Maxillary Sinus Function After Sinus Lifts for the Insertion of Dental Implants

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Purpose: The influence of bone augmentation of the floor of the maxillary sinus for the insertion of dental implants on sinus function has not been well investigated. In this study, the influence of the sinus lift on the development of maxillary sinus pathology was evaluated using generally accepted diagnostic criteria.

Material and Methods: A group of 45 patients in whom a sinus lift procedure had been performed were evaluated for sinus pathology 12 to 60 months after bone transplantation and implant insertion, using a questionnaire, conventional radiographic examination, and nasoendoscopy.

Results: Postoperative maxillary sinusitis was detected in two of five patients with a predisposition for sinusitis, but in none of the other 40 patients. The occurrence of iatrogenic sinus membrane perforations during surgery was not related to the development of postoperative sinusitis in patients with healthy sinuses.

Conclusion: The occurrence of postoperative chronic sinusitis appears to be limited to patients with a predisposition for this condition. These predisposing factors need to be considered when evaluating patients for sinus lift procedures.

In patients with extensive resorption of the maxillary alveolar ridge and functional denture problems, augmentation of the maxillary sinus floor with bone grafts makes the reliable insertion of endosseous implants for the support of an upper full denture possible. Different surgical procedures using a variety of grafting materials have been reported in literature.1-19 Augmentation of the maxillary sinus floor usually is performed through an osteotomy of the lateral sinus wall, careful elevation of the sinus membrane, and medial and upward rotation of the elevated sinus membrane together with the mobilized bony part of the lateral sinus wall.1,3,4 Thereafter, the space created in the sinus is firmly packed with autogenous bone or bone substitutes. According to the literature, the incidence of development of maxillary sinusitis after an augmentation of the sinus floor ranges from 0% to 20%.5-17,20-22 This percentage is lower than one would expect on theoretical grounds. Because postoperative sinusitis could possibly compromise the success of the sinus graft or implants, and the patient’s physical well-being in general, appropriate preoperative screening for disturbed drainage of the sinus seems mandatory.

Altered anatomic relations in the nasal cavity and the area of the ostio-meatal complex are often involved in sinus drainage disturbances. Diminished maxillary sinus drainage is closely related to a reduced size of the maxillary ostium.23-32 Several studies on the function of this ostium have shown a reduced size in cases of sinusitis.36,37 Relevant drainage-related factors include septal deviation, nasal polyposis, allergy, obstructive lung disease, infundibular pathology, and radiation therapy. Another potential drainage-related factor might be a perforation of the membranous lining of
the maxillary sinus during the sinus lift operation.\textsuperscript{17,20}
There is also a suggestion that maxillary sinus floor elevation contributes to the development of sinus cysts.\textsuperscript{38} The aim of this study was to evaluate the influence of the sinus lift procedure on the development of maxillary sinus pathology.

**Patients and Methods**

**Patients**

Between 1990 and 1994, 45 patients (22 women and 23 men; mean age, 44 years; range, 18 to 65 years) with insufficient bone height in the posterior part of the maxilla for the insertion of endosseous implants were treated with augmentation of the floor of the maxillary sinus with autogenous bone grafts according to the protocol of Raghoebar et al.\textsuperscript{1} Preceding the surgical procedure, all patients were asked about a history of maxillary sinusitis-related symptoms. A questionnaire on sinus drainage-related factors had to be completed, and a radiographic examination (Waters’ view) was performed. Perforation of the sinus membrane during the augmentation procedure was noted. All patients received antibiotics (1 g cephalosporine) that were started 24 hours preoperatively, 3 times a day, and continued for 1 week. Postoperatively, all patients were seen at regular intervals and asked specifically about sinus problems. Complications of the surgical procedure, including infection of the maxillary sinus, loss of bone particles through the nose, and wound dehiscence also were recorded. After abutment insertion (6 months after implantation), all patients were supplied with implant-supported upper dentures or fixed bridges.

**Criteria for Diagnosing Maxillary Sinusitis**

Sinusitis is characterized by a typical triad of symptoms: nasal congestion or obstruction, pathologic secretion, and headache.\textsuperscript{39} However, these symptoms are extremely variable. Sinusitis is also suspected in patients complaining of pain or tenderness in the region of the sinus, in combination with mucopurulent rhinorrhea. To diagnose sinusitis, examination of the condition of the nasal mucosa is mandatory. Mucosal redness and edema, and the presence of mucopurulent discharge around the ostium, are the most important clinical criteria for making the diagnosis. Although computed tomography (CT) scanning of the paranasal sinuses gives more details, mucosal thickening, an air-fluid level, or opacifications are diagnosed reliably with conventional radiographic examination. In case of protracted symptoms of sinusitis, additional procedures, especially for the evaluation of drainage from the sinus and sinoscopy, are indicated.

**Evaluation**

To assess for any sinus pathology caused by the sinus floor augmentation procedure, the patients were recalled for a clinical and radiographic examination 12 to 60 months after grafting. The assessments included the following parameters:

- Presence of actual sinus pathology on traditional radiographies (Waters’ view), comparison with pre-surgical radiographs;
- Evaluation for any sinus pathology related to surgery, including perforation of the sinus membrane during the operation, infection of the maxillary sinus postoperatively, loss of bone particles through the nose, and wound dehiscence;
- Nasoendoscopic examination. Following local anesthesia and decongestion of the nasal mucosa, inspection of the middle and superior meatus was performed to gather information about the drainage of the maxillary and ethmoid sinuses in the infundibular region. A rigid Hopkins fiberoptic scope with a diameter of 4 mm and an angle of vision of 30° was used.

**Statistical Analysis**

A \( \chi^2 \) test was performed to assess for any significant difference in the occurrence of postoperative sinusitis between the group of patients preoperatively suffering from transient sinusitis and patients without such symptoms.

**Results**

Preoperatively, two patients had a proven allergy to the housedust mite, and three patients had obstructive lung disease (predisposing factors for sinus pathology). These patients had had recurrent periods of sinusitis for many years. At the time of the operation, however, these patients showed no clinical and radiographic signs of any sinus disorder. The other 40 patients showed neither clinical nor radiographic signs of any sinus pathology preoperatively.

A total of 85 sinus floors were grafted. In 29 of these sinuses (34%), the sinus membrane had been perforated accidentally during the operation. Neither wound dehiscence nor loss of bone particles through the nose had occurred in any of the patients during the recall periods. One patient mentioned a change in the sound of the voice as a result of the grafting procedure.

Two weeks postoperatively, two of the five patients with a predisposition for sinusitis developed subacute maxillary sinusitis, which was confirmed clinically and
FIGURE 1. Water's view showing evidence of maxillary sinusitis after a sinus lift procedure.

radiographically (Fig 1). In one of these patients, the sinus membrane also had been perforated accidentally during the surgical procedure. In both patients, the sinusitis symptoms ceased after treatment with antibiotics and decongestants. In none of the other 40 patients was an episode of sinusitis recorded, although the sinus membrane had been perforated accidentally in 28 patients.

Sinusitis as a complication of a sinus lift procedure had a significantly higher incidence in patients with predisposing factors for maxillary sinusitis ($\chi^2 = 8.95$, $df = 1$, $P < .01$) than in patients with no predisposing factors for sinusitis. Endoscopic assessment of the nasal cavity showed oversized turbinates and septal deviation combined with a nasal spine in the five previously mentioned at-risk patients. Visualization of the maxillary ostium in the middle meatus showed evidence neither of preexisting (subclinical) maxillary sinusitis, nor of other pathology in the 40 asymptomatic patients.

**Discussion**

The results of this study show that the incidence of maxillary sinusitis after bone grafting of the sinus floor is low. In patients without preexisting sinus problems, no acute symptoms were induced by this procedure, nor did symptoms develop during the 12 to 60-month follow-up period. Transient sinusitis only developed in patients with a predisposition for sinusitis, but even in these patients the symptoms ceased after appropriate treatment and did not recur. Thus, sinus drainage did not seem to be compromised in healthy persons after sinus floor augmentation, nor did accidental perforations of the mucous lining of the maxillary sinus result in sinusitis postsurgically. These perforations need no special treatment. In addition, the cortical bone plate placed just below the sinus membrane prevents spill of the grafted material through an incidental mucosal perforation.1

Previous investigations have reported acute sinusitis is up to 20% of patients after the sinus lift procedure.5,9,15,20-22 However, an evaluation according to accepted criteria for diagnosis, as well as preoperative evaluation of sinus drainage-related factors, is lacking in these clinical reports. It has been suggested that all patients be evaluated preoperatively by intranasal observation to determine the size of the inferior turbinate and the position of the nasal septum. When these structures are deviated in form and size, and have caused chronic sinus problems, sinus floor grafting is contraindicated20 before their correction. To select patients with an increased risk for the development of sinusitis, we recommend that only patients suffering from previous symptoms of sinusitis or predisposing factors should be evaluated preoperatively to rule out structural drainage problems of the paranasal sinuses. In case of compromised sinus drainage, sinus lifting procedures may further reduce the sinus drainage and thus may provoke exacerbations of sinusitis.

Radiographic examination of the maxillary sinus may show mucosal pathology. However, it should be mentioned that the reliability of this information appears to be 73%.40 Nasoendoscopy has been shown to be a more detailed and reliable diagnostic method than conventional radiographic examination alone.

The considerable discrepancy between conventional radiographic examination and endoscopic findings, have made nasoendoscopy widely accepted. Nasoendoscopy provides an excellent view of the anatomic relations in the nasal cavity and middle meatus. If preoperatively sinus drainage disturbing factors are observed, further investigations should be made. For instance, nasal obstruction is often seen in patients with septal deviation or allergy, combined with oversized inferior and middle turbinates. Altered airflow may then induce irritation of the nasal mucosa. Increased thickness of the mucosal lining may reduce the size of the maxillary ostium. Knowledge of the anatomic relations of the structures of the nasal cavity and the infundibulum are important for understanding the pathogenic mechanisms of maxillary sinusitis. However, in this study, nasoendoscopy did not show additional cases of maxillary sinusitis, compared with only radiography. Nevertheless, when sinus drainage disturbing factors are present, or when dealing with clearance-compromised patients, endoscopic examination is helpful in diagnosing subclinical sinusitis as a risk factor in patients undergoing the sinus lift procedure. Preoperative evaluation of sinus drainage-related factors, and additional radiographic examination, will detect
the presence of an asymptomatic maxillary sinusitis. In the literature, however, there is a considerable discrepancy regarding detection of maxillary sinusitis using conventional radiographic examination and endoscopy.\(^{1,2}\) It is true that the introduction of nasoendoscopy, visualization of the ostio-meat complex and nasal vestibulum plays an important role in the evaluation of sinus drainage pathology and the diagnosis of sinusitis.

It is prudent to evaluate all patients with a history of frequent sinusitis to rule out the presence of an obstructive phenomenon that could be aggravated by inflammation associated with the sinus grafting procedure. From this study it is concluded that augmentation of the maxillary sinus floor by autogenous bone grafting in patients without sinus problems and no radiographic evidence of pathologic diseases does not induce a sinusitis attributable to reduced sinus drainage. In these cases, nasoendoscopy is not necessary. A prospective study evaluating preoperative nasoendoscopy before maxillary sinus augmentation needs to be done before recommending nasoendoscopy for all patients who have a history of sinus clearance factors.

**References**