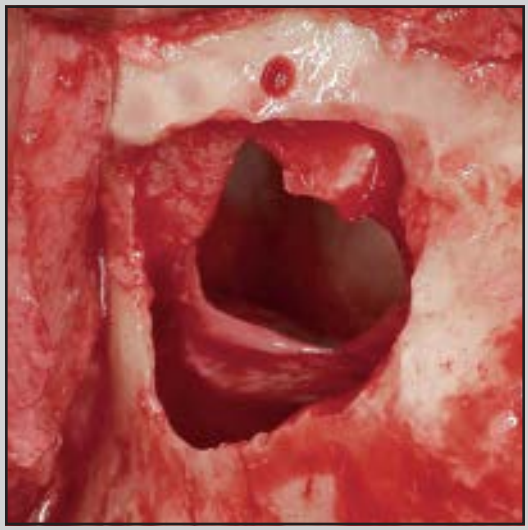

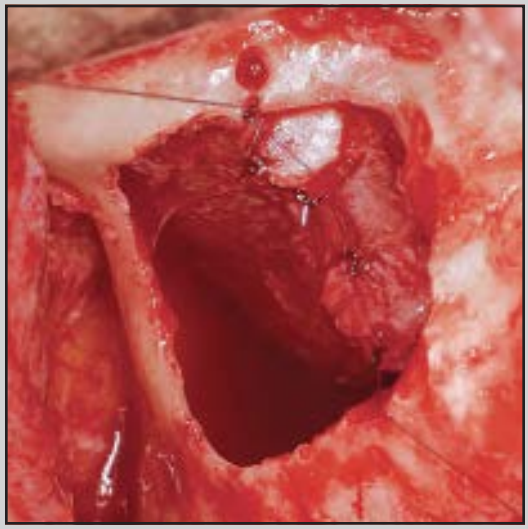

An Innovative Technique to Manage Sinus Membrane Perforations: Report of Two Cases

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The most frequent intraoperative complication of maxillary sinus elevation procedures is the perforation of the sinus membrane, for which various protocols and grafting materials have been proposed in the literature. This article describes a novel suturing technique to close large sinus mucosa perforations. The technique is demonstrated through two clinical cases in which the sinus perforations occurred (1) *in the course of a maxillary sinus elevation procedure and* (2) *after the removal of a cystic lesion. Bone grafting material and dental implants were placed simultaneously with the sinus repair. No infections occurred, and clinical and radiographic outcomes at 1 year postloading revealed successful implant osseointegration.* (Int J Periodontics Restorative Dent 2015;35:373–379. doi: 10.11607/prd.2195)

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Maxillary sinus augmentation represents a predictable reconstructive surgical procedure to increase the vertical bone height volume in the posterior maxilla, allowing for the placement of osseointegrated implants.[1–3] It involves the elevation of the sinus membrane and the placement of a grafting material underneath the reflected membrane. Although the sinus elevation procedure is relatively safe, there are potential problems that pose limitations to its successful application.[4,5] The most commonly reported surgical complication is the perforation of the sinus membrane, which is observed in approximately 20% (range: 0% to 58%) of sinus floor elevation procedures.[6,7] A perforation of the sinus membrane results in a direct communication between the graft material and the sinus cavity. This can cause loss of the graft into the sinus, graft infection, sinusitis, and severe complications such as bleeding into the maxillary sinus (ie, hemosinus) with or without overinfection, and oroantral fistula.[8–10]

There are no clearly defined guidelines for the treatment of sinus perforations.[11] As reported in the literature, small lacerations usually do not need treatment because the membrane folds on itself during the elevation.[12] If the perforation is large or located in an unfavorable area, it needs to be closed to complete the

Fig 1 *Preoperative computed tomography (CT) scans reveal severe bone resorption at the maxillary left molar region. A dome-shaped raised image forms the medial wall of the left maxillary sinus, with sharp demarcation of the lateral borders and absence of any bony destruction.*

grafting procedure. In such cases various techniques have been proposed, including suturing, use of resorbable membranes, fibrin glue adhesive, and block grafts.[12–17]

Severe sinus perforations that cannot be repaired adequately represent an absolute contraindication to the continuation of the surgery.[11,17] A second surgical session has to be scheduled to complete the sinus elevation, but the scar tissue may jeopardize detachment of the sinus membrane from the sinus inner bony aspect.[18] Large perforations located within the body of the antrostomy are the most challenging to manage.

This report describes a novel suturing technique to repair large sinus membrane perforations by means of a resorbable suture anchored to the adjacent sinus bony wall.

Case Report 1

A 54-year-old woman was referred for rehabilitation of edentulism with dental implants in the maxillary left molar area. A well-defined shadow arising from the mesial wall of the maxillary left sinus was detected in the panoramic radiograph. The patient was completely asymptomatic. A computed tomography (CT) scan of the paranasal sinus confirmed the diagnosis of an antral cyst (Fig 1). The maxillary residual bony height was about 5 to 6 mm and required sinus augmentation to allow implant placement.

A comparison of the films with a previous panoramic radiograph revealed that the cyst had increased in size, so a surgical session was scheduled to remove the cystic lesion and carry out the sinus augmentation procedure. Written informed consent was obtained.

Antibiotics (2 g amoxicillin and clavulanic acid) and steroidal anti-inflammatory medication (dexamethasone 4 mg) were administered orally 1 hour prior to surgery, and intraoral antisepsis was performed with 0.2% chlorhexidine gluconate (CHX) mouthrinse for 1 minute. The sinus area was accessed using the lateral approach technique as described by Boyne and James.[19] It consisted of full-thickness flap elevation and osteotomies to form a bony, rectangular window, approximately 25 x 20 mm, and to expose the lateral sinus bony wall. The antrostomy was performed using a 1.5-mm diamond bur (Komet) mounted on a high-speed handpiece under copious sterile saline irrigation. The bony wall was removed and stored in physiologic solution. Afterward, the sinus membrane was partially raised and the cystic lesion removed (Fig 2).

A large Class III[20] vertical sinus membrane perforation was made and required repair before proceeding with the sinus augmentation. It was located in the middle of the antrostomy, extending for the total dimension of the osteotomy site (Fig 3). The membrane surrounding the perforation was gently and completely dissected with a blunt instrument (Hu-Friedy). As a result, the membrane could be mobilized. The vertical perforation was closed by means of simple interrupted sutures with resorbable 6-0 Vicryl (Ethicon), a round atraumatic needle, and microsurgical needle holder (Castroviejo, Hu-Friedy). Before suturing, one cortical hole was made on the superior border of the antrostomy by using the same bur as the one used for the osteotomies. The first interrupted suture was placed 4 to 5 mm from the most caudal extension of the perforation. The needle entered at least 3 mm from the mesial and distal margins of the perforation and was gently rotated in order to keep from lacerating the membrane. The surgical knot was

Fig 2 *An antrostomy is made in the lateral sinus wall to gain access to the sinus membrane. The sinus membrane was partially raised, and the cystic lesion was identified.*

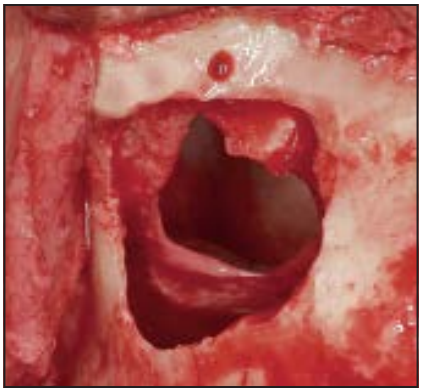

Fig 3 *Following removal of the cyst, a large vertical sinus membrane perforation is visible in the middle of the antrostomy.*

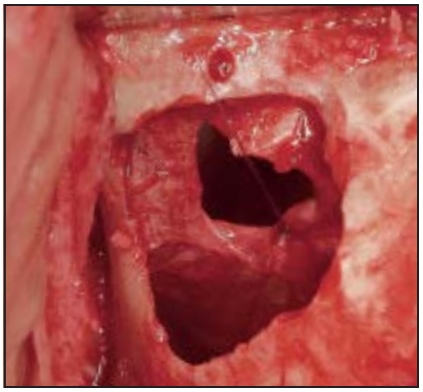

Fig 4 *The obliteration of the perforation was obtained by means of simple interrupted sutures. The first suture was placed 4 to 5 mm from the most caudal extension of the perforation.*

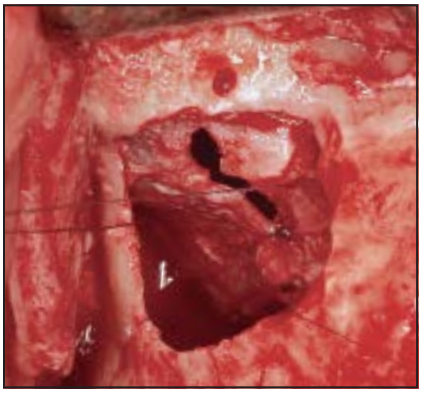

Fig 5 *Suturing proceeds by applying additional interrupted sutures every 4 to 5 mm along the perforation. The needle enters at least 3 mm from the mesial and distal margins of the sinus hole.*

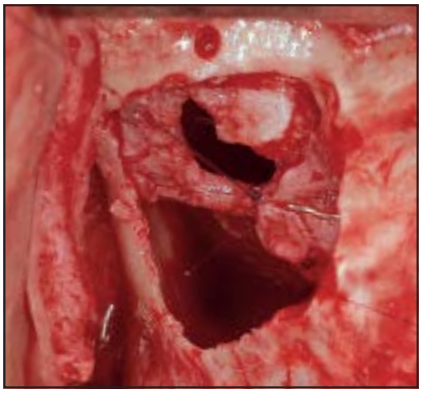

Fig 6 *Interrupted sutures are placed along the perforation.*

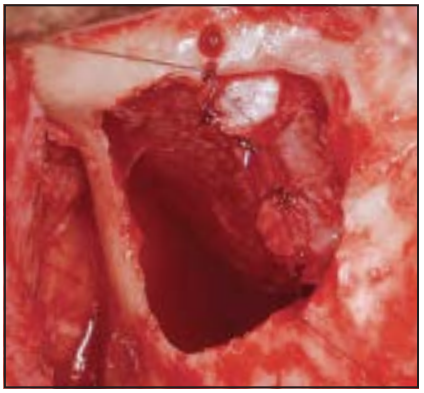

Fig 7 *The last knot is placed 7 to 8 mm from the upper border of the access window. The long end of the last suture is held and passed through the cortical hole. The knot is tied to fasten the sinus membrane at the adjacent bone surface.*

tied without any tension and cut by leaving one end, 6 to 7 cm long, in order to apply tension to the sinus membrane during the next suture (Fig 4).

Suturing proceeded with other interrupted sutures, each of them directed from the mesial to the distal wound margins with surgeon knots positioned every 4 to 5 mm in the caudocranial direction (Figs 5 and 6). The last knot was placed 7 to 8 mm from the upper border of the access window. The long end of the last suture was held and passed through the cortical hole. The knot was tied to fasten the sinus membrane at the adjacent bone surface (Fig 7). The perforation was completely closed, and the sinus elevation could be resumed. The maxillary sinus was loosely filled by a mixture of porcine bone granules (OsteoBiol, Tecnoss Dental) and particulate bone graft at the proportion of 70:30. Two cylindrical implants (4.0-mm diameter, 14.0-mm long) with a titanium plasma-sprayed surface were simultaneously inserted in the augmented sinus (Pit-Easy, Oraltronic). Finally, a resorbable collagen membrane was applied above the antrostomy (Parasorb Resodont, Resorba Medical) and the flap repositioned and closed with Vicryl interrupted sutures.

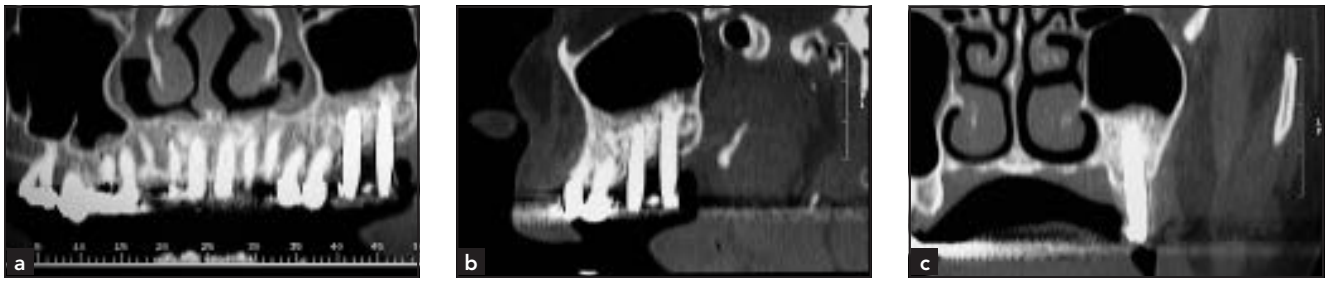

Fig 8 *CT scan images 1 year after prosthetic rehabilitation reveal the large amount of bone regenerated, the successful osseointegration of the inserted implants, and the absence of thickening of the repaired sinus membrane.* (a) *Coronal view.* (b) *Parasagittal view.* (c) *Frontal view.*

The patient was advised not to blow her nose for 1 month and was asked to return in 2 weeks for suture removal. She was instructed to take dexamethasone for 3 days, antibiotics (amoxicillin and clavulanic acid 1 g) and analgesics (ibuprofen 600 mg) every 12 hours for 7 days. The mechanical plaque control was supplemented by CHX 0.2% mouthrinse three times a day for the first 2 weeks.

The postsurgical course was uneventful. After 6 months of healing, the implants were uncovered for abutment connection and prosthetic restoration. After 12 months of prosthetic loading, the implants were clinically stable, fully functional, and free from complications. The probing depth values were ≤ 3 mm at all sites around the inserted implants, and bleeding on probing was not detected. The CT scan showed three-dimensional graft containment and absence of periimplant bone loss (Fig 8).

Case Report 2

A 60-year-old nonsmoking, healthy Caucasian man asked for a functional and esthetic rehabilitation of the lateral posterior area of the left maxilla. The CT scan showed insufficient bony support due to alveolar bone resorption and pneumatization of the maxillary sinus. The height of the residual bone ranged between 4 and 6 mm. Thus, the individual prosthetic plan pointed toward the choice of an implant-supported fixed prosthesis following the optimization of the sites through the sinus elevation procedure. Written informed consent was obtained.

The sinus was accessed via the lateral window approach.[19] During elevation of the sinus membrane, an inadvertent large horizontal Class III perforation[20] was made. It required closing before resuming the sinus elevation procedure (Fig 9). Due to the mesiodistal direction of the horizontal perforation, a series of three holes was made in the upper border of the antrostomy with the same small round bur used for the osteotomies (Fig 10) after the complete and careful elevation of the sinus membrane. Resorbable sutures (6-0 Vicryl, Ethicon) were used to gently engage the sinus membrane, starting at 4 to 5 mm from the most distal extremity of the perforation. The suture traversed both membrane perforation margins, and the surgical knot was tied with a simple interrupted technique. The long end of the suture was held and anchored to the adjacent bony wall by passing the round needle through the first hole made in the lateral sinus wall. Suturing proceeded with two other interrupted sutures to completely close the perforation. Every knot was completed with the stabilization of the sutured flaps to the sinus bony wall by tying the sutures through the second and the third holes, respectively, made along the

Fig 9 *During the elevation of the sinus membrane, a large perforation is accidentally made on the lateral sinus wall.*

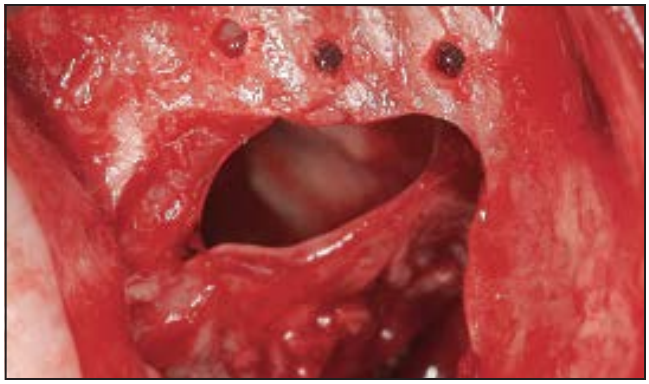

Fig 10 *Three cortical holes are made in the upper border of the antrostomy to provide a site through which to suture.*

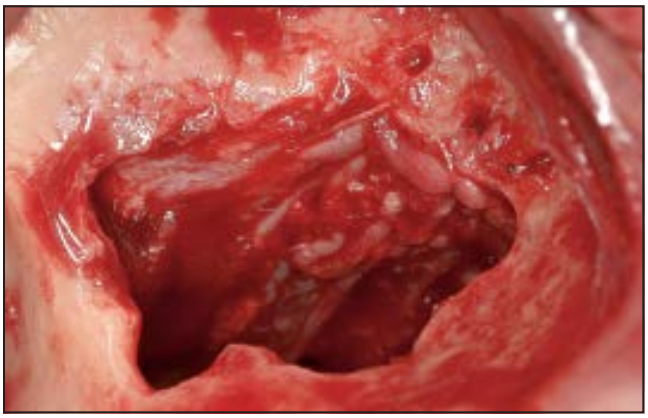

Fig 11 *Interrupted sutures are placed along the perforation and tied through the three cortical holes made along the border of the sinus window.*

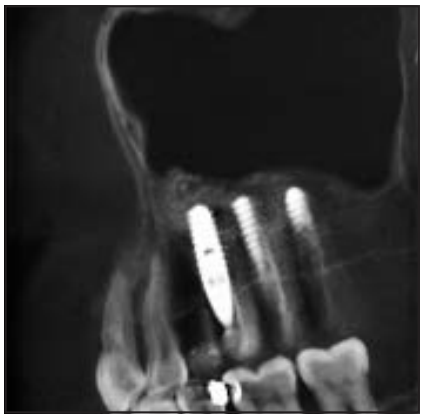

Fig 12 *CT scan 12 months postsurgery reveals complete containment of the grafted material, its reorganization in the antrum and around the implants, and the absence of sinus inflammation.*

upper border of the window (Fig 11). A resorbable collagen membrane (Parosorb Resodont) was trimmed and placed over the repaired sinus membrane.

The space obtained by elevating the sinus membrane was filled by a mix of OsteoBiol and autogenous bone. A total of three 4-mm-wide implants (one 12-mm long at the second premolar and two 14-mm long at the first and second molars) were simultaneously positioned (Pit-Easy, Oraltronic). The antrostomy was subsequently closed by placing a resorbable collagen membrane (Parosorb Resodont). Finally, primary closure of the flap was achieved using Vicryl interrupted sutures.

Postoperative management was the same as in case 1. Six months after placement, the implants were uncovered and the patient was rehabilitated with fixed prosthetic restorations. After 1 year of functional loading, the implants were asymptomatic, immobile, and osseointegrated. No periodontal bony defects were observed on probing. No signs of infection or bleeding were detected. The CT scan showed good integration and consolidation of the particulate graft and the absence of signs of sinus inflammation (Fig 12).

Discussion

Despite the number of reports describing the technical aspects of sinus augmentation procedures and demonstrating their efficacy, the authors have found a paucity of literature on the management of sinus membrane perforations.

This report described an innovative technique[21] for suturing large (> 10 mm) horizontal and vertical sinus perforations with or without the placement of a barrier membrane. The first step is to carry out the complete reflection of the sinus membrane surrounding the perforation to relieve any pressure and to allow sufficient movement of both margins of the sinus perforation. If the sinus membrane is not adequately mobilized, it will not fold on itself and the suture cannot be applied. It may be necessary to extend the osteotomy in order to gain access to the membrane close to the perforation.

According to the vertical or horizontal orientation of the sinus perforations, one or three to five cortical holes are made in the upper border of the antrostomy, respectively. Vertical perforations are closed by means of a series of interrupted sutures with the last knot placed 7 to 8 mm from the superior border of the access window. The long end of the last suture enters through the cortical hole to ensure tight anchorage of the sinus membrane to the lateral sinus wall. In such a way, the last 7 to 8 mm are obliterated through the folding over of the membrane. In case of horizontal defects, the bone perforations along the upper border of the antrostomy provide a site to suture through.

The sinus repair allowed for the simultaneous insertion of two to three implants in the grafted sinus. At 12 months postloading, the CT scans showed complete containment of the grafted material, its reorganization in the antrum and around the implants, the absence of sinus inflammation or thickening of the repaired sinus membrane, and the successful osseointegration of all inserted implants.

At present, the most commonly used technique to repair sinus perforations is the application of a resorbable membrane. However, some authors described reduced bone formation and compromised implant survival rates with this technique.[14,16] Moreover, the repair of the sinus membrane with a collagen membrane may not preclude the displacement of graft particles into the sinus cavity.[14] The Loma Linda Pouch technique was proposed to overcome such limitations.[22] The collagen membrane forms a pouch around the graft material and at the same time seals the sinus perforation and the lateral antrostomy. However, the collagen membrane may slow down the remodeling process of the graft material by completely isolating it from the sinus blood supply.[23,25] In some cases, thickening of the sinus membrane was detected.[22]

Thus, the suturing technique may represent a therapeutic option to manage large perforations due to the faster healing process of the injured site. Numerous suturing techniques had been described in the literature.[20,25,26] Testori et al applied a few sutures on the sinus wall and created a strut for placement of collagen membrane.[25] Hassani et al anchored the perforated sinus membrane to the adjacent bony wall and placed a bioresorbable membrane. The suture was passed through two holes made in the apical or lateral border of the antrostomy, and the knot was tied by means of a horizontal mattress technique.[26]

The technique presented in this article has the advantage of completely closing large Class III sinus perforations developed incidentally during sinus elevation procedures or consequent to the surgical removal of sinus cysts. The choice to apply a resorbable barrier membrane relied on the sinus mucosa thickness. In the presence of thick sinus mucosa, the perforation was repaired by only suturing it. The membrane repair was adequate to resist pressure during graft packing. For thinner sinus membranes, it was considered prudent to protect the repaired membrane by placing a resorbable barrier before inserting the graft material.

Several factors should be taken in account when suturing the sinus membrane. It is important to emphasize that sinus membrane consistency and limited access make it difficult or impossible to suture membrane perforations. When the antrostomy cannot be enlarged to expose the perforated area and the sinus membrane is very thin, suturing the perforation is not achievable. Moreover, it should be regarded as technique sensitive and requires a high level of professional skill.

Conclusions

The suturing technique described in this article represents a safe and cost-effective option for treating large perforations. It shows excellent patient satisfaction because it can help the patient avoid a second operation and a longer timeframe before concluding the prosthetic rehabilitation. Clinical trials are necessary to validate this technique and to evaluate the advantages and disadvantages in comparison with other procedures.

Acknowledgments

The authors report no financial relationships related to any products involved in the study. The study was supported by the authors' own institutions.

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