A novel biological approach to minimize the invasiveness of sinus lift therapy

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This article presents the biological rationale for a novel one-visit sinus lift procedure using a 6.5 mm wide implant specifically designed for sinus elevation and achieving primary stability with minimal bone anchorage.

INTRODUCTION

Sinus lift is a surgical procedure that aims at increasing the amount of bone in the upper jaw to better support dental implants. The sinus is entered either through a lateral window or through the implant osteotomy and the Schneiderian membrane, that lines the maxillary sinus, is lifted to create a space that is filled with bone grafting material to form new bone.

Twenty years ago, a sinus lift was anything but non-invasive: Large lateral windows (typically 14 x 8 mm) were opened for access to the sinus. Regular platform implants Ø4 x 13 mm or Ø4 x 15 mm were used, and therefore sinus lifts of 15 mm or more were needed to accommodate the long implants. A wide range of grafting materials were used, ranging from alloplasts to xenografts and not always with the proper regeneration properties.

This invasive protocol mandated a staged approach that required long treatment times, often more than a year (Figure 1).

Over the years, technical advances have led to less invasive surgery. The advent of piezo surgery and sonic instruments have made the lateral window approach more predictable and resulted in fewer perforations of the Schneiderian membrane.¹,² More recently, specialized drills for the preparation of small lateral windows (5-6 mm in diameter) and drills with blunt tips for secure crestal approach procedures, as well as computer controlled pump systems to inflate the sinus with water pressure, have minimized the invasiveness of the procedure even more.

The advances in technology has made it possible to rethink the sinus lift procedure and combine good therapies and biological knowledge into a procedure with reduced treatment time and improved patient comfort without jeopardizing the clinical outcome.

Figure 1: Treatment steps and total treatment time of a staged sinus lift approach compared to the one-visit sinus lift approach.
Four main parameters can be altered to improve the healing rate:

- Window size
- Bone graft material
- GBR membrane
- Implant design

By optimizing these four parameters it is possible to safely go from the one year treatment using the staged approach to a procedure where tooth extraction, sinus lift, implant placement and placement of the healing abutment are done in one single visit, and where the healing time is reduced to 3-4 months (Figure 1).

Let us take a closer look at these four parameters:

**WINDOW SIZE**

The lateral window should be kept as small as possible. Minimizing the size of the lateral window has many benefits: The grafted site gets more stability from the surrounding walls; there is more bone left in place from where the bone formation can start; and the window itself heals faster.

Using a specialized drill kit (Sinus Lateral Approach Kit, Neobiotech, South Korea) a small window (Ø5-6 mm) can be made. Using this technique, the window area size is more than 5 times smaller than with the traditional approach (Figure 2).

If there is enough residual bone height, a crestal approach can be utilized. This makes the procedure even less invasive since there is no need for a lateral window.

**BONE GRAFT MATERIAL**

The bone grafting material should work hand in hand with the implant surface and the host bone during the healing process. In addition, it should be dimensionally stable and regenerated to vital bone within 3-4 months.

A cancellous particulate allograft with a particle size of 1-2 mm consisting of bone minerals and type 1 collagen (Puros Allograft Particulate, Zimmer Biomet, Palm Beach Gardens, FL, USA) has these desired properties: It maintains volume, and shows low levels (< 8%) of residual particles after 5-6 months in sinus lift procedures.

**GBR MEMBRANE**

It has been shown that covering the lateral window with a membrane increases the treatment success and vital bone formation compared to uncovered windows. Therefore, it is advisable to always cover the lateral window.

A resorbable membrane should be used to cover the Schneiderian membrane if the sinus is accidentally perforated or if the Schneiderian membrane is very thin (<0.3 mm).

**IMPLANT DESIGN**

Bone healing in the sinus has a rate of approximately 1 mm per month from the sinus walls to the implant. A distance of 6 mm from bone to implant therefore takes around 6 months to heal, whereas a 3 mm augmentation heals in approximately 3 months. By utilizing a wider implant it is possible to “bring the implant closer to the bone” and achieve faster bone healing.

In 2012, a collaboration with Neoss started to design a wider implant for the sinus.
Since 1996, computed tomography (CT) has been a routine tool in sinus augmentation treatment in our clinic. A sample of 100 sinus CT scans were examined to establish the average dimensions of the sinus. The width of the sinus was measured at different heights (7, 9 and 11 mm) from the crestal plane (Figure 3).

In the region of the first and second molar there is an average of 15 mm width at a height of 11 mm, and an average of 13 mm width at a height of 9 mm (Table 1). To achieve a distance between implant and sinus wall of about 3-4 mm, an implant diameter of 6.5 mm is a good size.

![Figure 3: CBCT scan analysis of sinus dimensions. Sinus width was measured 7, 9 and 11 mm above the bone crest.](image)

**Table 1:** Average sinus dimensions (n=100).

<table>
<thead>
<tr>
<th>Sinus width</th>
<th>Second premolar</th>
<th>First molar</th>
<th>Second molar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 mm</td>
<td>11.6 ± 3.1 mm</td>
<td>15.6 ± 1.4 mm</td>
<td>15.1 ± 1.8 mm</td>
</tr>
<tr>
<td>9 mm</td>
<td>9.6 ± 2.7 mm</td>
<td>13.8 ± 1.3 mm</td>
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</tr>
<tr>
<td>7 mm</td>
<td>8.0 ± 2.4 mm</td>
<td>10.7 ± 1.4 mm</td>
<td>10.0 ± 1.2 mm</td>
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</table>

**Implant length**

The stability of an implant is correlated to the bone-to-implant contact (BIC), and the BIC is directly proportional to the implant surface area. As seen in Table 2, the implant surface area of a regular 4.0 x 15 mm is 253 mm². When using a wide 6.5 mm diameter implant the same surface area (256mm²) is achieved with a 9 mm implant. Hence, by using a wider implant less bone height is needed, which in turn means that there is no need to perform a big sinus lift to get a better bone-to-implant contact.

**Design features**

High primary stability is essential when aiming to minimize the healing time. The Ø6.5 mm Neoss implant has the ability to achieve high stability in very little bone, through its unique collar design. The collar is conical, the threads are slightly more aggressive and extend up on the collar closer to the implant platform. This combination creates a threaded wedge that is engaging even when the available bone height is very limited.

The implant also has a rounded apex to minimize sharp edges that could tear the Schneiderian membrane during insertion and healing.

**CONCLUSIONS**

By combining the technical and scientifical advances that has been made over the last decades, a sinus lift procedure has been developed where tooth extraction, sinus lift, implant placement and abutment connection are done in one visit. By utilizing a wide (Ø6.5mm) implant specifically designed to achieve high stability in very limited bone, the healing time is minimized and the definitive restoration can be placed within 3-4 months. The concept is summarized in Figure 4.

![Figure 4: Factors influencing healing time. (A) Small lateral window for faster healing. (B) Cover window with membrane. (C) If the Schneiderian membrane is perforated or very thin, cover with GBR membrane. (D) Allograft material. (E) Wide implant body minimizes graft width. (F) Highly engaging collar design. (G) Rounded apex.](image)
Deciding what sinus lift approach to use

When is it safe to go for a crestal approach, when should a lateral window be opened, and in which cases should a staged approach be chosen? The height of the residual bone is the deciding factor. A decision flowchart is shown in Figure 5.

Figure 5: Decision tree for choosing the appropriate surgical method based on residual bone height.

REFERENCES


