LATERAL AND CRESTAL BONE PLANING ANTROSTOMY: A SIMPLIFIED SURGICAL PROCEDURE TO REDUCE THE INCIDENCE OF MEMBRANE PERFORATION DURING MAXILLARY SINUS AUGMENTATION PROCEDURES

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This clinical report presents a simplified surgical procedure for accessing the maxillary sinus antrum via lateral and crestal approaches, which reduces the potential for sinus membrane perforation and subsequent complications when graft materials and dental implants are placed into the sinus. Due to visual limitations, perforations and associated complications can jeopardize the success rate of the graft and the implants. While there is a lack of clinical data, clinical observations suggest that the procedure, described by the authors as lateral/crestal bone planing antrostomy, can reduce the possibility of perforation of the maxillary sinus membrane during the lateral and crestal approaches to the grafting of the maxillary sinus floor. The technique involves the use of specially designed rotary instruments that plane away the bone in thinner layers, with less chance of excess bone removal and membrane perforation. (J Prosthodont Dent 2011;105:147-153)

Maxillary sinus floor elevation is a reconstructive procedure that augments a deficient posterior maxilla when pneumatization of the maxillary sinus is present, allowing dental implants to be placed that support single crowns or a fixed prosthesis. The conventional technique for maxillary sinus elevation involves surgical access through the lateral wall of the zygomatic buttress of the maxilla, followed by elevation of the sinus membrane and placement of a bone graft material. This technique, first described by Tatum in 1976, and first published by Boyne and James in 1980,1,2 is also referred to as the lateral approach to the maxillary sinus floor. This surgical procedure, which uses various graft materials, has been evaluated by several authors.3-8 In a recent systematic review of published randomized controlled trials of different maxillary sinus augmentation techniques and materials, the authors concluded that bone substitutes were as effective as autogenous bone for augmenting the maxillary sinus.4

While sinus grafting is considered to be a relatively invasive technique, a low incidence of surgical and postsurgical complications has been reported.9,10 The most common surgical complication is perforation of the sinus membrane,9,14 which occurs in 7 to 10% of the procedures, but has been reported to occur in as many as 35% of procedures.10,13,15-17 Membrane perforations, as described in the literature, are associated with postoperative complications, which include acute or chronic sinus infection, bacterial invasion, swelling, bleeding, wound dehiscence, loss of the graft material, and a disruption of normal physiological sinus function.10,13,16,18-20

Various surgical modalities have been used to reduce trauma and membrane perforation when performing maxillary sinus graft procedures. Barone et al21 analyzed the surgical access to the maxillary sinus, osteotomy, and sinus membrane elevation by comparing 2 treatment procedures, one involving the use of a piezoelectric device and the other using conventional instruments. No significant differences were recorded between the 2 treatments in any of the investigated clinical parameters. Interestingly, some authors have not reported any correlation between membrane perforations and implant survival,9,10,13,16,22-24 while others12-15 have reported a correlation between implant failure and sinus membrane perforation.

A less invasive procedure for sinus membrane elevation along with immediate dental implant placement was introduced by Summers.25 This procedure is indicated when the residual amount of alveolar bone is between 4 and 8 mm below the sinus floor. The sinus membrane is elevated with osteotomes from a crestal approach through the osteotomy prepared for dental implant placement, without the need for a lateral window.7

A recent systematic review4 concluded that a 3- to 6-mm residual alveolar bone height combined with a crestal lift approach and placement of 8-mm implants may result in fewer

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complications than a lateral window approach to place 10-mm implants. However, the authors cautioned that these conclusions were based on a small number of trials with short follow-up periods and a high risk of bias. Furthermore, the ostetome/crestal sinus membrane elevation (OCSME) is a visually restrictive procedure used to access the maxillary sinus floor and, therefore, is a technique-sensitive procedure with inherent difficulty, especially when direct visual examination of the maxillary sinus membrane is required. Despite widespread clinical application of this procedure, and the advent of multiple surgical variations of the technique, few studies have reported incidence of sinus membrane perforations when the OCSME technique is used.

Grafting the cavity and subsequent placement of implants is an alternative to the conventional approach of accessing the maxillary sinus, and is described by the authors as lateral bone planing antrostomy. The technique gradually eliminates the bone from the lateral aspect of the maxillary sinus during the lateral approach to the antrum, and in a single implant osteotomy site during the crestal approach to the sinus. This technique has the potential of minimizing the rate of sinus membrane perforation during surgery. This clinical report describes the use of specially designed surgical drills and curettes to access the maxillary sinus cavity via lateral and crestal approaches for maxillary sinus grafting in the treatment of 2 patients.

CLINICAL REPORTS

Patient 1

A 68-year-old, healthy, nonsmoking woman presented to the Center for Implant Dentistry at the Loma Linda University School of Dentistry for the treatment of a completely edentulous maxilla with dental implants. Following clinical examination, the patient was presented with a treatment plan that included bilateral grafting of both maxillary sinuses via a lateral approach and the placement of dental implants. The implants were to be placed 8 months after grafting to support and retain a fixed maxillary complete denture. After thorough discussion of the treatment plan, the patient consented to have the maxillary sinuses grafted as proposed. The patient was presented with both the option of a fixed maxillary complete denture and a maxillary implant-retained overdenture. The patient selected the fixed option.

A careful analysis of cone-beam computerized tomography (CBCT) images was performed to determine the precise location in which to execute the lateral approach to the maxillary sinus cavity (Fig. 1). After local anesthesia was administered bilaterally in the maxilla, the patient was prepared for a full-thickness flap reflection and exposure of the lateral aspect of the maxillary sinus bilaterally.

A series of specially designed surgical drills and curettes (DASK Advanced Sinus Kit; Dentium, Seoul, Korea) that can be used to displace the maxillary sinus floor from the lateral and crestal approaches was used to prepare the area for maxillary sinus grafting. For the lateral approach to the maxillary sinus, a dome-shaped drill (6 mm in diameter x 4 mm in height) was used to prepare the lateral wall of the maxillary sinus. The drill uses internal and external irrigation for cooling at a speed of 800-1200 rpm (Fig. 2). Bone thinning was accomplished using light pressure and rotating strokes under copious irrigation on the lateral aspect of the sinus wall to gradually eliminate the bony thickness until the maxillary sinus.
membrane was identified by a bluish hue appearing through the thin bone (Fig. 3). This phase of the maxillary sinus graft surgical procedure is described by the authors as lateral bone planing antrostomy (LBPA). The area where access to the maxillary sinus cavity was to occur was expanded to reach a dimension of approximately 20 mm in length and 10 mm in height.

The bone was thinned and made flexible by a gradual planing process, so that it could be easily displaced inward along with the membrane (Fig. 4). The sinus membrane was then carefully elevated from the sinus floor using the specially designed curettes (DASK Advanced Sinus Kit; Dentium). The curettes were used to detach the membrane from the anterior, inferior, and medial walls of the maxillary sinus cavity (Fig. 5). Upon confirmation of an intact sinus membrane and sufficient superior displacement, the sinus cavity was then grafted with 2 cc of 1.0- to 2.0-mm particles of hydroxyapatite (HA) coated with beta-
tricalcium phosphate (TCP) (Osteon; Dentium) (Fig. 6). The mucoperiosteal flap was then repositioned and sutured with continuous horizontal mattress sutures and single interrupted ties (GORE-TEX suture; W.L. Gore & Associates, Inc, Flagstaff, Ariz).

The same procedure was accomplished for the opposite side, maintaining the integrity of the maxillary sinus membrane. A postoperative CBCT was made to evaluate the volume of graft material placed in the sinus floor (Fig. 7). Postoperative medications consisting of 500 mg amoxicillin 3 times per day for 1 week, or 300 mg clindamycin 4 times per day for 1 week, were prescribed for the patient. The patient was seen 2 weeks after the surgery for suture removal, and no complications were noted. The patient indicated that there was minimal discomfort and swelling after the surgery.

Patient 2

A healthy, 52-year-old nonsmoking man presented for treatment of a single edentulous area of the left maxillary first molar. The clinical and radiographic examination showed partial pneumatization of the maxillary sinus in that area. Based on measurements made from digital periapical radiographs and a CBCT analysis, 7 mm of bone was present below the maxillary sinus floor (Fig. 8). The patient was presented with a treatment plan that included a crestal approach to the maxillary sinus floor and lifting of the membrane for the simultaneous placement of graft material and a dental implant. The site would then be allowed to heal for 6 months after surgery. The patient consented to the treatment as presented.

Local anesthesia was administered and the site was prepared for a crestal approach to the sinus cavity. Using a midcrestal incision, a mucoperiosteal flap was elevated, exposing the crest of the ridge. In anticipation of the surgery, the radiographic images were evaluated, and a decision was made to place a dental implant with dimensions of 5 mm in diameter by 12 mm in length (Dentium, Seoul, Korea); this procedure would be performed simultaneously with an osteotome sinus membrane elevation. Following the recommended drilling sequence, the site was prepared 1 mm short of the existing floor of the maxillary sinus. A 3.3-mm-diameter, dome-shaped crestal approach drill (Dentium) was used to eliminate the remaining bone below the sinus floor (Fig. 9). The drill was used at a speed of 800 rpm with a copious amount of internal irrigation (Fig. 10). Using minimal pressure to guide the drill apically, the sinus floor was accessed, thus permitting the use of specially designed crestal sinus curettes (Dentium) to complete the displacement of the maxillary sinus membrane through the osteotomy site (Fig. 11).

The Valsalva maneuver confirmed the intact condition of the maxillary sinus membrane. As part of the protocol currently in use at the Loma Linda University Center for Implant Dentistry, 0.25 cc of graft material consisting of 0.3- to 0.5-mm hydroxyapatite particles (HA) coated with beta-tricalcium phosphate (TCP) (Osteon; Dentium) was introduced through the osteotomy and carefully displaced using a dome-tipped curette (Dentium).

An intraoperative digital periapical radiograph was made to ensure sufficient graft material was present below the sinus floor. The previously selected implant was placed at a torque of 35 Ncm, the mucoperiosteal flap was repositioned over the implant, and suturing was completed.

A postoperative CBCT and a periapical radiograph were made to evaluate the volume of graft material placed apical to the implant in the

![Pre-operative cross-section CBCT radiograph depicting sinus floor level in relation to crest of ridge.](image1)

![Dask drill (3.3 mm diameter) for crestal bone planing antrostomy.](image2)
maxillary sinus floor (Fig. 12). Amoxicillin (500 mg, 1 capsule every 8 hours for 7 days) and ibuprofen (800 mg, 1 tablet every 8 hours as needed for pain) were prescribed. Instructions for postoperative care were given to the patient. The patient was seen 2 weeks after the surgery for suture removal and stated that there had been no discomfort or swelling after the surgery.

DISCUSSION

This clinical report of 2 patients presents a modification to conventional surgical procedures for accessing the maxillary sinus antrum via lateral and crestal approaches. The procedure described by the authors as lateral/crestal bone planing antrostomy has the potential to reduce the perforation rate of the maxillary sinus membrane during the lateral and crestal approach to the grafting of the maxillary sinus floor.

Conventional methods to access the maxillary sinus cavity for grafting procedures consist of using rotary instrumentation, a piezoelectric hand-piece, and osteotomes. Some authors have indicated that more time is required to perform the osteotomy and to complete the sinus membrane elevation with the piezoelectric device than with conventional rotary instruments. Vercelloti et al described the advantage of piezosurgery as having the ability to cut the bone window while avoiding the risk of membrane perforation. Additionally, piezoelectric elevators can then be used to lift the sinus membrane without any increased risk of perforation.

The major limitation of piezosur-
surgery seems to be the time factor. Cutting procedures are substantially more time consuming due to the low cutting efficacy of the surgical tips compared with conventional osteotomy devices. According to other studies, depending on the bone structure and thickness, the duration of the osteotomy procedure can be increased by up to fivefold or more.

In the authors’ experience, the proposed procedure, described as lateral/crestal bone planing antrostomy (LBPA, CBPA), has the potential to reduce the time required surgically to access the maxillary sinus cavity, as well as to reduce the incidence of maxillary sinus membrane perforation. One comparative study evaluated the use of the piezoelectric device versus rotary instruments during maxillary sinus antrostomy in 13 patients. Membrane perforation occurred in 30% of the maxillary sinuses in the piezoelectric group and in 23% of maxillary sinuses in the rotary instrumentation group.

In contrast, the reduction in surgical time with this technique is based on the exclusive use of a single drill for LBPA and CBPA; there is no need to use additional instruments such as piezo tips, chisels, mallets, and other instruments used with conventional techniques. The diameter of the drill aids in the immediate outlining of the antrostomy during its use. Direct access to the paper-thin bone immediately adjacent to the maxillary sinus membrane, or to the membrane itself, facilitates and simplifies the detachment of the Schneiderian membrane from the inner walls of the maxillary sinus cavity. Seventeen patients were treated using the described lateral bone planing antrostomy (LBPA) procedure; only one patient (5.8%) had a perforated maxillary sinus membrane.

Fourteen additional patients were treated using the CBPA procedure with simultaneous implant placement. Two patients exhibited signs of a perforation when the Valsalva maneuver was performed, but the small perforation could not be visibly detected. In both of these perforations, dental implants were placed and the patients remained asymptomatic. The patients were free of complications during the initial 2 weeks, and at the 1-, 3-, and 6-month postoperative appointments.

**SUMMARY**

The clinical report describes 2 techniques and the application of specifically designed surgical instruments that may decrease the incidence of maxillary sinus membrane perforation and decrease surgical time, thus lessening complications during and after maxillary sinus graft procedures. Controlled clinical studies with randomized designs are needed before definitive conclusions can be drawn.

**REFERENCES**


References

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