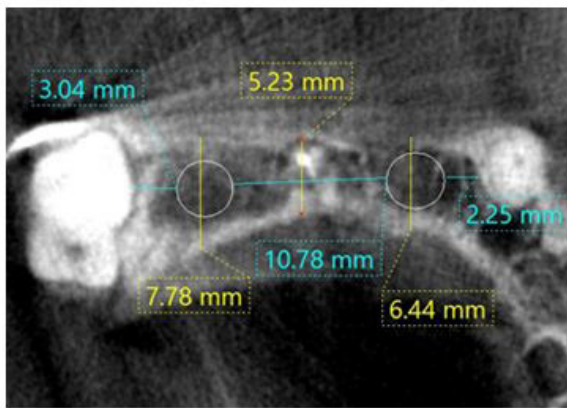


Figure 3. Axial view 14-16

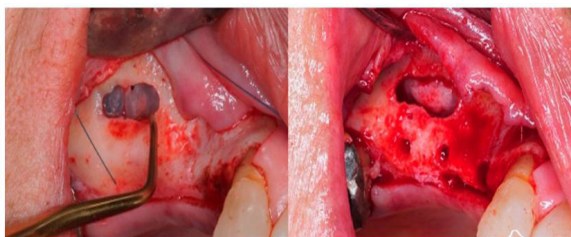


Figure 4A. Perforation of Schneiderian membrane occurred near the septum during SFE; B. Healed Schneiderian membrane after 3 months

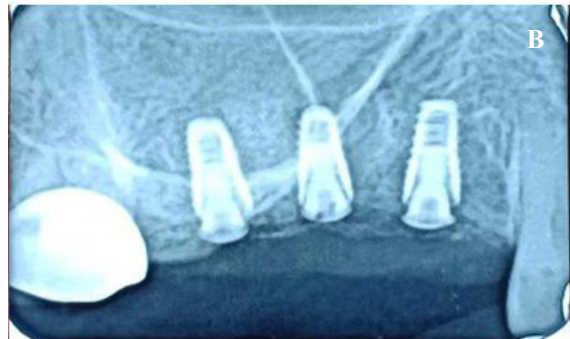
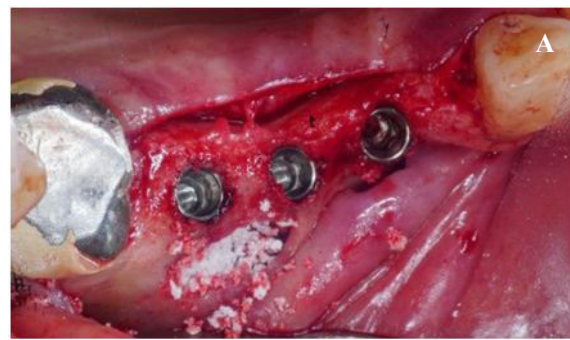


Figure 6A. Implant placement and bone grafted site; B. Postoperative radiograph



Figure 5. Angulation check using parallel pin (A. occlusal; B. Buccal)

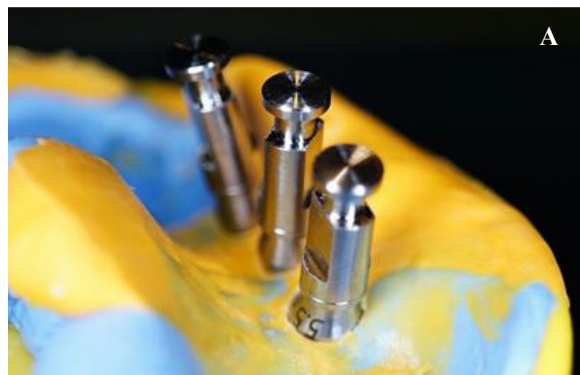


Figure 7A. Fixture-level impression; B. Screw-retained crown

## DISCUSSION

Preoperative evaluation is essential in implant dentistry. History taking, physical examination and radiographic assessment should be performed before the treatment. Medical conditions such as respiratory infection, chronic sinus disease, chronic sinus/facial pain, otitis media, history of nasal/sinus surgery, maxillary reconstruction and smoking should be noted. Radiographic assessment, especially CBCT, is strongly recommended for SFE surgery due to the limitation of panoramic imaging in evaluating the remaining available bone, sinus pathology and sinus morphology (including the presence of sinus septum). The lateral window approach was being used in this case in consideration of the presence of septum, multiple implant placement and the 4.38 mm (6.08 mm) RBH available in 15 (16).<sup>1</sup>

The prevalence of Schneiderian membrane perforation increases in the presence of sinus septum, thin membrane and soft tissue adhesion.<sup>10,11</sup> The most accurate way to diagnose perforation of the Schneiderian membrane is through visual inspection, but in conditions where a visual inspection is not possible, the Valsalva manoeuvre should be carefully performed. There is no association between sinus perforation and implant survival rate, so an implant can still be inserted after management of the perforation.<sup>11</sup> Such management depends on the perforation's size, in which a class 1 perforation is below 2 mm in diameter and requires no management; class 2 is 2–5 mm in diameter, and a membrane folding technique could be considered; class 3 is greater than 5 mm and causes a complete tear of the membrane, requiring postponement of the procedure to allow the membrane to heal for at least 3 weeks and for the gingival and granulation tissue to grow over the perforation area; class 4 is where an oro-antral communication occurs and the soft tissue remain intact, so the split-thickness sinus membrane sandwich technique might be considered as management; and class 5 is complete communication, where both soft and hard tissues are separated and the invagination technique is required.<sup>12</sup> In the present case, the perforation was classified as class 2 (2–3 mm); ideally, the membrane folding technique would be used to repair the perforation site, but the operator decided to delay the implant placement and cover the perforation site because of the very thin membrane around the septum.<sup>12</sup> Sinus re-entry was done after 3 months to allow perforation of the membrane to close.

Preoperative CBCT imaging revealed a bucco-palatal dimension that was adequate for a 4 mm diameter implant to be used, which is advantageous because the larger the diameter of the implant, the less likely that a fracture occurs.<sup>13</sup> A graftless approach was not indicated in this case because an implant protrusion length of more than 4 mm has worse long-term

outcomes.<sup>14</sup> The space between the membrane and the sinus floor should be filled with grafting material; autogenous bone graft is a gold standard for bone grafting because of its osteogenesis properties, but harvesting bone from other parts of the body can increase donor site morbidity, and, moreover, all types of bone grafting materials (allografts, xenografts and alloplasts) are quite favourable for use in SFE cases.<sup>15</sup> To prevent morbidity in this case, the authors used b-TCP bone grafting material to fill the space as its osteoconductivity allows it to act as a scaffold or framework to promote bone growth and it has no potential for disease transmission, such as Creutzfeldt–Jakob disease.<sup>1,16–18</sup> Implants were placed at a crestal level because, according to many studies, there are no differences in marginal bone loss between subcrestal and crestal level implant placement.<sup>19–21</sup> Post-operative medication included co-amoxiclav 625 mg 3 times a day for 5 days, dexamethasone 0.5 mg twice a day for 5 days and etoricoxib 90 mg daily for 5 days.

Implant loading in the mandible can be done after 3 months, but in the maxilla, it is recommended after 6 months. Many aspects should be considered before earlier loading, including identifying primary implant stability, surface characteristics, the quantity of the alveolar bone, bone healing, interim prosthesis design, occlusion and successful osseointegration. Immediate loading can be done within 48 hours of implant placement, early loading from 48 hours to 3 months, conventional loading from 3 to 6 months and delayed loading after 6 months. Conventional loading was more advantageous in this case, after considering bone quantity and the primary stability of the implant.<sup>22</sup> An adequate keratinised gingiva is required to form a biological seal that provides a barrier against bacteria and oral toxins around peri-implant tissues; a lack of soft tissues around the implant might impair the seal, so plastic periodontal surgery, such as a connective tissue graft, might be needed. The biological width in a peri-implant (3–4 mm) is slightly longer than in natural teeth (2.04 mm), and this biological seal contributes to the longevity of the implant.<sup>23,25</sup> The gingival thickness in this case report showed a keratinised gingiva that was adequate to form the biological seal in the peri-implant area.

Various impression techniques introduced into implantology include closed tray and open tray impressions. In this case, a closed tray impression technique was selected because the implants were sufficiently parallel to each other and, in the case of fewer implant placements, there is no difference in accuracy between the closed tray and open tray techniques. In the closed tray impression technique, the impression coping is retained in the mouth after removal of the impression and is connected with implant analogue before the gypsum is poured.<sup>26</sup>

Screw-retained crowns were used in this case, and the abutment was cast with cobalt-chromium because this type of restoration offers a high survival rate, biological advantages, healthier peri-implant tissues and greater ease of repair in the case of future complications, such as screw loosening or fractured components without damage to the crown or implant; cement excess around the restoration can also induce peri-implant mucositis.<sup>27</sup> The limitation of this case report was insufficient data from implant follow-ups, with the only complication report after 1-year of follow-up being screw loosening.

## CONCLUSION

Implantology is a multi-disciplinary science with a high level of complexity. To improve the outcomes of treatment in implantology and to minimize the risk of complications that might occur during placement, clinicians must have sufficient basic knowledge, including diagnosis, treatment planning, surgical techniques and complications. Should a complication occur, clinicians should have good strategies and knowledge to manage and treat the complication.

## CONFLICT OF INTEREST

The authors declare that there were no conflicts of interest related to this case report.

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