

Piezosurgery-Driven Crestal-Approach Sinus Augmentation before Dental Implant Placement—A Case Report

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Abstract

When the ridge height in the posterior maxilla is less than 5 mm, lateral approached sinus augmentation is traditionally used to increase bone volume before implant body insertion. A 34-year-old healthy male with a vertical height of less than 2 mm on the left first molar, piezoelectric ultrasound surgery from crest was performed for sinus augmentation. The bone height increased greater than 10mm after surgery. Six months after the procedure, the regenerative bone volume was adequate for successful implant placement. Until now, this single implant-supported crown functions well.

Key words: Sinus augmentation, Piezoelectric ultrasonic surgery, Crestal approach, Ridge resorption.

Introduction

Sufficient bone quantity is necessary for successful dental implant therapy. Sinus augmentation is a common surgical procedure aimed to increase the amount of bone in the posterior maxilla for dental implant placement in patients with atrophic ridge. This procedure showed high implant survival with a low incidence of complications¹. Sinus augmentation can be done by osteotomy techniques through the lateral window approach or the crestal approach, depending on residual bone height². Patients

with less than 5 mm of residual bone height are usually treated by the lateral window technique and staged implant surgery³. However, the lateral window method is technique-sensitive. Previous studies showed that similar implant-supporting crown conditions could be achieved, regardless of the sinus augmentation techniques used^{1, 4}. Therefore, the treatment approach should be decided upon careful individual evaluation¹. Herein, we introduce a new crestal approach that uses piezoelectric ultrasonic surgery, as an alternative to the lateral window sinus augmentation. This new approach is described in

a patient with severe ridge resorption.

Case report

A 34-year-old healthy male patient came to our department following the loss of the upper left first molar. The vertical distance between the maxillary sinus and the alveolar ridge was too small, measuring about one millimeter (Fig. 1). Thus, we had to perform a sinus augmentation surgery before implant placement. The sinus augmentation was accomplished using Piezoelectric Ultrasonic Surgery from a crest approach, which was named as “sunroof method” by us.

The sunroof method includes the following steps:

1. Crest incision and full-thickness flap elevation under local dental anesthesia.
2. Osteotomy (erosion method) on the ridge crest with ultrasonic round insert tip (SL-3 tip) of Piezoelectric Ultrasonic Surgery Unit (OP-1, Cur Scaler Company, Taichung, Taiwan). The size of osteotomy was small as possible; however, it is large enough for tips insertion and performance.
3. Sinus membrane separation and elevation with two different tips for sinus augmentation, one designed for window approach (SL-7 tip) and another used in crest approach (SL-9 tip), according to the manufacturer's instructions (Piezoelectric Ultrasonic Surgery Unit OP-1, Cur Scaler Co., Taiwan) (Fig. 2). All sinus membrane elevation was performed directly with the surgical tips up to the superior limit of the graft.
4. Collagen plug (Teruplug, Olympus Terumo Biomaterials, Japan) on the upper portion of sinus and filling with Bio-Oss (Geistlich Biomaterials, USA) and OraGraft (LifeNet, USA) in the sinus cavity.
5. Resorbable porcine membrane (Sunmax dental membrane, Sunmax Co., Taiwan) was used to cover the crest opening.
6. Sutured with 4-0 PTFE (ACE Surgical Supply Co., USA). These were removed two weeks later.
7. Antibiotic (Augmentin) and analgesia were prescribed for seven days.
8. The wound was cleaned daily after suture removal, using chlorhexidine.

Six months after healing from the procedure, there was sufficient regenerative bone volume for implant placement (Fig. 3). The increased bone height was greater than 10 mm. At this point, a dental implant fixture (4 × 10 mm; Osseotite Taper Certain Implant, 3i, Zimmer Biomet, USA) was placed into the soft regenerative bone (Fig. 4). The implant site preparation and sinus lift were performed using osteotome till reaching the condense bone. After implant osseointegration, the implant-supported crown was fabricated, placed, and is functioning well (Fig. 5). We have presented here an alternative surgical method for sinus augmentation, instead of the traditional lateral window technique.

Discussion

The lateral window sinus augmentation procedure for implant site development in atrophic posterior maxilla has a predictable outcome, regardless of the biomaterial used^{5, 6, 7}. However, the timing of implant placement, Schneider's membrane thickness, lower residual bone height, and smoking habits affect implant survival rate in grafted sinuses^{8, 9, 10}. Additionally, lateral window sinus augmentation is very

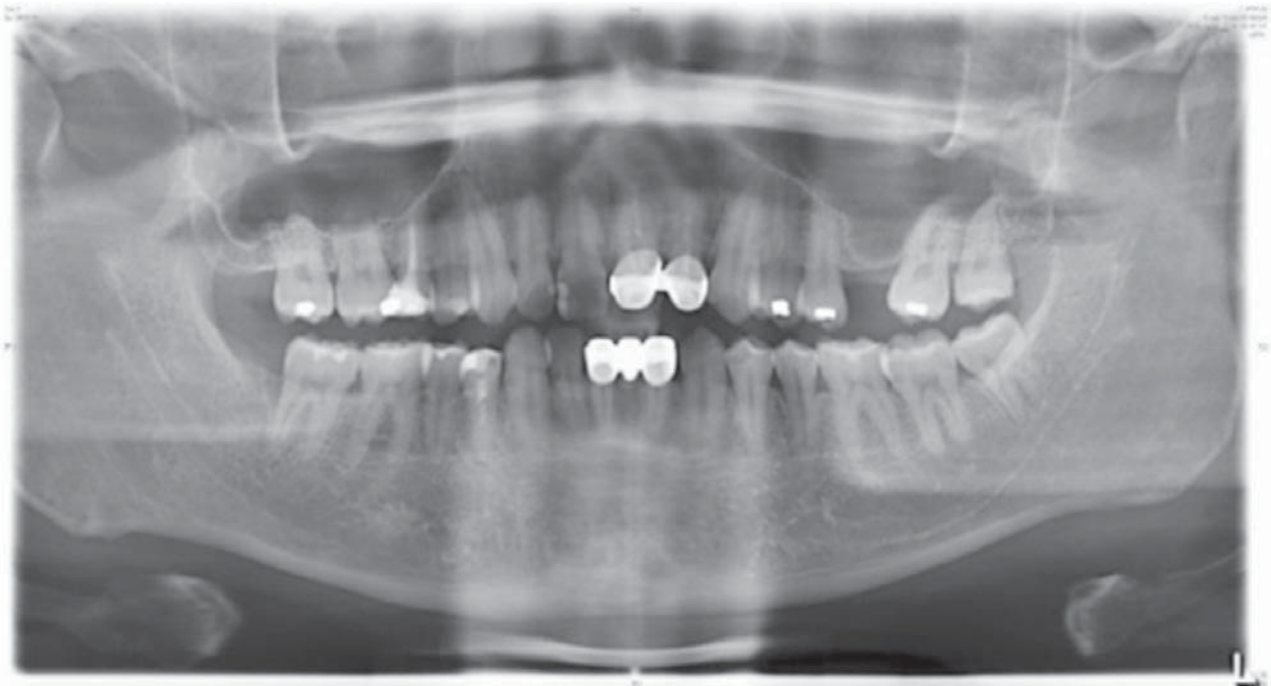


Fig. 1. Initial radiographic assessment. Ridge height of left first molar was less than 2 mm as seen in the initial radiograph.

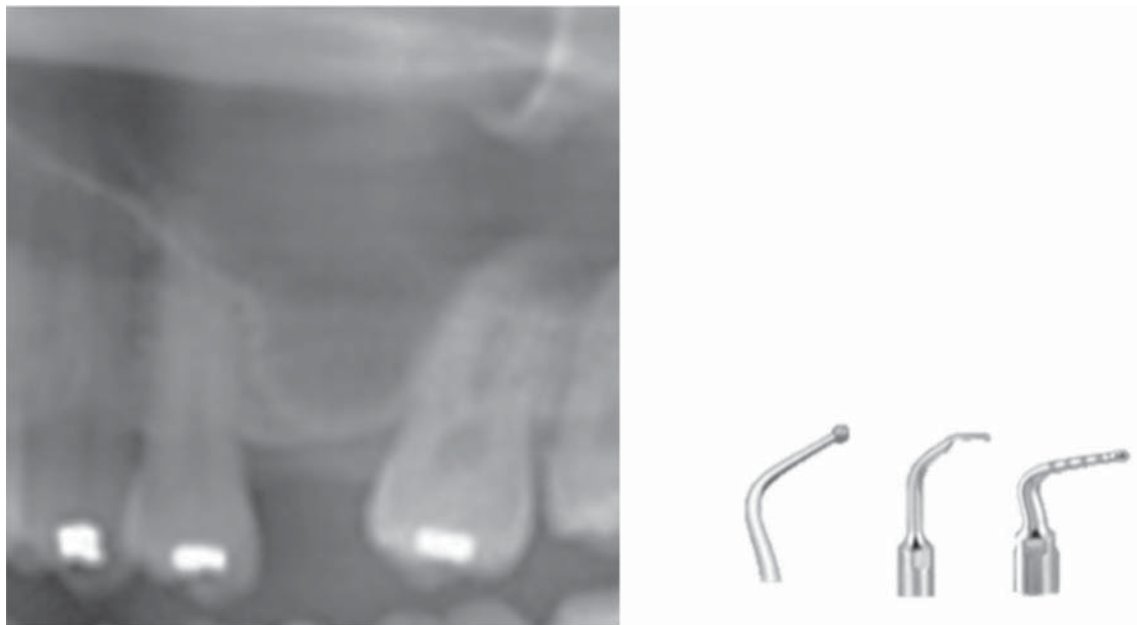


Fig. 2. The tips of the “Piezoelectric Ultrasonic Surgery Unit” used in this case. From left to right: drill for osteotomy (SL-3 tip), sinus membrane separation that is also used in lateral window sinus lift (SL-7 tip), and sinus membrane elevation (SL-9 tip; with internal irrigation) that is used in the crestal approach.

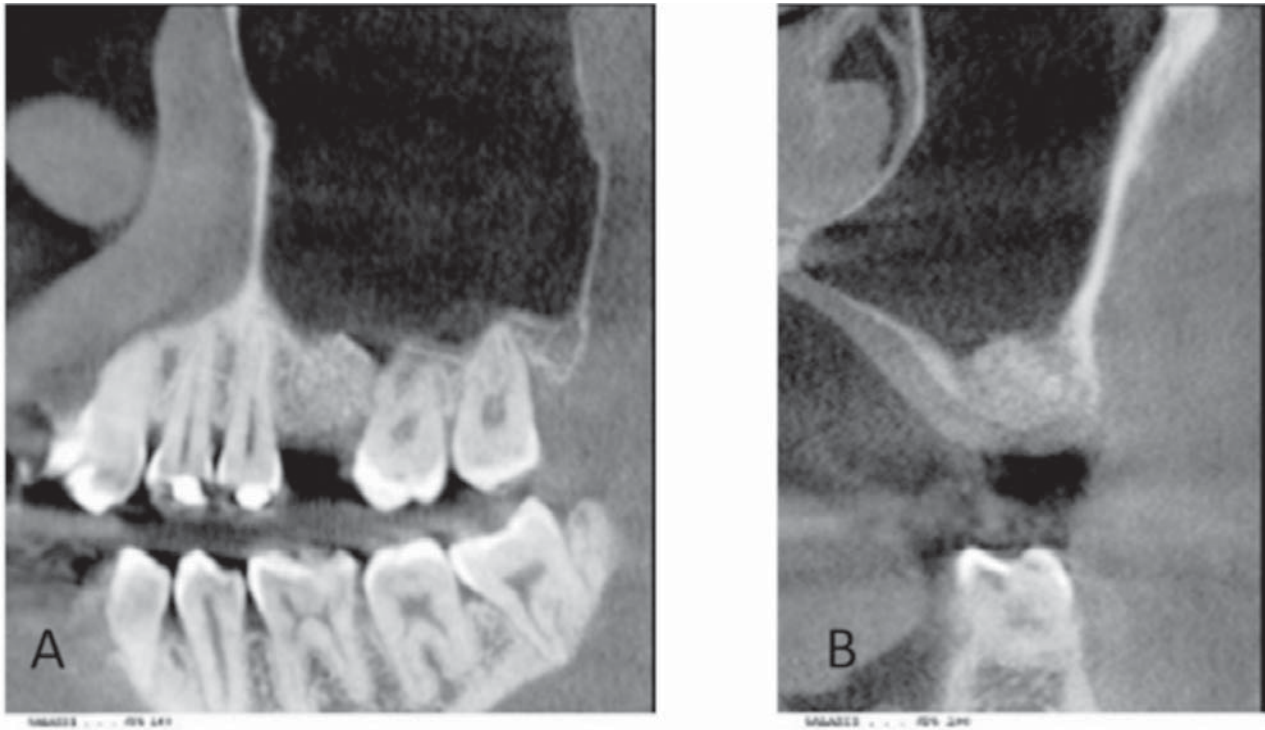


Fig. 3. Cone beam computed tomography (CBCT). Six months after the sinus augmentation procedure. A: Frontal view; B: Sagittal view.

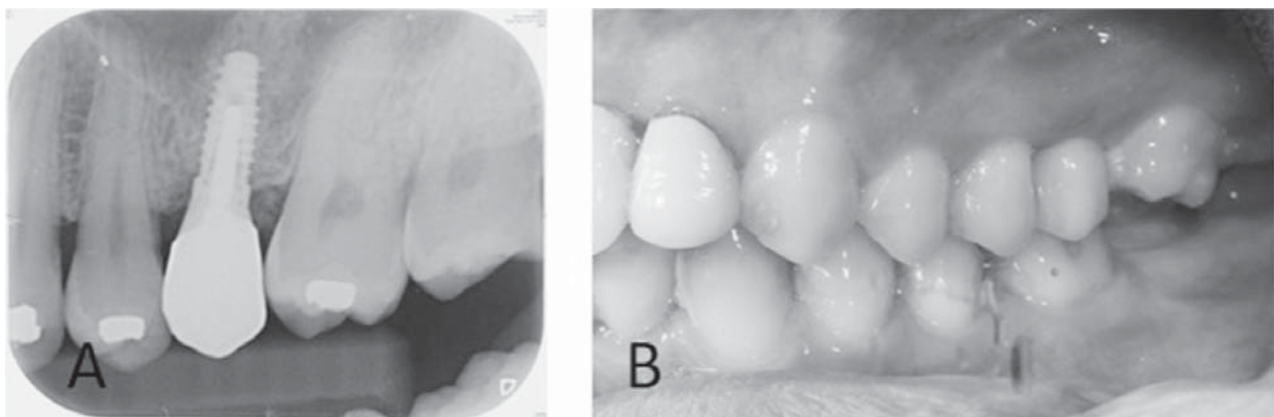


Fig. 4. Prosthetic completion. A: Radiography; B: Clinical photography.

technique-sensitive. Membrane perforation, swelling, hemorrhagic events, and wound infection are the common complications of the lateral approach^{11, 12}. Even when using less traumatic sonic instruments or a piezoelectric device, these complications could not be avoided completely¹³⁻¹⁸.

Another, less invasive, sinus augmentation procedure is the crestal approach in which hydraulic pressure, vibration technique, or antral membrane balloon elevation is used. This technique causes fewer Schneider’s membrane perforations, and it has a predictable implant survival rate^{19, 20}. To fully detach the periosteum of the sinus membrane from the bony floor, and thus improve bone regeneration, crestal hydrodynamic ultrasonic surgery was found to be better than the application of hydraulic pressure or balloon-assisted sinus lift²¹⁻²⁵.

Herein, we have introduced the crestal approach technique using the piezoelectric ultrasonic method in sinus floor elevation surgery. We named the technique as “sunroof method”. The piezoelectric ultrasonic surgery unit cuts only in hard tissues. Therefore, it causes less

trauma to the soft tissue, neurovascular tissue, and the Schneider’s membrane^{13, 26-30}. In addition, piezosurgery was shown to be comfortable to the patient because of its low morbidity, and simple to the surgeon because of the clear view of the surgical field^{2, 30-32}. There are some differences between the sunroof method and previous studies: 1. Two different ultrasonic tools were used for sinus membrane separation and elevation, one of which was designed and used in lateral sinus augmentation originally; 2. The residual bone height before surgery was less than 2 mm; dental implant placement was still successful after sinus lift^{2, 24, 25, 27, 32}. The less invasive crest approach may be better than the lateral window approach in patient’s concern in this case. The thinner the crestal bone height is, the easier for this technique to perform. The increased bone height after six months of healing was greater than 10 mm, which is similar to what was reported when using balloon elevation¹⁹. The sinus membrane perforation rate in the crestal approach is lower than or equal to that in the lateral approach. However, the perforation rate in crest approach is often underestimated due to

Table 1. Comparison between the lateral window technique and the crestal sunroof technique using piezoelectric ultrasonic surgery

Sinus augmentation	Lateral window ^{11, 13, 14, 16-18}	Crestal approach ^{27, 28, 31}	Crestal sunroof
Residual height	< 5 mm	2~8 mm	< 2 mm; thinner bone height is better
Sinus elevation	10~12 mm	3.5~10 mm	> 10 mm
Perforation of Schneider’s membrane	10.9% (0~30%) less in erosion method	2.78%~8.9%	no perforation in this case
Invasiveness	more	less	less
Implant placement	staged	simultaneously or staged	staged
Implant survival rate	88.9~97.2%	87.7~97.2%	implant survival in this case

lack of direct vision. In both approaches, the rate differs according to the osteotomy methods and materials used^{11, 13, 14, 16, 17, 27, 28}. Comparisons of other parameters between the three techniques is presented in Table 1.

In conclusion, the new surgical method for sinus augmentation would be considered after careful clinical and radiographic evaluation. While shown to be successful, long-term follow-up and more cases are needed to confirm its effectiveness.

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利用壓電方式由齒槽脊方向進行人工植牙前的 鼻竇重建—病例報告

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摘 要

當上顎後牙區齒槽脊垂直高度小於5毫米時，在人工植牙置入之前，通常需要增加骨量與齒槽脊垂直高度，傳統上會應用橫向窗口方式的上顎竇重建手術來達到此目的。一位34歲健康男性，其左上第一大白齒的齒槽脊垂直高度小於2 mm，利用壓電超音波手術並採用峰頂法手術來重建上顎竇。手術後骨頭高度增加超過10毫米。手術六個月後，再生骨體積足以成功植入人工植牙。到目前為止，這個單一人工植牙功能很好。

關鍵詞：上顎竇重建，壓電超音波手術，峰頂方法，齒槽脊吸收。

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