

University of Groningen

Maxillary sinus floor elevation surgery

Timmenga, Nicolaas Marius

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2003

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Timmenga, N. M. (2003). *Maxillary sinus floor elevation surgery: effects on maxillary sinus performance*. s.n.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Chapter 9

Summary

In edentulous patients, the continuing process of resorption of the maxilla, related to loss of teeth in the upper jaw, may eventually result in poor denture retention. When this problem can not be solved by prosthetic improvement, additional procedures, such as insertion of endosseous implants to support the prosthetic construction, are needed. However, reliable insertion of endosseous implants in the maxilla is often complicated by insufficient height and width of the alveolar process. In such cases, reconstructive preprosthetic surgery is necessary before implants can be inserted reliably at preferred sites.

A common procedure aimed at establishing an adequate environment for the insertion of endosseous implants is elevation of the maxillary sinus floor with autogenous bone and/or bone substitutes. Although sinus floor elevation a commonly used surgical procedure in the field of reconstructive maxillofacial surgery, the effects of such a procedure on maxillary sinus physiology are unknown. In the literature, post-elevation maxillary sinusitis has been reported to occur in 13.8% on the average (standard deviation 9.4%). When this complication occurs, the inserted bone graft might be at risk. The aim of this study was to investigate the course, prevention and treatment of post-maxillary sinus elevation morbidity. Special attention was paid to the occurrence of maxillary sinusitis in a group of patients without pre-operative symptoms or clinical and radiological signs of maxillary sinusitis.

In addition to the above mentioned topics, a brief general introduction to some anatomic and physiologic aspects of the maxillary sinus, relevant for maxillary sinus floor elevation with iliac crest bone grafts, is provided in **chapter 1**.

In **chapter 2**, the long-term clinical and radiographic outcomes, with regard to the graft, the implant survival and patient satisfaction with their implant-supported overdentures were studied retrospectively in 99 patients. The sinus floor was elevated with bone grafts derived from the iliac crest (n=83), the mandibular symphysis (n=14) or maxillary tuberosity (n=2). The width and height of the alveolar crest had to be increased in a first stage procedure in 74 patients, while in the other 25 patients elevation and implant insertion could be performed simultaneously (width and height of the alveolar crest > 5 mm) because in the latter cases sufficient primary implant stability could be obtained during first stage surgery.

Perforation of the maxillary sinus membrane occurred in 26% of the cases. Perforations did not predispose to the development of sinusitis. Loss of bone particles and sequestration were observed in one (diabetic) patient only. In this patient a dehiscence of the oral mucosa occurred. A second elevation procedure

was necessary in this patient. Symptoms of transient sinusitis were observed in three patients (3%). These symptoms were successfully treated with decongestants and antibiotics. Two other patients (2%) developed a purulent sinusitis, which resolved after a nasal antrostomy. Thus, post-elevation maxillary sinusitis occurred in 5% of the patients in this study, which is lower than generally assumed in the literature ($13.8 \pm 9.4\%$).

In all cases, the bone volume was sufficient for implant insertion. Thirty-two of the 392 inserted Brånemark implants (8.2%) were lost during the follow-up. No sinus pathology was observed after insertion of the implants. The patients received implant-supported overdentures (n=72) or fixed bridges (n=27). All in all, the patients were very satisfied with the prosthetic construction.

From this study it is concluded that sinus floor elevation surgery with autogenous bone grafts is a reliable procedure if properly planned and performed. It has been shown to result in good overall denture satisfaction of patients. The procedure is not without complications, however, and the surgeon must be able to manage problems that arise preoperatively as well as those that develop in the early and late postoperative phases.

Chapter 3 describes a retrospective study on the development of maxillary sinus pathology following sinus floor elevation surgery with autogenous bone grafts. Assessment of post-elevation sinusitis was performed according to generally accepted diagnostic ENT-criteria. Evaluation was performed 12 to 60 months after the surgical procedure, using a questionnaire on sinus clearance related factors, conventional radiographic examination according to Waters, and nasendoscopy. In total 45 patients were evaluated.

Postoperative maxillary sinusitis had developed in two out of the five patients with a predisposition for sinusitis and in none of the other 40 patients. The occurrence of iatrogenic sinus membrane perforations during the elevation procedure was not found to be related to the development of post-operative sinusitis in patients with healthy sinuses.

From this retrospective study it was concluded that elevation of the maxillary sinus floor by autogenous bone grafting in patients without anamnestic or radiographic evidence of pathologic disease does not induce sinusitis. In these cases performance of nasendoscopy does not seem to be necessary. Furthermore, it was stated that a prospective study has to be performed on the value of preoperative nasendoscopic examination in patients with a history of sinus clearance impair-

ment factors who need elevation surgery of the maxillary sinus floor before recommending preoperative nasendoscopy for all such patients.

In **chapter 4**, the two out of 156 patients (i.e., 1.5%) that developed chronic sinusitis following sinus elevation surgery were described. These patients were among the patients who had been treated between 1988 and 1998 with bilateral sinus floor elevation with autogenous bone grafts. Both patients needed functional endoscopic sinus surgery to establish adequate drainage of the maxillary sinus to recover, and to prevent loss of the inserted bone graft. In addition, transient sinusitis had developed in seven patients (4%). The possible relationship between pre-operative sinus clearance disturbances and development of post-elevation maxillary sinusitis was discussed. General guidelines for the treatment of transient and chronic maxillary sinusitis after sinus floor elevation surgery were given.

The effects of maxillary sinus floor elevation surgery on maxillary sinus performance were prospectively studied in a group of 17 consecutive patients who needed maxillary sinus floor elevation surgery with iliac crest bone grafts. The patients had no pre-operative anamnestic, clinical or radiographic signs of actual sinus pathology. All patients were subject to extensive anamnestic and clinical investigation on sinusitis, conventional radiography (Waters' projection) and unilateral endoscopic inspection of the maxillary sinus mucosa and ostio-meatal unit. This triad of evaluations was performed preoperatively, immediately preceding the elevation procedure (the maxillary sinus to be inspected endoscopically was randomly assigned prior to the study), and three (at insertion of the implants) and nine (at uncovering of the implants) months post-elevation. In addition, biopsies of the maxillary sinus mucosa and a sinus lavage-fluid aspirate were collected immediately pre-elevation surgery and at the three and nine months' evaluations.

In **chapter 5** the results of the clinical and radiographic investigations, and the endoscopic examination are described. Five out of 17 patients had a history of an impeded sinus clearance, but did not show any clinical or radiological signs of actual sinus pathology preoperatively. Nor did the other 12 patients. By contrast, unilateral endoscopic elevation revealed pre-existing subclinical mucosal pathology in two out of five patients with a history of sinus clearance impairment and in one out of the other 12 patients. Three months post-elevation, clinical and radiographical examination showed chronic maxillary sinusitis in one non-compromised patient. Moreover, serial unilateral endoscopic evaluations revealed subclinical maxillary mucosal pathology in four other patients (two had a history

of an impeded sinus clearance), confirmed by Waters' projection in three of these four patients. Nine months post-elevation, only subclinical maxillary mucosal pathology was detected endoscopically in two patients (one compromised, one non-compromised patient), confirmed by Waters' projection in this last patient. Five implants (5.9%) were lost during the nine months' observation period.

In **chapter 6**, the microbiological and morphological data are presented. The three months' microbiological evaluation showed a significant increase of cultures with bacterial growth, while the nine months' culture results were comparable to the preoperative status of the maxillary sinus. Morphologically, neither fibrosis nor an altered inflammatory response or thickening of the epithelium and lamina propria was observed postoperatively. The number of goblet cells in the epithelial layer was increased.

From these investigations it was concluded that the effect of maxillary sinus floor elevation surgery with autogenous bone grafts showed to be of a temporary nature and did not appear to have clinical consequences in patients without signs of pre-existing maxillary sinusitis.

Chapter 7 deals with the value of conventional radiography according to Waters' projection for assessing maxillary sinus inflammatory disease, which according to the literature is at least questionable. Therefore, the aim of this study was to evaluate the diagnostic validity and utility of Waters' projection of the maxillary sinus with particular regard to sinus mucosal swelling as a consistent sign of maxillary sinusitis.

In a retrospective study, 40 patients with symptoms of pain in the region of the paranasal sinus, recurrent rhinorrhea and nasal congestion were evaluated. These patients had had these signs of maxillary sinusitis for at least three months and had not responded to conservative treatment. Conventional radiographs according to Waters and coronal and axial CT-scans were made in all patients within an hour. The recordings were subsequently blinded and assessed in a random order by two independent well-trained observers with standard radiodiagnostic criteria for sinus mucosal swelling. Intra- and interobserver agreement was quantified by calculating Cohen's kappa. The diagnostic significance of Waters' projection was assessed with the CT scan images as reference standard by calculating sensitivity and specificity, positive predictive value, likelihood ratio, and diagnostic odds ratio.

Cohen's kappa for the intraobserver agreement was 0.96 for Waters' examination and 0.92 for CT scanning. The interobserver agreement for Waters' projection and CT scanning were 0.76 and 0.92, respectively. With CT scanning as reference standard, the sensitivity and specificity of Waters' projections to detect maxillary sinus mucosa swelling were 83.3% and 69.2%, respectively. The positive predictive (diagnostic) value of Waters' projections was 83.3%, the positive likelihood ratio 2.7 and the diagnostic odds ratio 11.25.

From this study it was concluded that Waters' projections did not reliably rule out the presence of maxillary sinus mucosal swelling. Therefore, when false positive or false negative findings have serious consequences, one should certainly consider additional examinations, e.g. Caldwell's projection or CT-scanning and/or nasendoscopy.

The general discussion of this thesis is described in **chapter 8** and deals with the temporary changes of the maxillary sinus physiology, as might be expected post-elevation in patients without pre-operative sinus clearance related factors. The aspects of these changes and the consequences for sinus physiology and for the lifted antral mucosa in particular are discussed in this chapter.

With regard to the mild inflammatory response of the antral mucosa that occurred post-operatively, this response was not different from the responses that can be observed in the maxillary sinus of healthy individuals not having been exposed to maxillary sinus surgery. Therefore, it should be considered as a sign of the normal physiologic activity of the mucosal airway defence system rather than as a sign of pathology. In other words, in the majority of the healthy subjects sinus floor elevation surgery results at most in a temporary clearance impairment of the maxillary sinus and mostly the resulting signs are subclinical. On the other hand, subjects with a history of sinus clearance disturbing factors, although they show no signs of sinus pathology at the time of sinus floor elevation surgery, run a much higher risk of developing sinus pathology post surgery. In these subjects, pre-operative screening can be worthwhile. If in such a subject screening shows a structural clearance disturbance, surgical intervention might be needed before sinus floor elevation surgery is performed even if there are no actual signs of sinus pathology.

With regard to the surgical procedure, grafting of the floor of the maxillary sinus with autogenous bone grafts or bone substitutes is thought to be a technique-sensitive procedure. Therefore, it is generally assumed that there is an inherent risk of increased post-operative complications in case of iatrogenic perfora-

tions of the membrane of the maxillary sinus, inadequate graft fixation, contamination of the maxillary sinus with micro-organisms during surgery, and poor wound closure. As is obvious from the results of this study, there is no higher risk of developing maxillary sinusitis post-surgery if the perforations are handled with care during surgery, e.g. by placing a cortical bone plate just below the perforations.

Finally, guidelines are provided for the prevention and treatment of post-elevation maxillary sinus pathology.