

Maxillary Sinus Augmentation Following Removal of a Maxillary Sinus Pseudocyst After a Shortened Healing Period

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Purpose: Dome-shaped radiopacities on the floor of the maxillary sinus are commonly interpreted as a sinus cyst on radiographs during dental implant planning. They might present an obstacle in sinus grafting, leading to bone graft failure or implant loss later. The therapeutic approaches to the removal of such cystic lesions and the following sinus augmentation are still controversial. The purpose of this article is to present a modified technique that can be used for predictable removal of a maxillary sinus cyst and sinus augmentation after a shortened healing period in patients with maxillary sinus pseudocysts.

Materials and Methods: A total of 11 patients with a mean age of 43.7 years with a radiographic dome-shaped opacity in the posterior maxilla sinus were included in this study. A lateral sinus window (with a diameter of about 5 mm) was prepared, and removal of the cyst was performed with grasping forceps. Three months after removal of the cyst, a conventional sinus augmentation with xenogeneic material was undertaken. Dental implants were placed 6 months later. Panoramic radiography and coronal/axial computed tomography were performed to diagnose the sinus lesion preoperatively and for follow-up.

Results: A total of 11 pseudocysts were removed from the sinuses of 11 patients under local anesthesia. Histologic evaluation showed antral pseudocysts in all specimens. A soft tissue scar was evident after 3 months of healing at the time of sinus augmentation. No sinus membrane perforation was seen or occurred during the sinus augmentation. A total of 17 implants were placed and restored prosthetically. No clinical complications were observed. The patients were followed up for a mean of 29.2 months (range, 17-43 months) after prosthetic loading, during which no implants were lost and no recurrence of the antral pseudocyst was observed.

Conclusion: The described modified surgical technique allows the minimally invasive removal of the antral pseudocyst and histologic verification of the diagnosis without compromising the nasointral entrance as well as the anatomy of the sinus for future sinus augmentations. It can be performed under local anesthesia without endoscopic equipment while shortening the treatment period.

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The maxillary sinus augmentation procedure has been routinely performed with high success and is described to be a safe, predictable technique for bone augmentation in the posterior maxilla, providing a base for endosseous implant placement.^{1,2} According to the literature, the maxillary sinus is a pyramidal-shaped structure and communicates with all the accessory sinuses of the respiratory system, and proper maintenance of normal physiology is necessary to decrease the incidence of sinus augmentation complications.^{3,4}

Maxillary sinus cysts are a frequent diagnosis on radiographs with a prevalence of up to 21%.³ Sinus cysts include a range of lesions that can be separated into distinctive entities with different clinicopathologic features and behavior. The distinctive features and criteria for diagnosis have recently been reviewed, and a simple classification was given.⁵ Cysts of the maxillary antrum are classified into 4 groups: mucocele, postoperative maxillary cyst, retention cyst, and pseudocyst. The antral mucocele is generally considered rare.⁵⁻⁷ The postoperative maxillary cyst has been reported to occur with a high incidence in Japan but appears to be rare in other parts of the world.^{8,9} Pseudocysts and retention cysts are the most common lesions in the maxillary sinus and are observed incidentally on radiographs.¹⁰⁻¹²

Pseudocysts and retention cysts rarely require removal in normal patient assessment.¹⁰⁻¹² However, the presence of maxillary antral pseudocysts and retention cysts may present an obstacle during sinus elevation and might result in future complications and potential failure.^{3,13-16} According to literature reports, the presence of an antral cystic lesion could be considered a contraindication for sinus augmentation. Before sinus augmentation, these lesions should be identified and treated.^{3,15} A Caldwell-Luc operation or endoscopic sinus surgery has been recommended as the optimal treatment, and complete removal of the sinus lining is advocated to avoid recurrences. At least 6 months' healing time after antral cystic lesion removal was suggested before a sinus augmentation should be performed.^{3,15,16}

The purpose of this article is to present a modified surgical technique for predictable removal of a maxillary sinus cyst followed by sinus augmentation after a shortened healing period.

Materials and Methods

PATIENT SELECTION

From October 2005 to May 2008, a total of 11 patients (3 women and 8 men) ranging in age from 25 to 62 years (mean, 43.7 years) were consecutively enrolled in this prospective study and underwent maxillary antral cyst removal and sinus augmentation at the Department of

Implant Dentistry, Peking University, School and Hospital of Stomatology, Beijing, China. Patients were partially edentulous in the posterior maxilla and required sinus augmentation because of insufficient residual alveolar bone height before implant placement. None of the patients had a history of clinical symptoms associated with the sinus lesion.

The criterion for sinus augmentation was that the residual alveolar ridge height was less than 6 mm. Patients were excluded from the operation if they had a medical history of uncontrolled systemic diseases.

Patients who were scheduled for maxillary antral cyst removal and sinus augmentation underwent clinical examination and radiographic evaluation. Orthopantomogram (Planmeca Promax, Finland) was used to assess the maxillary sinus anatomy, as well as residual alveolar bone height, and to identify a suspicious sinus lesion in each patient. Computed tomography scans (Siemens AG, Germany) were used optionally for further identification of the position of the sinus lesion and for follow-up in 7 patients. Patients with a spherical or dome-shaped radiopacity in the sinus were included. Informed consent was obtained from each patient. This study protocol was approved by the Ethics Committee of Peking University.

SURGICAL TECHNIQUE

Prophylactic oral premedication was used routinely. Amoxicillin (1.5 g; Bristol-Myers Squibb, China) and ibuprofen (0.6 g; GlaxoSmithKline PLC, China) were used 1 hour before the operation, as well as mouth rinsing with 0.2% chlorhexidine (Minsheng Pharma, China) for 2 minutes. Local anesthesia (infiltration of posterior superior alveolar nerve and greater palatine nerve) was executed with articaine hydrochloride with 1:100,000 Adrenalin (Merignac Cedex, France).

MAXILLARY ANTRAL CYST REMOVAL

In the vestibular sulcus just above the region of the missing posterior maxillary teeth, an incision was made and a mucoperiosteal flap was elevated to expose the surgical site. A window with a diameter of about 5 mm was cut through the lateral sinus wall by use of a low-speed round bone bur (Komet, Germany). The lower border of the window was at least 3 mm above the sinus floor. The sinus membrane was perforated by use of the micro tissue pliers (No. 6662; Kohler, Germany). Visual inspection of the sinus area was performed through the lateral window to identify the position of the lesion by use of surgical loupes ($\times 2.5$; Carl Zeiss, Germany). Removal of the lesion was then easily accomplished with the micro tissue pliers (No. 6662; Kohler) (Figs 1, 2). The normal-appearing sinus mucosa surrounding the lesion was not removed (Fig 3). After irrigation with saline solu-

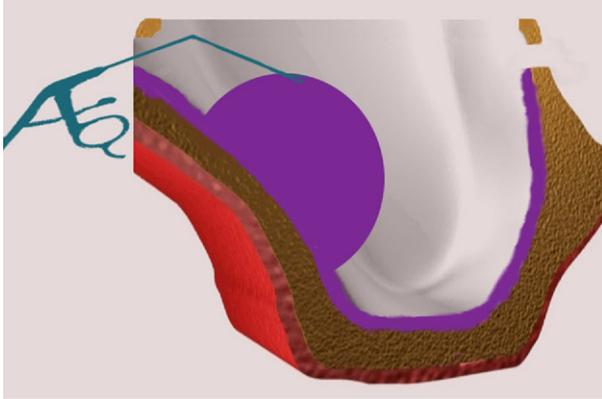


FIGURE 1. Schema showing how to remove antral cyst with micro tissue pliers.

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tion, the mucoperiosteal flap was closed with interrupted No. 4-0 resorbable suture (Vicryl No. 4-0; Ethicon, Somerville, NJ). The specimens were sent for routine histopathologic examination.

SINUS AUGMENTATION

After 3 months of healing, an incision on the alveolar crest extending to the mesial and distal part of the edentulous area was made with the patient under local anesthesia with articaine hydrochloride with 1:100,000 Adrenalin (Merignac Cedex). Sharp dissection was performed to carefully raise a mucoperiosteal flap and expose the former window. A larger window in the lateral sinus wall was cut cautiously, encircling the former window, avoiding a perforation of the Schneiderian membrane (Fig 4). Then, the sinus membrane was carefully reflected from the sinus floor to achieve sufficient space for the bone substitute. When no visible perforation was observed, the space was filled with bovine bone mineral (Bio-

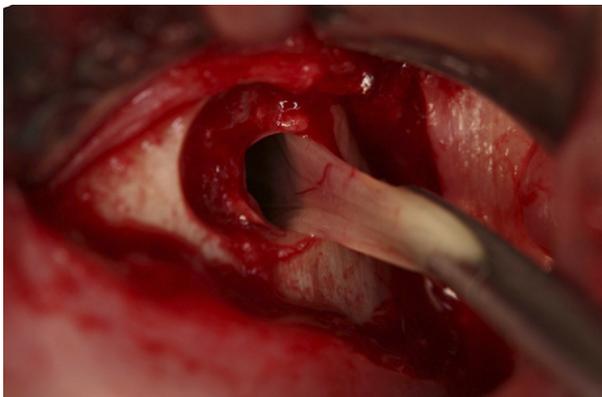


FIGURE 2. The cyst was removed with micro tissue pliers.

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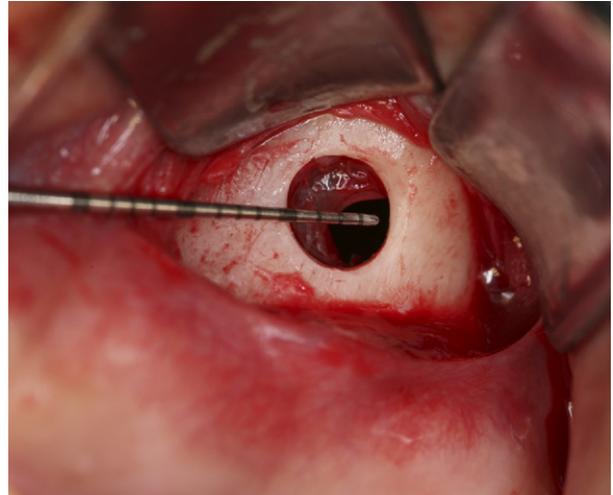


FIGURE 3. Window, with small membrane perforation beneath it.

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Oss, diameter 1-2 mm; Geistlich Pharma AG, Switzerland). The flap was repositioned and sutured with No. 4-0 resorbable suture (Vicryl).

IMPLANT PLACEMENT

After a healing time of 6 months, dental implants (Camlog [Wimsheim, Germany] and Nobel Biocare [Göteborg, Sweden]) were placed in a submerged mode according to the guidelines of the manufacturers. Second-stage surgery was performed after a further healing period of 6 months, and implants were restored with implant crowns if the torque value was greater than 35 Ncm.



FIGURE 4. The new window was prepared 2 mm larger than the former one, and it surrounded the former one. The scar tissue of the former window was used as the new roof, and the sinus membrane surrounding the new window was elevated carefully.

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POSTOPERATIVE MANAGEMENT

After all surgical interventions, the patients were instructed to take the following medications: amoxicillin (Bristol-Myers Squibb), 1.5 g/d for 7 days; dexamethasone (Minsheng Pharma), 2 g for 2 days; and 0.2% chlorhexidine mouthwash (3 times daily for 10 days). They were asked to avoid physical stress and increasing the pressure in the sinus cavities for 4 weeks. Postoperative complications, such as swelling, hematoma, sinusitis, cyst recurrence, infection, and paresthesia, were recorded. Postoperative panoramic radiographs and computed tomography scans were taken before implant restoration and then yearly to compare and detect a recurrence of the cyst. Routine clinical follow-up was scheduled at 1 week postoperatively and then every 2 to 3 months until implant exposure. After prosthetic rehabilitation, patients were followed up at 3 months, at 6 months, and then annually.

Results

A total of 11 pseudocysts (range, 12-21 mm; mean, 19.4 mm) were removed from the sinuses of 11 patients under local anesthesia, and no recurrence was observed until the last recall after pseudocyst removal with a mean of 29.2 months (range, 17-43 months). The area of the pseudocyst was visually identified, and localized removal of the pseudocyst with the micro tissue pliers was performed in all cases. During removal of pseudocysts, the Schneiderian membrane appeared to be thin and friable with a smooth yellow surface. The cyst fluid was yellow or yellow-green. Histopathologic reviews of the histologic specimens were undertaken by an experienced pathologist. Histopathologic examinations of the surgical specimens showed cystic lesions comparable to antral pseudocysts. Microscopically, the cystic walls consisted of connective tissue and lining columnar ciliated epithelium (Fig 5). The surrounding connective tissue exhibited a chronic inflammatory infiltrate, but neither seromucous acinus nor ducts were observed.

The healing time for all patients (N = 11) was 3 months after the sinus cyst removal. Healed scar tissue was visible without bony closure of the window in all patients. No Schneiderian membrane perforation was observed during the sinus augmentation operation. Only minor postoperative edema was observed in all patients. A total of 17 implants were placed. Of those 17 implants, 13 were Camlog Rootline implants and 4 were NobelSpeedy Replace implants (Nobel Biocare). There were no clinical complications during the follow-up. Until the last recall, no implant loss was observed, and no recurrence of the pseudocyst was detected on the follow-up radiographic examinations. The mean follow-up after prosthetic loading was 29.2 months (range, 17-43 months).

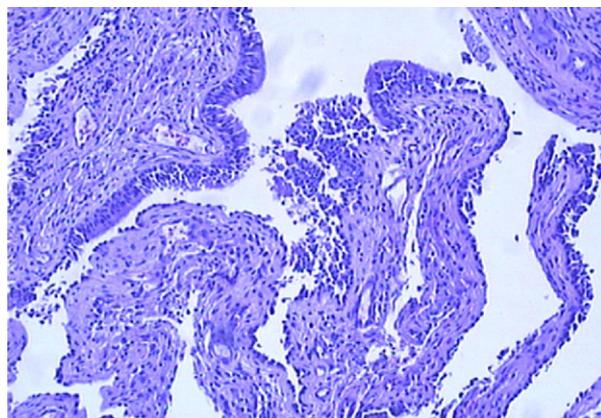


FIGURE 5. Histology showing that pseudostratified ciliated epithelium was observed and inflammatory infiltration was observed in the connective tissue (hematoxylin-eosin stain, original magnification $\times 40$).

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Discussion

According to the literature, maxillary antral cysts have traditionally been treated by a Caldwell-Luc operation or endoscopic sinus surgery. They have been recommended as the optimal treatment, and a healing period of at least 6 months has been proposed before further treatment can be performed.^{3,11,15-20} The Caldwell-Luc approach has been proven to be safe and effective for the treatment of maxillary sinus disease, but it is known to destroy the normal sinus membrane and hinder the standard lateral sinus lift approach because of the operative trauma of the area.

More recently, endoscopic intranasal sinus surgery has become the surgical procedure of choice for maxillary sinus cysts.^{3,11,17-19,21} This technique has proven to be less invasive than the Caldwell-Luc approach, but surgical expertise and endoscopic equipment are needed.^{21,22} It has been reported that synechia formation after a transnasal endoscopic approach has been seen because of the manipulation with the forceps, resulting in mucosal damage of the septum and inferior turbinate. Postoperative scarring can divide the antrum into walled-off compartments, which are separated from the ostium by a fibrous septum and cannot drain at all.^{6,10,11,23} Meanwhile, the endoscopic equipment is not routinely accessible for the normal dentist because of its pricing and limited availability. The mini-window approach described in this study is performed without sophisticated tools only by use of micro tissue pliers and conventional sinus lift instruments while allowing the removal of the cyst without excessive damage of the surrounding sinus mucosa.

On the other hand, the technique used in this study can be described as minimally invasive because postoperative morbidity was low. A systematic review of en-

oscopic sinus surgery reported overall complications for endoscopic sinus surgery of up to 22.4%.²² DeFreitas and Lucente²⁴ reported that the Caldwell-Luc procedure had a high complication rate, in which immediate post-operative complications occurred in 89% of patients, with approximately 19% of patients having major chronic complications as a result of the operation.

According to the literature, normally, 6 to 12 months is necessary for the regeneration of new respiratory ciliated epithelium before further treatment can be performed, because normal sinus epithelium is removed during the Caldwell-Luc operation.^{3,15-20} In this study normal sinus epithelium was preserved during cyst removal, and sinus augmentation was performed 3 months postoperatively in all cases, suggesting that a shortened healing period is sufficient to allow for the closure of the sinus membrane perforation, without recurrence of the cyst.

In recent literature it is still being discussed whether the antral pseudocysts should be removed before the sinus augmentation.^{3,15,16,25,26} One study reported on successful sinus augmentations in the presence of antral pseudocysts.²⁵ However, 2 aspects needed to be addressed: Wang et al²⁶ reported that 29.4% of the maxillary sinus cysts were found to increase in size after follow-up with Waters view films for 38 to 102 months, indicating increasing obstruction of the ostium and thus possibly an increased risk of bone graft and implant failure in the future. Meanwhile, no histologic evaluation and verification of the diagnosis can be performed when not removing the lesion. This increases potential risks because other sinus pathologies may have a similar appearance to a pseudocyst, including benign and malignant neoplasms, which require a different treatment procedure.^{10,12,13}

The described modified surgical procedure allows the minimally invasive removal of the antral pseudocysts followed by histologic verification of the diagnosis without the use of endoscopic equipment.

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