Perforation of the Schneiderian membrane constitutes a major intraoperative complication of maxillary sinus floor elevation with graft materials, but postoperative perforation of the sinus membrane is very rare. This case report demonstrates that conservative treatment involving drainage and the administration of systemic antibiotics can be used to successfully treat postoperative sinus membrane perforation with infection of the graft material.

**Key Words:** sinus lift, complications, sinus membrane perforation

**INTRODUCTION**

Maxillary sinus floor elevation with autogenous or synthetic grafting material has been proved to be a reliable treatment method that enables the insertion of endosseous implants in patients with a severely-resorbed maxilla. The lateral window technique involves a top hinge door in the lateral maxillary sinus wall, as introduced by Tatum but first described by Boyne and James in 1980. This technique has been shown to be highly successful and predictable, with an implant survival rate of over 90% for more than 3 years.

Despite its predictability and the high success rates achieved with this augmentation technique, complications do occur. Perforation of the maxillary sinus membrane is the most common complication that occurs during sinus floor elevation procedures, however, postoperative sinus membrane perforation has been seldom described. If perforation of the Schneiderian membrane occurs after sinus augmentation, it is difficult to repair the membrane appropriately, and graft material may be displaced into the sinus, leading to infection, which may cause maxillary sinusitis and threaten implant survival. This report describes the case of a patient who experienced postoperative perforation of the sinus membrane with infection of the graft material and illustrates the successful treatment employed.

**CASE REPORT**

A 44-year-old man with a noncontributory medical history visited the clinic for reconstruction of the right edentulous posterior maxilla; he was a non-smoker. Radiographic examination revealed a partially pneumatized right maxillary sinus requiring sinus floor elevation and an available bone height of approximately 4–6 mm (Figure 1). The treatment plan included the simultaneous placement of dental implants and sinus augmentation, because the patient had sufficient residual bone to ensure primary stability of the dental implants. Clinical and radiographic screening before the sinus augmentation procedure showed neither a history nor acute signs of sinus-related pathology. Therefore, nasoendoscopy was not performed. From the day before the intervention, antibiotic therapy (cefditoren pivoxil, 100 mg, 3 times daily) was initiated. Prior to surgery, the patient was asked to rinse his...
mouth with a chlorhexidine digluconate solution (0.2%) for 1 minute.

The sinus augmentation procedure followed the technique described by Tatum.² The membrane was carefully elevated inward to the medial sinus wall, together with the residual adherent bony window. The graft materials were placed in the anterior and medial parts of the sinus cavity, and then titanium implants (Osstem Implant Co, Seoul, Korea) were inserted through the alveolar bone into the grafts, using the surgical template. All implants were at least 10 mm in length and placed with good primary stability. After implant placement, the rest of the created space under the sinus cavity was grafted by using bovine-derived bone mineral (OCS-B; NIBEC, Seoul, Korea) combined with autogenous bone, and the lateral window opening was covered with a collagen membrane (CollaTape; Zimmer Dental Inc, Carlsbad, Calif). Autogenous bone was harvested from the maxillary tuberosity. No complications occurred during the surgical procedure; perforation of the Schneiderian membrane was not observed macroscopically and was examined by the Valsalva maneuver (Figure 2).

Antibiotic therapy was continued for 5 days postsurgically (cefditoren pivoxil, 100 mg, 3 times daily). Nonsteroidal anti-inflammatory drugs (mefenamic acid, 250 mg, 3 times daily) and nasal decongestants (pseudoephedrine HCl, 60 mg, 3 times daily) were prescribed along with a chlorhexidine 0.2% mouth rinse. The patient was also advised not to blow his nose and to sneeze with an open mouth for 1 week after surgery. However, 2 weeks postoperatively, when the patient returned for suture removal, swelling and tenderness was evident in the right buccal vestibular area. Radiography confirmed sinus membrane perforation (Figure 3). Incision and drainage was performed under local anesthesia, and the area was thoroughly lavaged with saline, followed by placement of a draining tube; the patient was seen 5 times a week until the tube was removed. The patient was informed that the membrane perforation may result in bone graft failure, necessitating the complete removal of the infected graft material.
After the acute inflammation had subsided, removal of the entire infected graft material using the Caldwell-Luc approach was planned. However, after 2 weeks, the pain had subsided, and the patient's clinical symptoms were improved. Radiologic findings showed neither sinusitis nor scattered bone in the sinus (Figure 4). The patient was referred to an otolaryngologist for sinus evaluation and assessment of foreign materials. Nasoendoscopy showed that the swelling of the mucosal lining, which did not affect the osteomeatal complex, was limited to the floor of the sinus, and bloodstained crusting was observed on the sinus floor. The otolaryngologist found no bone fragments in the sinus cavity. The patient continued to be monitored for 3 months, and the Caldwell-Luc approach was deferred. At 40 days postoperatively, fistula formation on the prior drainage site was observed. Treatment was completed with hydrogen peroxide and saline irrigation and removal of the drain 3 weeks later. No further complications were observed, and the implants were exposed and restored as planned after 6 months.

Computerized tomography (CT) scanning was performed 1 year postoperatively to assess the condition of the sinus membrane and the bone reaction to the implants. CT scan showed that the sinus mucosa was healed well, covering the graft material entirely (Figure 5). Although the right nasal mucosa was found to be more thickened than the left nasal mucosa, this observation seemed not to be related to the perforation of the sinus membrane, as assessed by the otolaryngologist, and the patient had no symptoms related to mucosal thickening. CT scan showed a radiolucent area in the center of the grafted area, but loss of the bone-implant contact was restricted to the apical tip area of the implants. Although implant survival and function were favorable postoperatively, the option of additional bone grafts to ensure long-term implant survival was explained to the patient, but the patient refused any additional surgical treatment. The patient received a follow-up every 3 months, and the dental implants have been functioning well for 13 months (Figure 6).

**Figures 5 and 6.** Figure 5. Computed tomography scans taken 1 year postoperatively. Note the intact sinus mucosa covering the graft material. CT scan showed a radiolucent area in the center of the grafted area, but the loss of the bone-implant contact was restricted to the apical tip area of the implants. Figure 6. Intraoral photograph and panoramic radiograph taken 13 months after implant loading.
Postoperative Perforation of the Schneiderian Membrane

DISCUSSION

This case report demonstrates that conservative treatment involving drainage and administration of systemic antibiotics can be used to treat postoperative sinus membrane perforation with infection of the graft material.

In the present study, it is possible that the sinus membrane was perforated intraoperatively and was not visible when tested using the Valsalva maneuver. However, the small, invisible perforation usually does not need treatment because the membrane folds on itself during the elevation. If a large perforation exists, it would be confirmed by the Valsalva maneuver. Unfortunately, few reports have described cases in which an intact membrane is maintained during the operation, with perforation of the sinus membrane clearly occurring postoperatively. Indeed, some reports do not describe whether the perforation occurred during the operation or after the operation. Therefore, it is very difficult to find an article that describes the postoperative perforation precisely, and it is obvious that this complication is very rare. Bone fragments displaced into the sinus cavity may lead to acute or chronic inflammation. Displaced bone fragments may obtrate the ostium directly and create conditions for initial phlogosis of the mucosa, with edema and progressive obstruction of the nasosinus ostium. As a result, with no patent drainage pathway, the maxillary sinus quickly becomes obstructed, inflamed and then infected. Bhattacharyya reported the case of a patient with postoperative perforation of the sinus membrane and bilateral chronic maxillary sinusitis. In this patient, membrane perforation was not noted during sinus surgery, but both maxillary sinuses were found to contain both attached and free bone spicules during subsequent endoscopic sinus surgery, which was performed for diagnostic and therapeutic purposes. The patient’s sinonasal symptoms significantly decreased after endoscopic surgery, but purulent postnasal discharge persisted, and he therefore underwent transoral excision of the bone grafts.

A literature search revealed no previous reported cases of postoperative perforation of the Schneiderian membrane treated with conservative therapy. Though not a case of postoperative perforation, Prousseafs et al showed panoramic radiographs, similar to those included in the present report. In their patients, graft material was dislodged beyond the boundaries of the sinus membrane despite repair of the perforated membrane with a collagen membrane during sinus augmentation. The authors did not describe the use of any additional treatments, but observed resorption of the dislodged graft material at 6 months after loading. Healing was uneventful, but bone formation was significantly lower in patients with a perforated membrane than in patients with a nonperforated membrane, as assessed by histomorphometric analysis, which influenced implant survival. In the present patient, CT scan showed a radiolucent area in the center of the grafted area. Loss of bone-implant contact was restricted to the apical tip area of the implants; however, an additional bone graft, which was refused by the patient, was advised for long-term implant survival. In addition, regrafting of the hollow space would be necessary if bone loss were to occur in the body of the implants.

Conservative treatment offered 2 advantages. First, it reduced the total treatment period. Surgical removal of bone graft required a reentry procedure which would be performed 6–9 months later. Second, it helped to avoid the difficulty of managing the fibrotic sinus membrane during the reentry procedure. Mardinger et al reported that Schneiderian membrane mobility was minimal with a fibrotic clinical appearance in most of the reentry group, which made it difficult to elevate the membrane and increased the incidence of membrane perforations.

The ability to visualize bone and soft tissue and obtain thin sections and multiple views makes the CT scan the standard tool for maxillary sinus imaging. Also, the exact location of a foreign body within the maxillary sinus and the amount of bone graft loss can be determined with this technique. Nasoendoscopy has been used as a diagnostic tool in cases of maxillary sinus disease. Therefore, we recommend CT scanning or nasoendoscopic evaluation to assess the condition of the sinus and examine bone particles, prior to determining the most suitable treatment method. If CT scanning or nasoendoscopic evaluation does not show any pathologic changes, including graft material in the sinus after the resolution of acute infection by drainage and irrigation with saline, conservative treatment should be considered. Further, several factors, including the amount of
remaining bone graft that can influence implant survival, the possibility of infection control, and the likelihood of sinus mucosa healing, must be considered to ensure optimal outcomes.

Little is known about the factors involved in postoperative membrane perforation. Overfilling may cause necrosis of the Schneiderian membrane with loss of the graft into the sinus, resulting in sinusitis.12,14 Pressurizing the thin sinus membrane may result in late perforation during the placement of the graft material in the compartment made by the elevation of the sinus membrane.11 It may be speculated that a change in pressure in the sinus and an increase in intragraft pressure resulting from an infection in the graft area may also be involved.

Because few cases of postoperative perforation of the Schneiderian membrane have been reported and this case report represents just 1 such case, the predictability and reliability of conservative treatment for postoperative membrane perforation remain unclear, as do the underlying healing mechanisms. However, it may be hypothesized that gravity and slight positive intrasinus pressure may result in the perforated membrane returning to the original position without surgical intervention. One important consideration that must be stressed is that the sinus membrane has great potential for healing. Indeed, in the present patient, the sinus mucosa, which was perforated postoperatively, healed completely without surgical repair, thereby covering the bone graft. Interventional studies are needed to confirm the predictability and reliability of this conservative approach and to establish the clinical protocols for the treatment of postoperative membrane perforation.

**ABBREVIATION**

CT: computerized tomography

**REFERENCES**


