A new crestal approach for sinus floor elevation: Case reports

Introduction

The posterior maxilla often presents specific problems for placement of dental implants. Frequently poor bone quality with inadequate bone volume has rendered long-term success rates for implants. To overcome this situation, usually sinus floor elevation was carried out through the lateral approach technique or crestal approach, so called, osteotome method. The osteotome technique, first described in 1994, has been known for the primary advantage of being less invasive than lateral window approach. However, osteotome technique comes with the magnitude of forces and the amount of heat. This malleting osteotome technique has several post operative complications such as unpleasant discomfort and inner auditory organ damage once in a while. Also the possibility of damage on the sinus membrane still remains.

This report introduced a new sinus floor elevation technique in which only the inferior cortical wall underneath the sinus would be perforated without tearing of sinus membrane by drilling instead of malleting using a rotary instrument, called S-reamer. S-reamer (Neobiotec Co., Korea) used in this report was designed to remove the bone beneath sinus floor without tearing any sinus membrane (Fig. 1A). The head of the reamer was designed like letter ‘S’ to prevent tearing of membrane by keeping the bone chip in the bone reservoir of the reamer head to make the head surface smooth (Fig. 1B). The image of S-reamer was captured from the movie when it was drilling on the sinus wall of pig (Fig. 2). It revealed that moving drill did not tear the sinus membrane even it was pushing over the border of inner sinus wall. This technique would be a minimal invasive sinus floor elevation procedure and an effective way to achieve sinus inferior cortical fixation for this reason.

Case reports

Total ten patients were included for this report. Two of them were treated at a private dental clinic (Seoul, Korea). The others visited at Seoul National University Bundang Hospital. Crestal sinus lifting procedures using S-reamer and implant installation were performed in each of the patients.

Case 1

A 63-year old female patient complained difficulty of chewing due to missing teeth on left posterior area. Conventional oral examination was performed. Panorama radiographic image showed that residual bone height was not enough for conventional implant placement.
Initially 8.2 and 6.4 mm alveolar bone existed below the sinus floor respectively (Fig. 3A). To overcome insufficient alveolar bone for implant placement, sinus lift was assessed. Drilling was performed 1 mm shorter than the existing bone length. Then, a certain diameter of the S-reamers matched to the diameter of an implant placed was chosen and a stopper 1 mm longer than the existing bone was connected and drilled with 800-1200 rpm until the stopper toughed on the alveolar crest (Fig. 3C).

Changing 1 mm shorter stopper, drilling on the sinus inferior cortical bone was repeated until the cortical wall was perforated (Fig. 3B and C). This osteotome technique was accurately planned and measured because implant bed was prepared by only drilling not compressive malleting. To check any perforation of the cortical wall, a depth gauge was inserted carefully and measured the remnant bone height precisely (Fig. 3D).

Any perforation of sinus membrane should be recognized by blurring test. In this case Schneiderian membrane was not torn even if the spinning S-reamer contacted to the membrane. It may be due to the smooth surface of the S-reamer in which bone chips were supposed to remain in the reservoir of the head of the reamer.

After verifying the membrane was not perforated, a synthetic bone graft material was used such as CalPore® (βTCP 60% + HA 40%) in this case. 0.2-0.3 cc of bone particles were pushed inside using a condenser until reached to enough height (Fig. 3E). At this moment a bone spreader was applied in order to spread graft material into the sinus cavity properly below the Schneiderian membrane (Fig. 3F). Spreading was repeated after adding bone. When the bone grafting was performed, two 5x11.5 mm implants (SinusQuick®, Neobiotech Co., Korea) were placed without bone graft. Implants were inserted into the sinus up to 1-1.5 mm and all implants earned initial stability ranging approximately 35-45Ncm. Left side was treated with conventional lateral window approach. Four 4x13 mm implants were placed simultaneously. Post-operation panorama view was taken (Fig. 4B). Restoration was finished at fourteen days after implant installation (Fig. 4C). No complications have been reported.

Besides these two cases, eight patients had implant surgery with sinus lift procedure using S-reamer simultaneously at Seoul National University Bundang Hospital. Fourteen implants were placed with help of S-reamer in order to increase apico-occlusal bone dimension (Table 1). Four implants did not require additional bone support. Approximately initial remained bone level were various from 4.4 to 10 mm. As a result, 8 mm to 12 mm length of implants were installed according to site preparation including internal sinus augmentation. One of the post-operative radiographic image demonstrated that about 3-3.5 mm grafted material was detected on the apex of implant fixture (Fig. 5A and B). There were no post operative complications reported.

**Discussion**

Implant insertion in the posterior region of the maxilla is a challenging procedure. The reduced bone quantity and low bone quality are limiting factors. Although Summer’s osteotome method is considered less
invasive than lateral window approach, post-operative problems was existed once in a while. Besides simple complications, a recent report mentioned that it had been associated with the provocation of benign paroxysmal positional vertigo (BPPV). These authors also warned that the trauma induced by percussion with surgical hammer, along with hypertension of neck during operation, could displace otoliths by BPPV.

In 2006 Ferrigno et al., pointed that from the patient aspect, implant site preparation is more comfortable when performed with spiral drills than with continuous malleting. This kind of opinions has been supported by other studies. For instance, Fugazzotto described the use of a calibrated trephine bur in the first step in the procedure, mentioning that this method is less traumatic and disconcerting to the patient compared to repeated malleting.

On the other hand, summer’s osteotome technique may not achieve inferior cortical fixation from inferior border of sinus floor because it breaks the cortical bone broadly. Compared with malleting method, this osteotome technique can mostly obtain true meaning of inferior cortical fixation by preparing proper size of hole matching to the size of an implant placed. Taken into another concern, Strietzel et al., mentioned that indication for the use of osteotome technique should be considered critically with respect to the bone quality: bone quality class 1 or 2 is not suitable for this kind of implant bed preparation via compressive packing method.

In 2003, Wallace and Froum published a review article on implant survival rate related to sinus augmentation. They proposed a 93.5% overall survival rate of implants with conventional Osteotome techniques. Interestingly it was noted that the higher survival rate of localized management of sinus floor and crestal core elevation which was 96.9% and 98.3% respectively.

According to recent meta-analysis for survival rate of implant with osteotome technique, the combined data revealed survival probability of 98% until loading and 99% after 56 month of loading. Other systemic review and meta-analysis study reported that the outcome of dental implantation using the osteotome technique in terms of implant survival seems to be similar to that of implants placed by means of the conventional implantation technique. It concluded that survival and success rate were 95.7% and 96% after 24months and 36 month respectively.

Conclusion

This report showed that implant placement following drilling osteotome technique was less invasive than conventional malleting osteotome. The prognosis of implant using drilling osteotome technique is estimated to be at least as same as the published data of implants placed by conventional malleting osteotome method. The newly designed "S- Reamer osteotome technique" can be used as a predictable alternative treatment modality as compared with "malleting osteotome technique" as well as external lateral window technique.

References

6. Fugazzotto PA et al. Sinus Floor augmentation at the time of maxillary molar extraction : Success and failure rates of 137 implants in function for up to 3 years. J Periodontol 2002; 73: 39-44.
9. Shalabi MM et al. A meta-analysis of clinical studies to estimate the 4.5-year survival rate of implants placed...


Table 1

<table>
<thead>
<tr>
<th>case</th>
<th>Age/sex</th>
<th>Site (Rt/Lt)</th>
<th>Site</th>
<th>Residual bone level#</th>
<th>S-reamer Yes/No</th>
<th>Implant-type, Implant length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26/F</td>
<td>Lt</td>
<td>1st PM</td>
<td>9mm</td>
<td>Yes</td>
<td>Implantium†, 10mm</td>
</tr>
<tr>
<td>2</td>
<td>54/M</td>
<td>Rt</td>
<td>2nd PM</td>
<td>9.6mm</td>
<td>Yes</td>
<td>Implantium, 12mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1st M</td>
<td>10mm</td>
<td>Yes</td>
<td>Implantium, 12mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1st M</td>
<td>8mm</td>
<td>Yes</td>
<td>Implantium, 12mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lt</td>
<td>2nd M</td>
<td>Yes</td>
<td>Implantium, 12mm</td>
</tr>
<tr>
<td>3</td>
<td>47/M</td>
<td>Lt</td>
<td>1st M</td>
<td>4.5mm</td>
<td>Yes</td>
<td>Osstem GS§, 10mm</td>
</tr>
<tr>
<td>4</td>
<td>56/M</td>
<td>Lt</td>
<td>1st PM</td>
<td>9mm</td>
<td>Yes</td>
<td>Implantium, 10mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1st M</td>
<td>6mm</td>
<td>Yes</td>
<td>Implantium, 8mm</td>
</tr>
<tr>
<td>5</td>
<td>58/M</td>
<td>Lt</td>
<td>2nd PM</td>
<td>9.5mm</td>
<td>Yes</td>
<td>Implantium, 10mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1st M</td>
<td>6mm</td>
<td>Yes</td>
<td>Implantium, 10mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2nd M</td>
<td>6mm</td>
<td>Yes</td>
<td>Implantium, 8mm</td>
</tr>
<tr>
<td>6</td>
<td>57/M</td>
<td>Lt</td>
<td>2nd PM</td>
<td>9.5mm</td>
<td>Yes</td>
<td>Osstem GS, 11.5mm</td>
</tr>
<tr>
<td>7</td>
<td>46/F</td>
<td>Rt</td>
<td>1st M</td>
<td>6mm</td>
<td>Yes</td>
<td>Tiunite¶, 10mm</td>
</tr>
<tr>
<td>8</td>
<td>44/M</td>
<td>Lt</td>
<td>1st M</td>
<td>4.4mm</td>
<td>Yes</td>
<td>Implantium, 8mm</td>
</tr>
</tbody>
</table>

# Approximate value based on panoramic radiographic image
† implantium®, Dentium, Seoul, Korea
§ Osstem GS®, Osstem Implant system, Seoul, Korea
¶ Tiunite®, Nobel Biocare, Gothenburg, Sweden.

Fig. 1. A. and B. S-reamer tip was designed like letter 'S' to protect tearing of membrane through keeping bone chip around tip while spinning.
Fig. 2. It reveled that moving drill did not tear the sinus membrane even it was pushing over the border of inner sinus wall.

Fig. 3. A. 63-year old female patient. Preoperative radiographic image explained that 8.2mm and 6.4mm of apico-occlusal dimension of alveolar bone was remained at left first and secondary axillary molar respectively.

Fig. 3. B and C. Drilling was performed until stopper touched the alveolar bone crest. Changing shorter stopper, drilling on the crestal bone underneath of sinus floor was repeated.

Fig. 3. C.

Fig. 3. D. To check any perforation, Depth gauge was inserted carefully and measured the remnant bone height precisely.

Fig. 3. E. A condenser was used connecting with stopper until reached to enough height.
Fig. 4. A. A 46 year old male patient visited at a private dental clinic. His chief problem was pain on right upper side previously. Right first premolar had an abscess which was extracted. Subsequently radiographic image was obtained which revealed that he lost all premolar and molar on both side of upper jaw.

Fig. 4. B. 10mm, 7mm, 7mm and 8.5mm length implant were chosen from right first premolar to secondary molar. Alveolar bone defect was grafted with synthetic bone material on distal of right first premolar. Left side was finished with conventional lateral approach sinus lift and all 13mm implant installation.

Fig. 4. C. Final restoration was delivered at two weeks after surgery.

Fig. 3. F. A bone spreader was applied in order to spread graft material into the sinus cavity properly below the Schneiderian membrane.

Fig. 3. G. Three days after surgery, post-operation CT scan and panorama was taken. In the Panoramic view of CT scan, adequate amount of bone was filled around fixtures.

Fig. 3. H. In one month after surgery, final prosthesis was delivered since it was regarded as initial stability was achieved for immediate loading.
Fig. 5. A and B. One of the post-operative radiographic image demonstrated that about 3–3.5mm grafted material was detected on the apex of implant fixture. Radio-opaque bone graft material was Osteon® (Dentium, Korea).

Fig. 6. A and B. Summer’s osteotome technique can not achieve a bi-cortification from inferior border of sinus floor because inner cortical lining bone was broken broadly. Compared with malleting method, this drilling osteotome acquired true meaning of bi-cortification.