A Less-Invasive Window Design for Lateral Wall Maxillary Sinus Augmentations

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The purpose of this article is to compare the larger (8 × 10-mm single implant and 15 × 20-mm multiple implant) lateral window designs used in the sinus elevation procedure with a newly proposed, less-invasive window design and discuss the advantages and limitations of the new design. The less-invasive window designs differ from the larger window designs in both the size and shape of lateral windows. Following creation of a round-window osteotomy, the quality of the sinus membrane and its ability to be elevated are assessed. The initial window can then be enlarged as a vertical oval window for a single implant or a horizontal oval window for multiple implants. The advantages of these window designs include the preservation of the lateral walls, blood supply to bone grafts, and better containment of the graft material. The limitations of these window designs are decreased visibility, accessibility for correcting a membrane perforation, and access for draining a sinus infection if one occurs. These complications necessitate increasing the size of the window as needed for successful treatment. The proposed less-invasive window design provides distinct advantages for a successful sinus elevation procedure and decreased patient morbidity.


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Windows started approximately 3 to 4 mm coronal to the floor of the sinus and extended vertically, apical to the desired height of the implants planned for placement. Horizontally, the windows extended posteriorly from the anterior border of the sinus to the mesial surface of the second molar. The window was designed to provide maximum accessibility to the sinus.7

Maxillary sinus window design is an important factor in preventing and managing maxillary sinus elevation complications (such as sinus membrane perforations and bleeding), avoiding the sinus septum, and providing lateral support for the graft material. The purpose of this article is to compare the larger lateral window design with a proposed less-invasive window design (LIWD) and discuss the advantages and limitations of the new design.

Less-Invasive Window Design

The LIWD varies depending on the number of implants (single or multiple) planned for placement in the augmented sinus. In both cases, prior to creating an LIWD, a trapezoid-shaped full-thickness mucoperiosteal flap is reflected. Soft tissue crestal incisions are made toward the palatal half of the ridge, with oblique vertical releasing incisions extending from the distal line angle of the adjacent mesial tooth and from the mesial line angle of the adjacent distal tooth to the mucogingival junction. These incisions are designed to increase access to the maxillary sinus lateral wall. A full-thickness flap is then reflected to expose the lateral wall of the maxillary sinus. The lateral window osteotomy is initiated at the superior border of the desired window. The superior border of the lateral window should be at the level or slightly above the apex of the desired length of the implants to be placed. A high-speed handpiece with copious irrigation is used with a long-shank fine round size #6 or #8 diamond bur. The bone is cut with light pressure and small strokes to create a round initial window (Fig 2). After the initial round window is made, the quality of the sinus membrane and its ability to be elevated are assessed (Fig 3). Elevation of the sinus membrane begins at the apical border of the window and continues until the sinus membrane is freed at all borders of the initial window. If necessary, the window can be extended for membrane elevation and creating the graft space required for an LIWD with a single implant (Figs 4 to 6) or multiple implants (Figs 7 to 9).

Single-Implant LIWD

The LIWD for single implants is designed as a vertically oriented 4 × 8-mm ovate window. After the initial window is created, the sinus membrane is elevated at the apical border of the window and extended by
also elevating around the borders. A high-speed handpiece with copious irrigation and a fine, long-shank, round diamond bur (size #6 or #8) is again used to extend the window coronally, starting 2 mm apical to the sinus floor. For single implants, minimal extension of the mesial and distal borders of the window support the bone graft and protect the roots of the adjacent teeth. Any required apical and coronal extension of the lateral window allows for additional accessibility and visibility of the sinus elevation (Figs 4 to 10).

Multiple Implants LIWD

The LIWD for multiple implants is designed as a horizontally oriented 5 × 10-mm window (Fig 11). Following creation of the initial window, the sinus membrane is elevated from the apical border of the window and further raised by elevating around all borders. A high-speed handpiece using copious irrigation and a fine, long-shank, round diamond bur (size #6 or #8) is used to extend the window posteriorly to the planned distal implant-recipient site. Extension of the lateral window mesially and distally provides the maximum visibility and accessibility for sinus membrane elevation and bone grafting. In addition, preservation of the window’s apical aspect of the lateral wall provides support for the bone graft; the apical aspect should be made 2 mm coronal to the most apical sinus area.

Following creation of the window, sinus elevator instruments are used to raise the sinus membrane from the anterior, inferior, medial,
Fig 6 Preoperative radiograph showing the missing maxillary first molar.

Fig 7 Radiograph of simultaneous implant placement with maxillary sinus graft.

Fig 8 Occlusal view of the single implant and cover screw.

Fig 9 Radiograph of the final implant and restored crown placed with LIWD.

Fig 10 Final crown on the single implant.

Fig 11 LIWD for placing multiple implants.
and posterior walls. This membrane elevation forms the space into which the bone graft is placed. The space is filled with autogenous, allogenic, or xenogeneic bone graft materials as preferred by the surgeon. Maintaining the lateral wall with LIWD provides lateral support and improved containment of graft materials. Because of the smaller window and lateral wall preservation, a membrane is not required for containment or regenerative potential (Fig 12).

The differences between larger windows and the LIWD include window size, preservation of the lateral walls, blood supply to bone grafts, containment of the graft material, visibility, accessibility for repairing membrane perforations, and the ability to drain a sinus infection if needed (Table 1).

**Discussion**

The main goal of the sinus augmentation procedure is to maintain a healing space within the sinus cavity, thus forming new bone, increasing bone volume, and allowing placement of a well-positioned dental implant. The LIWD with greater lateral wall offers support and stability for the bone graft inside the maxillary sinus and also provides a source of bone cells to surround the bone graft particles, thereby improving the amount of regenerated vital bone formed. Comparisons between LIWD and larger window designs are shown in Table 1.

The LIWD requires smaller flap incision and reflection, thereby reducing trauma and patient discomfort following the sinus augmentation procedure. Recently a retrospective study was conducted of lateral window size in sinus augmentation procedures in 49 patients (25 in the test group and 24 in the control group), based on the vertical height of the lateral window. Patients in the test group had a vertical window height of 3 to 5 mm whereas those in the control group had a height of 6 to 8 mm; it was concluded that the LIWD was as...
clinically successful as the large window in achieving augmented graft height. In addition, reducing the size of the lateral window decreases the potential of graft particles to migrate out of the maxillary sinus; migration of the bone graft particles into the soft tissue can cause discomfort, tissue inflammation, or formation of bone exostosis. These exostoses can be a source of irritation to the soft tissue and may require additional surgical debridement or bone reduction surgery. An increase in intrasinus pressure, which may be caused by postoperative inflammation or bleeding from within the sinus, can result in loss of graft material and its migration through the window. This is likely to occur if a membrane was not placed over the window or if the membrane was not properly stabilized. The displaced graft material is likely to cause an elevation in the buccal mucosa. The LIWD can reduce bone graft migration and the need for window coverage (via membrane) to contain the graft. Covering the lateral sinus window with a barrier membrane has been shown to have a low significant impact on the quantity or quality of new bone formation within the sinus.

Adequate elevation of the sinus membrane creates the space for bone to regenerate and allows dental implant placement in an ideal position. Successful elevation of the sinus membrane exposes the sinus walls, which supply blood and help provide more vital bone. Incomplete elevation of the maxillary sinus membrane, especially from the medial wall, is a common mistake during sinus augmentation, and partial elevation of the sinus membrane may lead to incomplete bone formation around the dental implant. However, the smaller opening of LIWD lateral window may limit the accessibility for complete elevation of the sinus membrane. Using instruments with smaller head sizes or increasing the size of the lateral window creates greater access to the sinus cavity, which increases the success of the procedure, avoids incomplete sinus grafting, and reduces the procedure complications.

Sinus membrane perforation has been reported as the most common complication of the sinus elevation procedure. The literature reports a 10% to 50% prevalence of membrane perforation. Sinus membrane perforation was assumed to be a detrimental factor for graft and implant survival rate: The sinus graft failure rate was reported to increase to 11.3% for those with perforated sinus

Fig 13 LIWD with sinus perforation.

Fig 14 Increased LIWD size to allow access for treating the membrane perforation.
membranes compared to 3.4% for nonperforated membranes. A sinus membrane perforation of more than 5 to 10 mm in diameter was shown to cause a significant reduction (91.89%) in the survival rate of the implants placed. In addition, a membrane perforated more than 10 mm was reported to reduce the survival rate of the implants placed to 74.14%. Creating a large window was assumed to be an advantage in preventing and managing these complications by improving visibility and accessibility to the membrane-perforated area and sinus cavity. However, in 2018, a retrospective study comparing the clinical survival rate, mobility, radiographic changes, and histomorphometric appearance of the bone placed in sinuses with perforated and non-perforated membranes reported that there were no significant differences between implant survival rates. In addition, sinus elevations with perforated sinus membranes showed no impact on the success of the procedure or the type of bone generated within the maxillary sinus. Moreover, the LIWD window can be increased in size to improve the accessibility if necessary in cases of sinus membrane perforation repair (Figs 13 and 14).

Large lateral sinus windows facilitate the accessibility of the sinus for draining and removal of any infected graft, if present. However, as discussed previously, the LIWD window can be modified and enlarged for additional accessibility in cases of managing inter- or postoperative complications.

Conclusions

Advantages of the LIWD are the preservation of lateral walls, improved blood supply to bone grafts, and better containment of the graft material. However, visibility, accessibility when repairing a membrane perforation, and the ability to drain a sinus infection if present may require increasing the LIWD size as needed to treat these complications. If the proper protocol is followed with the LIWDs described herein, these adjustments can be easily done and still retain most of the lateral wall.

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References