An Alternative Strategy to Manage a Large Perforation of the Schneiderian Membrane by Staged Re-entry into the Maxillary Sinus: Observed Clinical and Histological Changes of the Regenerated Schneiderian Membrane

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Abstract
Maxillary sinus membrane perforation or tear is the most common complication of the sinus grafting procedure. Repair of the sinus membrane is usually accomplished at the time of the sinus graft procedure and often results in uneventful postoperative complications. However, complications may still arise, especially with large sinus membrane perforations or complete tears that could lead to an infection of the maxillary sinus and other anatomic areas of the maxillofacial complex that could result in bone graft and dental implant failure. An alternative strategy and method to repair the Schneiderian membrane that results in a newly formed fibrotic sinus membrane is described that permits completion of dental implant treatment.

Keywords
Re-entry, Maxillary sinus, Infection, Sinusitis, Histology, Fibrotic Schneiderian membrane, Bioresorbable collagen membrane, Platelet rich plasma

Introduction
The maxillary sinus lift elevation procedure with bone graft augmentation is the most frequently performed surgical procedure to increase the vertical bone height of the posterior maxilla in preparation for dental implant placement. The procedure was first described by Tatum in 1976 [1-3] and later published by Boyne and James in 1980 [4]. Since the initial publication, the procedure has been modified by others and has a high clinical success rate of greater than 90% [5-9]. However, this surgical procedure to correct the atrophic posterior maxilla is not without complications. Boyne [10] hypothesized that the size of the sinus membrane perforation may affect the success of the sinus bone graft augmentation procedure.

The most common intraoperative complication reported with grafting of the maxillary sinus is a perforation of the Schneiderian membrane (Figure 1) that is often managed at the time the perforation is observed [10-18]. The incidence of sinus membrane perforation reported in the literature ranges from 7 to 56% [10,11,12,16]. A meta-analysis by Jensen and Terheyden [19] revealed that infections occur as high as 4.7% with this surgical procedure. If the sinus infection is not identified and managed early in the course of treatment, such a complication can lead to the development of acute and chronic sinusitis, displacement of the graft material into the sinus cavity, loss of the graft material and oroantral communication [19-22]. Perforation of the sinus membrane may also effect homeostasis of the maxillary sinus and bacterial colonization into the maxillary sinus [12,16-18,20-22]. In more severe cases, the infection may progress to involve other anatomic structures of the maxillofacial region, such as the other paranasal sinuses, orbit and anterior and middle cranial fossae [24-26].

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collagen bundles and elastic fibers that are moderately vascularized. The perios- teum is intimately attached to the subepithelial layer and is attached to the osseous walls of the sinus membrane.

Management of the Large Perforated or Completely Torn Schneiderian Membrane

There are many methods and techniques that have been published regarding management of the sinus membrane perforation, as this is the most frequent complication with the sinus elevation procedure with bone grafting [10-33]. A critical objective of sinus membrane repair is to prevent extravasation of the graft material into the sinus cavity. Schneiderian membrane perforations can be repaired with use of a bioresorbable collagen membrane (Figure 2A) autologous fibrin glue, demineralized freeze-dried human lamellar bone sheet, oxidized regenerated cellulose, sutures and with platelet rich plasma [9,11-15,17,18,23,30,31,35-37].

With large sinus perforations greater than 15 mm, Pikos described the use of a slow bioresorbable collagen membrane and platelet rich plasma (Figure 2B) that acts as an adhesive to repair both partial and complete sinus membrane tears [12,36]. However, with large sinus membrane perforations, some authors recommend aborting the sinus augmentation procedure due to the higher percentage of implant failures associated with such large perforations [6,7,9,16,29,38-40]. An alternative strategy is to repair the large sinus membrane tear or perforation using a bioresorbable collagen membrane and platelet rich plasma, but without adding the bone graft material. Twelve weeks or later after the sinus membrane has healed, the maxillary sinus can be re-entered and the bone graft material added to the floor with or without simultaneous implant placement.

Surgical Technique for Large and Complete Sinus Membrane Perforations

When the clinician encounters a large perforation or tear (Figure 1) during the sinus lift procedure or cannot control the membrane from tearing further, the clinician...
may elect to defer placing the graft material into the sinus cavity and focus on preparing the floor and walls to receive the graft material during the re-entry procedure that may occur 12 weeks or later. After the edges of the torn sinus membrane are elevated from the floor and walls of the sinus cavity and positioned medially, a bioresorbable collagen membrane can be directly placed over the sinus membrane. The clinician must make sure that the collagen membrane is not in contact with the floor and walls (anterior, medial and posterior) of the sinus cavity. Platelet Rich Plasma (PRP) is then sprayed on to the collagen membrane, sinus floor and walls (Figure 2B). Platelet rich plasma serves as a natural adhesive and barrier to the exposed sinus when applied to the bioresorbable collagen membrane and walls of the sinus cavity. More important, PRP has been shown to accelerate healing of soft and hard tissue as it is an autologous source of growth factors sequestered from the patient’s own blood [41] that contain several different types of growth factors that can be applied to the surgical site to enhance wound healing. Such biologic growth mediators have been shown to stimulate bone regeneration and soft tissue healing by promoting angiogenesis and increased levels of vascular endothelial growth factor [41,42].

**Reentry of the Maxillary Sinus and Histological Findings**

Twelve weeks or later after the sinus membrane has been repaired, re-entry into the maxillary sinus can be accomplished to add the graft material and place the implants. The newly formed fibrous buccal flap is continuous with the fibrotic Schneiderian membrane due to adhesions (Figure 3A and Figure 3B) and may be difficult to elevate the newly formed sinus membrane superiorly. Tearing of the sinus membrane when elevating in a medial direction is less likely due to the reparative process that results in a thick and fibrous sinus membrane (Figure 4A) that allows graft placement (Figure 4B).

**Discussion**

Many authors have reported on various techniques to repair the perforated and torn sinus membrane to complete the sinus elevation procedure, including grafting of the sinus [10-38]. Placing the graft material into the sinus cavity with a large perforation greater than 10.0 mm or more may result in an acute sinusitis that can progress to an infection of the sinus cavity, including the graft material. In such clinical scenarios, the graft material may need to be removed and the sinus cavity drained and irrigated to resolve the infection [22-32]. Furthermore, studies by Proussaefs, et al. [18] and Khoury [29] reported higher implant failures with sinus membranes that were perforated. The study by Proussaefs and colleagues [18] also observed significant differences in formation of vital bone formation between non-perforated sinus membranes and perforated sinus membranes (33.6% and 14.2%) and implant survival (100% versus 69.6%). Both authors hypothesize that the poor results associated with a repaired sinus membrane...
Conclusion

This article describes an alternative surgical strategy and technique to assist the clinician in management of a large perforation or complete tear of the sinus membrane that avoids the postoperative complications associated with this surgical procedure. Staged re-entry of the maxillary sinus to graft the sinus cavity is predictable and increases graft material and implant survival.

Disclosure

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References


