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Chapter 3

Maxillary Sinus Function after Sinus Floor Elevation Surgery

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Abstract

The influence of maxillary sinus floor elevation surgery for the insertion of dental implants on the function of the maxillary sinus has not been well investigated. In this study the influence of sinus floor elevation surgery on the development of maxillary sinus pathology was evaluated using generally accepted diagnostic criteria.

A group of 45 patients, in whom a sinus floor elevation surgery procedure had been performed, was evaluated for sinus pathology, 12 to 60 months after bone transplantation and implant insertion, using a questionnaire, conventional radiographic examination and nasendoscopy.

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.

The occurrence of postoperative chronic sinusitis appeared to be limited to patients with a predisposition for this condition. These predisposing factors need to be considered when evaluating patients for sinus floor elevation surgery procedures.

Introduction

In patients with an extensive resorption of the maxillary alveolar ridge and functional denture problems, elevation of the maxillary sinus floor with bone grafts makes a reliable insertion of endosseous implants possible for the support of an upper full denture. Different surgical procedures using a variety of grafting materials have been reported in literature (Boyne and James 1980; Branemark et al. 1984; Tatum 1986; Misch 1987; Smiler et al. 1987; Wood and Moore 1988; Kent and Block 1989; Chanavaz 1990; Hirsch and Ericsson 1991; Jensen et al. 1990 and 1991; Hall and McKenna 1991; Hochwald et al. 1992; Smiler et al. 1992; Tidwell et al. 1992; Raghoobar et al. 1993; Small et al. 1993; Jensen et al. 1994; Keller et al. 1994). Elevation of the maxillary sinus floor usually is performed through an osteotomy of the lateral maxillary sinus wall, careful evaluation 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 (Boyne and James 1980; Tatum 1986; Raghoobar et al. 1993). Thereafter, the space created in the sinus is firmly packed with autogenous bone and (or) bone substitutes. According to the literature, the incidence of development of maxillary sinusitis following an elevation of the sinus floor ranges from 0-26% of the cases (Misch 1987; Quiney et al. 1990; Chanavaz 1990; Tidwell et al. 1992; Ueda and Kaneda 1992; Kent and Block 1993; Jensen et al. 1994). 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 clearance disturbances. Diminished maxillary sinus clearance is closely related to a reduced passage of the maxillary ostium (Myerson 1932; Aust and Drettner 1971, 1974 and 1978; Drettner 1975; Aust et al. 1976; Daele and Melon 1976; Bertrand and Robillard 1985; Scharf et al. 1995). Several studies on the function of this ostium have shown a reduced size in case of sinusitis (Carenfelt and Lundberg 1977 and 1987; Wigand 1981; Ferguson et al. 1988; Stierna et al. 1991). Relevant drainage-related factors include septum-deviation, nasal polyposis, allergy, obstructive lung diseases, infundibular pathology and radiation therapy. Another potential drainage-related factor might be a perforation of the membraneous lining of the maxillary sinus during the sinus lift operation (Kent and Block 1993; Jensen et al. 1994). There is also a suggestion,

that maxillary sinus floor elevation contributes to the development of sinus cysts (Misch et al. 1991). The aim of this study was to evaluate the influence of the sinus floor elevation surgery 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 18-65 years) with insufficient bone height in the posterior part of the maxilla for the insertion of endosseous implants were treated with elevation of the floor of the maxillary sinus with autogenous bone grafts according to the protocol of Raghoobar et al. 1993. Preceding the surgical procedure, all patients were asked about their history of maxillary sinusitis-related symptoms. A questionnaire on sinus-related factors had to be completed and a radiographic examination (Waters' view) was performed. Perforation of the sinus membrane during the elevation procedure was noted. All patients received antibiotics (1 g Cephalosporine started 1 hour 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 (Yonkers 1992). However, these symptoms are extremely variable. Sinusitis is 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 confirming the diagnosis sinusitis.

Although computer 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 the drainage from the sinus and sinuscopy, are indicated.

Evaluation

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

- Presence of actual sinus pathology on conventional radiographs (Waters' view), comparison with presurgical radiographs.
- Evaluating 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.
- Nasendoscopic examination. Following local anaesthesia and decongestion of the nasal mucosa, inspection of the middle meatus was performed to gather information about the drainage of the maxillary sinus and ethmoids 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 χ^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 patient 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 recurrent periods of sinusitis for many years. At the time of the operation, however, these patients showed no clinical and radiographical 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 post-operatively, two of the five patients with a predisposition for sinusitis developed a subacute maxillary sinusitis, which was confirmed clinically and radiographically (Figure 1). In one of these patients, the sinus membrane 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 floor elevation surgery procedure has a significantly higher incidence in patients with predisposing factors for maxillary sinusitis ($\chi^2 = 8,95$, $df = 1$, $p < 0.01$), than in patients with predisposition for sinusitis.

Endoscopic assessment of the nasal cavity showed oversized turbinates and septal deviation combined with a nasal spine in the 5 previously mentioned at-risk patients. Visualisation 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.



Figure 1 *X-Waters showing maxillary sinusitis after sinus floor elevation surgery.*

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 included by this procedure nor did symptoms develop during the 12-60-months 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 reoccur. Thus, sinus drainage did not seem to be compromised in healthy persons after sinus floor elevation surgery, 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 (Raghoobar et al. 1993).

Previous investigations reported acute sinusitis up to 26% after sinuslifting (Misch 1987; Chanevaz 1990; Quiney et al. 1990; Tidwell et al. 1992; Ueda and Kaneda 1992; Kent and Block 1993). However, an evaluation according for accepted criteria on diagnosis as well as preoperative evaluation of sinus drainage-related factors, is lacking in these clinical reports. It has been suggested that all patients should be evaluated intranasal preoperatively 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 contraindicated (Kent and Block 1993) before their correction. To select patients with an increased risk on 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 floor elevation surgery procedures may 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 appeared to be 73% (Buiter 1976). Nasendoscopy 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, has made nasendoscopy widely accepted. Nasendoscopy provides an excellent view of the anatomic relations in the nasal cavity and

middle meatus. If preoperatively sinus clearance disturbing factors are observed, further investigations should be made. For instance, nasal obstruction, is often seen in patients with septum 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 passage of the maxillary ostium. Knowledge of the anatomic relations of the structures of the nasal cavity and the infundibulum are important for understanding pathogenetic mechanisms of maxillary sinusitis. However, in this study, nasendoscopy did not demonstrate additional cases of maxillary sinusitis, compared with only radiography. Nevertheless, when sinus drainage-disturbing factors are present, or when dealing with drainage-compromised patients, endoscopic examination is helpful in diagnosing (subclinical) sinusitis as a risk factor in patients undergoing the sinus floor elevation 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 with regard to detection of maxillary sinusitis using conventional radiographic examination and endoscopy (Buiten 1976). It is true that since the introduction of nasendoscopy, visualisation of the osteo-meatal 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 which could be aggravated by inflammation associated with the sinus grafting procedure. From this study it is concluded that elevation of the maxillary sinus floor by autogenous bone grafting in patients without sinus problems and no radiographic evidence of pathologic disease does not induce sinusitis. In these cases nasendoscopy is not necessary. A prospective study evaluating preoperative nasendoscopy before maxillary sinus floor elevation needs to be done recommending nasendoscopy for all patients who have a history of sinus clearance impairment factors.

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