# *Osteotome Sinus Floor Elevation Technique without Grafting Material and Immediate Implant Placement in the Atrophic Posterior Maxilla: Report of Two Cases*

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## SHORT TITLE

Osteotome Sinus Floor Elevation Technique in Atrophic Posterior Maxilla


## ABSTRACT

This case report deals with two patients that required implant placement in the atrophic posterior maxilla to support a fixed prosthesis with the less invasive and promptest procedure. The gold standard of care would be to perform a sinus augmentation with an autologous bone graft through the lateral approach with delayed implant placement. However, in these cases, the posterior maxillae were treated with an osteotome sinus floor elevation procedure without grafting material, and simultaneous placement of short, 8 and 10 mm long, tapered implants.

All implants achieved primary stability and were successfully loaded after 3.6 months of healing. At the 1- and 2-year control, they were clinically stable and the final prostheses were in function. The mean endo-sinus bone gain was 5.1 ± 1.3 mm; in one of the patients, the implants were completely embedded in the newly formed bone and the sinus floor had been relocated apical to its previous demarcation. These two cases suggest that the osteotome sinus floor elevation procedure without grafting material, and immediate placement of tapered implants, might be applied in situations where only the lateral approach was previously considered (as far as implants can achieve a firm primary stability). More patients and longer follow-ups are warranted to investigate how reliable can be this technique when it is applied to the atrophic maxilla.



## KEY WORDS

Dental implants, osteotome, sinus lift, grafting material, posterior atrophic maxilla, endo-sinus bone gain.

## Introduction

In the posterior maxilla, tooth extraction induces progressive and irreversible vertical bone resorption. This leads to an atrophic bone situation and limits the application of implant therapy. In such cases, the sinus lift procedure with bone augmentation is indicated; it is expected to facilitate implant primary stability, provide sufficient bone for optimal implant osseointegration and provide long-term success.[1]

The lateral window technique was first described by Boyne and James in 1980 [1]; it is the most frequently used procedure for vertical bone augmentation of the atrophic posterior maxilla. It requires an important volume of bone that is harvested from a donor site. The latter increases the patient's post-operative discomfort, pain, swelling, bruising and the infectious risk. An alternative to the lateral approach is the osteotome sinus floor elevation procedure; it is less invasive and the surgical treatment can be achieved with a single surgery.[2]

The reliability of short implants with a textured surface has been now well documented.[3,4,5,6,7] In sites with limited residual bone height (RBH), the surgical procedure is simpler and treatment duration can be reduced. For example, Renouard and Nisand reported a cumulative survival rate of 94.6% after 2 years of loading for 96 short implants placed in the severely resorbed posterior maxilla.[5] Recently, the need for autologous bone grafts and grafting material to achieve successful sinus augmentation procedures has been questioned.[7,8,9,10] In sites where the mean residual bone height was 5.4 mm, Nedir et al. showed that the osteotome sinus floor elevation procedure without bone grafting material was able to lead to an mean endo-sinus bone gain of 2.5 ± 1.2 mm. The latter was even found to be inversely correlated with the RBH, i.e. the lower the RBH, the higher the bone gain.[7]

The present paper addresses the treatment of two patients presenting in the posterior maxilla a mean RBH of 3.2 mm. Patients asked for the simplest and less invasive treatment; this led the practitioner to go for a surgical protocol, different than the classical lateral window procedure. Hence, these patients were treated by combining the osteotome sinus floor elevation procedure without a grafting material and the simultaneous placement of short tapered implants with a reduced thread pitch.

**Case report patient #1**

A 48-year-old Caucasian male attended for rehabilitation of his left edentulous posterior maxilla. His general health was good without contributive medical history. The patient was a heavy smoker (about 20 cigarettes per day) but had stopped smoking before the treatment. Despite a protracted periodontal therapy, the patient suffered extensive alveolar bone loss; the "resiliant periodontis" required extraction of all teeth of this posterior quadrant.

The periapical radiograph taken before surgery (fig 1-A) revealed a large procident sinus cavity, extending around the apex of the cuspids. Presence of a septum was identified at the former position of tooth # 25. The RBH was 3.0 mm at site #24, 5.0 mm at site #25 and 1.1 mm at site #26.

Prophylactic antibiotics (Amoxi-Mepha®, Mepha Pharma SA, Aesch, Switzerland; 750 mg, three times per day) were given the day before surgery and for six days following surgery. A mid-crestal incision was performed for flap elevation; vertical or periostal release incisions were avoided. Cortical bone marking, for site positioning, was performed with three round burs of increasing diameters from ∅ 1.4 to 3.1 mm (fig 2-

A). The ∅ 2.8 mm sinus osteotome (Straumann AG, Basel, Switzerland) was engaged to push the sinus floor axially. The use of osteotomes instead of drills prevented ovalization of the implant bed in the limited residual bone. The sinus floor was then broken by light malleting. It was then carefully pushed into the sinus cavity, up to a maximum height of 3 mm; the Schneiderian membrane was further elevated by implant placement. The osteotomy site was enlarged by the ∅ 3.5 mm sinus osteotome. Integrity of the membrane was controlled with an undersized depth gauge of ∅ 2.1 mm, however micro-perforation of the Schneiderian membrane could not be excluded.[11] No grafting material was used. Three tapered, 8 mm long, TE® implants, Ø 4.8 mm at the collar and Ø 4.1 mm at the apex (Straumann AG, Basel, Switzerland), were placed in the prepared osteotomy sites. Implant insertion was performed without tapping. The flap was sutured around the implant neck, allowing for a non-submerged healing (fig 2-B). The blood clot with bone particles surrounding the implants could be clearly noticeable on the post-operative radiograph (fig 1-B). During surgery, bone quality at implant sites was categorized according to Trisi & Rao [12]: normal at site #24 and soft at sites #25 and #26. All three implants achieved primary stability.

The healing period was uneventful and lasted 3.6 months. The space delimited by the elevated Schneiderian membrane could be maintained over time by the implants. The classical prosthetic steps were then conducted and a cemented porcelain-fused-to-metal prosthesis composed of three splinted crowns was placed. At the 1-year control, all implants were clinically stable and the final prosthesis was in function (fig 2-C). All implants gained endo-sinus bone; the mean gain was 5.5 ± 1.4 mm, varying from 4.7 to 7.1 mm. All implants were entirely embedded in the newly formed

mineralized tissue (fig 1-C). The mean crestal bone loss was 1.1 ± 0.3 mm. At 2 years, the bone levels were stable (fig 1-D).

**Case report patient #2**

A 77-year-old Caucasian man looked for rehabilitation of his left posterior maxilla that had been edentulous for several years; this previous smoker was in good general health with non contributive medical history. The RBH beneath the sinus was 3.0 mm at site #25 and 3.5 mm at site #26. The surgical procedure was similar to the one performed at patient #1; the only difference was that the osteotome sequence ended with the 4.2 mm diameter sinus osteotome, instead of the 3.5 mm diameter one used for the 4.8 mm diameter implants of patient 1. The reason was because larger diameter implants were planed. Ten-millimeter long tapered implants, 6.5 mm in diameter at the collar and 4.8 mm in diameter at the apex (Straumann AG), were inserted in sites #25 and #26.

Both implants achieved primary stability. After an uneventful healing period of 3.6 months, the implants were clinically stable. Abutment screwing with a torque of 20 Ncm did not lead to implant rotation. The final prosthesis was in function at the 1-year control. Dental CT scan, panoramic and apical radiographs were performed at the 1-year follow-up; newly formed mineralized tissue on each implant side was clearly visible on the 1-year radiographs (Figs 3 and 4). The mean bone gain and crestal bone loss was 5.0 and 0.4 mm at implant in site #25 and, 3.6 and 0.5 mm at implant site #26. The net bone gain was therefore 4.6 mm at implant in site #25 and 3.1 mm at implant at site #26. After 3.5 years, the implants were clinically and radiographically stable.

## Discussion

For the two patients, the available prosthetic height, measured from the bony crest of the edentulous sites to the opposing dentition, was about 9 mm; therefore endo-sinus augmentation was indicated rather than crestal augmentation. Standard current clinical practice would have required a sinus-lift procedure with autologous bone grafting and delayed implant placement.[13] This treatment would had needed 6-8 months of healing to allow for bone formation at the grafted area and a second healing period of 3-4 months after implant placement, i.e. a total of 9 to 11 months instead of 3.6 months. Furthermore, in patient #1, the lateral approach would have been complicated by the presence of a septum and might have led to membrane perforation.[14]

Both patients required the less invasive and shortest treatment. The osteotome sinus floor elevation procedure, although being technically demanding below a RBH of 5 mm, was minimally invasive. Because the Schneiderian membrane can support elevation in the sinus cavity up to 4-8 mm[15], the wished elevation of the sinus floor could be obtained.[16]

To enhance the primary stability in low density bone, the use of osteotomes is more relevant than the use of drills. By compression, the osteotomes can laterally condense bone and create a denser interface at the placed implants[17] , improving the initial bone-to-implant contact.[18]

Implant stability could be achieved despite the limited RBH down to 1.1 mm; this was due to the conical implant design, the threads brought up to the implant neck and a reduced pitch of 0.8 mm. The classical parallel-walled design of the used implant system, with its 1.25 mm thread pitch starting 1 mm away from the neck level, would not have allowed primary stability in these demanding situations.

The osteotome sinus floor elevation procedure described by Summers involves a grafting material that is condensed in the osteotomy site to elevate the sinus membrane.[19,20] If the Schneiderian membrane is perforated, the filling material can migrate into the sinus and lead to inflammation.[21,22] The present protocol, by avoiding a grafting material, has completely discarded this risk. With this technique, undetected perforations are likely to remain uneventful since the membrane can reform around up to 4 mm protruding implants.[23]

These two cases with a mean of 5.1 mm of endo-sinus bone gain are questioning also the necessity of a grafting material in sinus augmentation procedures: despite the lack of grafting material, the 1- and 2-year radiographs have consistently shown the implants embedded into newly created bone and the new apically switched demarcation of the sinus. Noteworthy, the additional bone height usually gained by the grafting material placed above to the implant apex showed to resorb with time, as short as one[24] or three[25] years. Amazingly, it gets stabilized at the implant apex[24] or slightly below[25] Therefore, the fact that apical bone gain in this procedure is limited by the implant length should not be considered as a limitation factor and a specific drawback of this technique without a grafting material.

Short implants have been used in these two cases in order to minimize the risk of membrane perforation. This could be contemplated because it has been now well documented that rough-surfaced short implants, in contrast to machine-surfaced implants, are as reliable as longer implants.[3,4,7,26,27,28]

In summary, tapered implants with a reduced thread pitch could be placed with good primary stability in the atrophic maxilla of two patients by an osteotome sinus floor

elevation procedure without grafting material. The regenerative properties of the bone beneath the sinus floor led to a high endo-sinus bone gain. Advantage of this procedure was to avoid an invasive surgery and permit treatment within a single surgical step. Before bringing this treatment protocol into more routine, more cases and longer follow-ups are obviously warranted. But these two cases, successful on the short term, might suggest that there might be room to treat the atrophic maxilla with a surgical procedure different than the classical lateral window opening for sinus augmentation.

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**Figure captions**

**Figure 1.** Peri-apical radiographs of the posterior area of patient # 1.

*A*, before implant placement; *B*, immediately after implant placement; *C,* at the 1-year control; *D,* at the 2-year control.

**Figure 2.** Clinical views of patient # 1:

*A,* during surgery. Flap elevation after mid-crestal incision. Cortical bone marking for site positioning; *B,* immediately after surgery. Cover-screws in place and sutures according to a 1-stage procedure; *C,* at the 1-year control with the final prosthesis in place.

**Figure 3.** Dental CT scan of patient # 2, oblique coronal reconstructions of sites #25 and # 26.

*A1-9*, before implant placement; *B1-9*, at the 1-year control.

A3, B3: site 25; A6, B6: site 26.

**Figure 4.** Panoramic radiographs of patient # 2:

*A*, immediately after implant placement; *B,* at the 1-year control.

Figure 1A

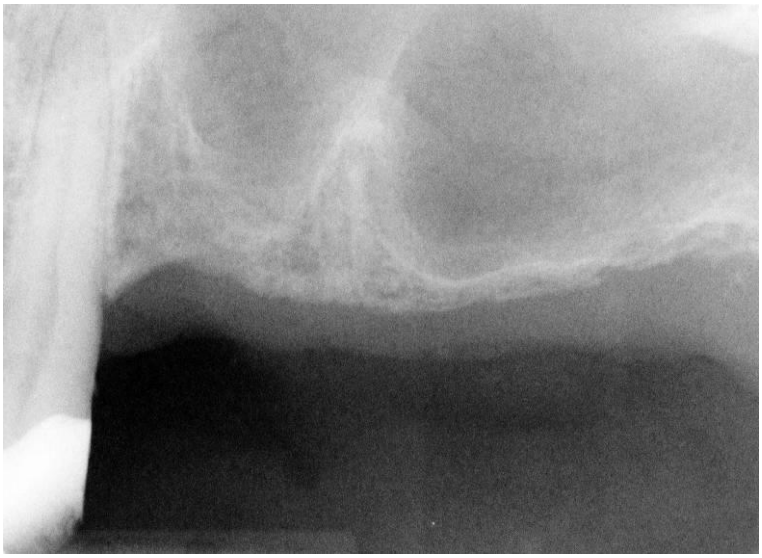

Figure 1B

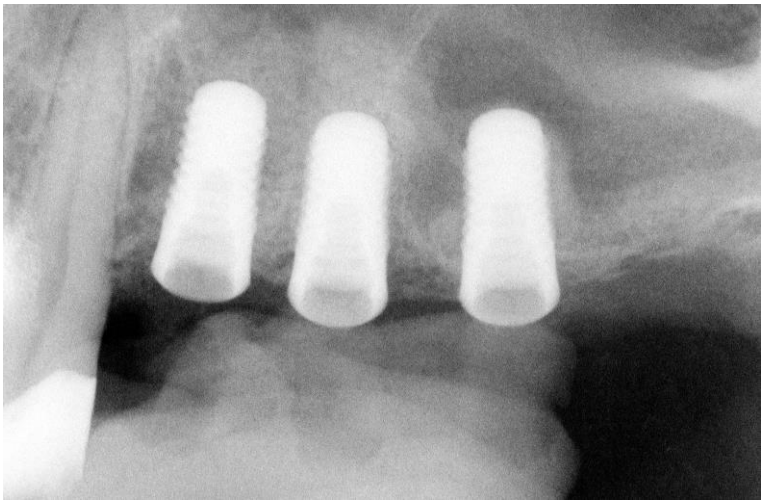

Figure 1C

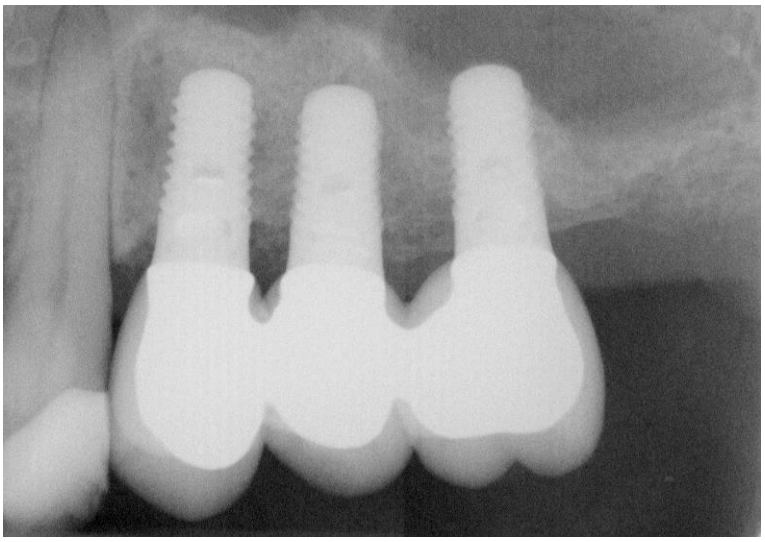

Figure 1D

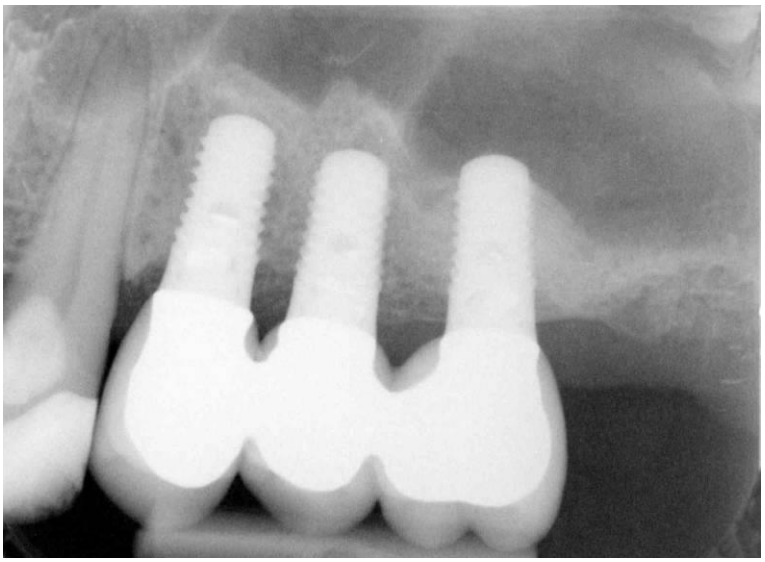

Figure 2A

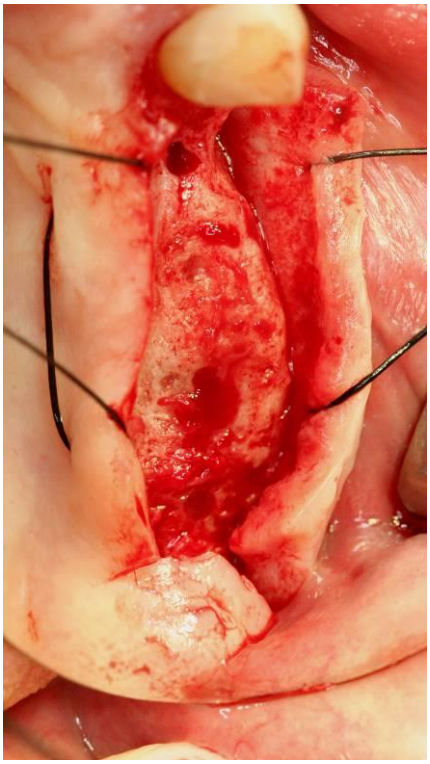

Figure 2B

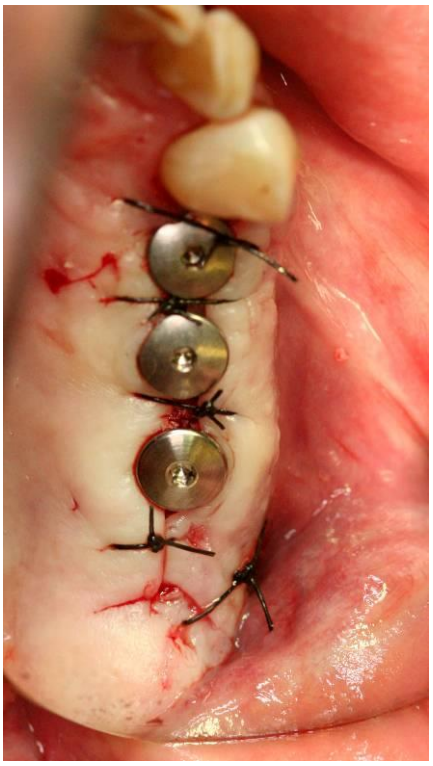

Figure 2C

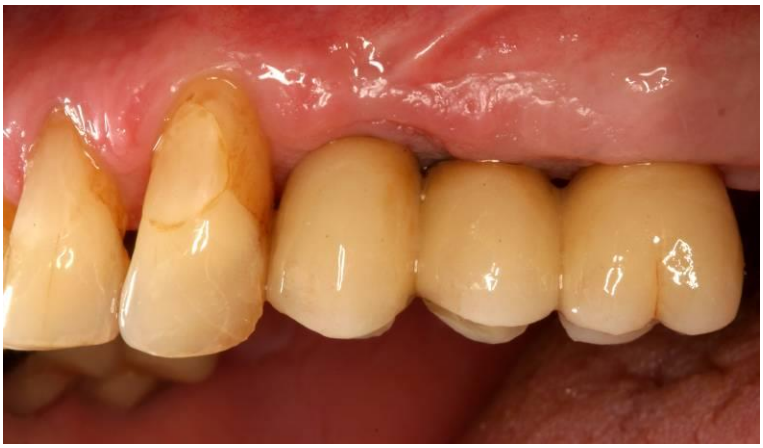

Figure 3A

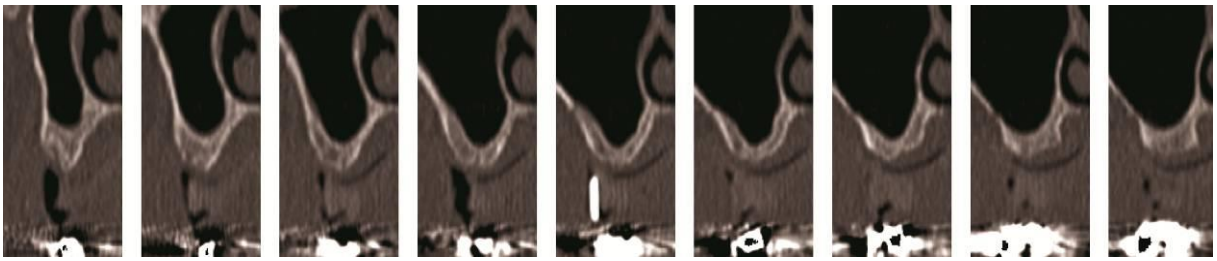

Figure 3B

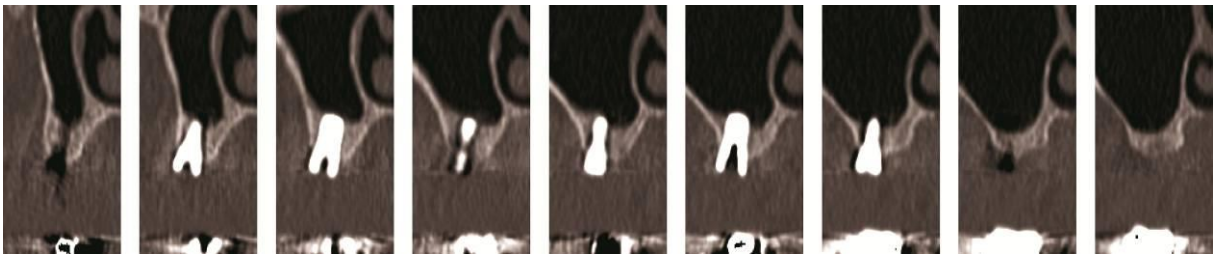

Figure 4A

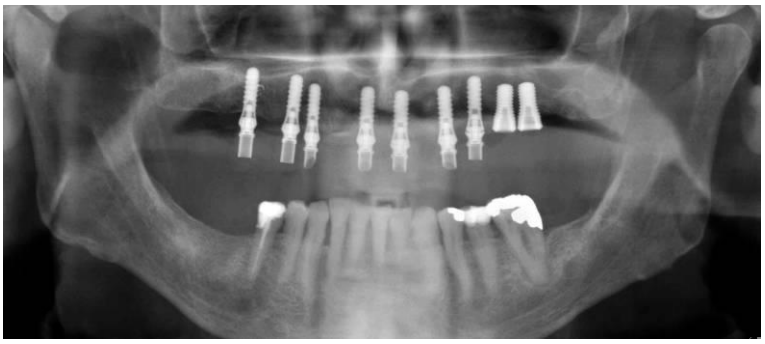

Figure 4B