Available online at www.sciencedirect.com
ScienceDirect
British Journal of Oral and Maxillofacial Surgery xxx (2016) xxx–xxx
BRITISH Journal of Oral and Maxillofacial Surgery
www.bjoms.com

Schneider membrane thickness classification evaluated by cone-beam computed tomography and its importance in the predictability of perforation. Retrospective analysis of 200 patients

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Abstract

Perforation of the Schneiderian membrane is a common complication of sinus augmentation. The aim of this retrospective study was to assess the associations between the lateral wall technique and the ridge approach and the risk of perforation, together with the relations between the thickness of the membrane and the risk of perforation. We studied 200 patients (103 men and 97 women) who had cone-beam computed tomography (CT) before a sinus lift with either a lateral wall technique (n = 100) or the rigid approach (n = 100) for insertion of prosthetic implants. Two-hundred cone-beam CT images were studied, and the mucosal thickness was evaluated. Perforations of the membrane were recorded during operation. The thickness of the Schneiderian membrane on cone-beam CT images was classified as Type I (not recordable), Type II (0-2 mm), Type III (3-4 mm), or Type IV(>4 mm). Type I was recorded in 52 (26%), Type II in 35 (18%), type III in 67 (34%), and type IV in 46 (23%). There were 16 perforations: 12 Type I and four Type II, seven of 100 with the lateral wall technique, and nine of 100 who had the rigid approach. Based on these results we suggest that a membrane 0-2 mm thick may be an important determinant of perforation, regardless of the procedure used.

Keywords: CBCT; Lateral wall technique; Membrane perforations; Maxillary sinus; Sinus lift; Ridge approach

Introduction

Pneumatisation of the maxillary sinus as a consequence of missing teeth limits the quantity of alveolar bone that is available for placement of dental implants, and may result in a lack of primary stability and difficulty in achieving osseointegration.[1] Several operations have been described that permit rehabilitation with an implant-supported prosthesis in patients with an atrophic posterior maxilla by the use of short, zygomatic or pterygoid implants and different methods of augmentation of the sinus floor.[2,3] Boyne and James[4] described the procedure, which had been originally developed by Tatum.[5] According to their original technique, the antrostomy is made on the buccal wall of the maxillary sinus. The sinus membrane is raised, and the graft (autogenous bone harvested from the iliac crest) is inserted.

During the years since the introduction of that technique, several operations have been developed to correct the bony deficiency created by pneumatisation of the sinus, including variations of Boyne and James' lateral window antrostomy[6] and a less invasive alternative to raise the sinus floor with concurrent grafting and immediate placement of implants known

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http://dx.doi.org/10.1016/j.bjoms.2016.08.003
0266-4356/

Please cite this article in press as: Rapani M, et al. Schneider membrane thickness classification evaluated by cone-beam computed tomography and its importance in the predictability of perforation. Retrospective analysis of 200 patients. *Br J Oral Maxillofac Surg* (2016), http://dx.doi.org/10.1016/j.bjoms.2016.08.003

as osteotome raising of the sinus floor.[4] In this technique both the bone removed during preparation for the implant and added additional graft material are conserved to displace the floor of the sinus upwards through a small, localised area with no need for dissection of the membrane.[7]

Various classifications have been developed to help decide which is the most appropriate surgical treatment based on the pattern of alveolar resorption. Generally, augmentation may be indicated when the distance from the sinus floor to the top of the alveolar ridge is less than 8-10 mm.[3,7] In 1987 Misch recommended a systematic approach to sinus grafting based on the height of available bone.[3] When the height of the residual ridge was 5 mm or less, he suggested that the lateral wall technique should be used, with implants being placed either at the time of grafting or 4-6 months later. This depended on the quality and quantity of the ridge, and the initial stability of the implant. Several authors have reported the incidence of perforation of the membrane during the preparation of the lateral window for sinus augmentation, with a prevalence ranging from 11%-54%.[7,9,10] For this reason, several authors have suggested the use of piezoelectric instruments with specifically designed diamond coated tips to prepare the osteotomy in the lateral window. The incidence of perforation ranged from 3.6%-7%.[10] The ridge approach with osteotomes was indicated when the residual bone height was 6 mm or more, as the initial stability of the implant came from the pre-existing bone under the antral floor. Different variables can influence the risk of perforation, such as the anatomical conditions, the presence of septa, root projections in the area of the sinus, the morphology of the sinus floor, and the choice of operation.[3]

Computed tomography (CT) is regarded as the gold standard for the diagnosis of problems with the sinuses because it provides multiple sections through the sinus at different planes, and allows both bone and soft tissue to be seen.[11] Recently cone-beam CT has been introduced for dental and maxillofacial imaging, and it is reliable for the evaluation of structures within the region, including the maxillary sinus.[12]

It is important to assess the risk of perforation of the membrane preoperatively. However, to the best of our knowledge, no reports have described the relation between choice of surgical technique based on preoperative thickness of the sinus membrane. The aim of the present retrospective study, therefore, was to describe a clinical classification of the thickness of the sinus membrane, evaluate it using cone-beam CT, and find out if there was any association among the thickness of the sinus membrane, the operative technique used, and the number of perforations.

Patients and methods

We retrospectively studied the casenotes of patients who had the sinus floor raised during the five-year period February 2008 - November 2013 by experienced surgeons in a private practice in Chieti, Italy. Patients were identified from the office database, and data were recorded on an implant-tracking software program (Implant Tracker, West Hartford, CT).

The retrospective review of casenotes included those of all participating patients in good health (American Society of Anesthesiologists' (ASA) grade 1 or 2), with missing posterior maxillary teeth who had given informed consent to treatment. Exclusion criteria included smoking more than 10 cigarettes/day. The procedure used was the sinus lift through the ridge approach or using the lateral wall technique, with simultaneous placement of a dental implant. Each patient had a cone-beam CT preoperatively to find out if the amount of crestal bone was more or less than 5 mm, as required by the protocol.[2,3,8] When it was less than 5 mm we used the lateral wall technique, and when it was more than 5 mm, the ridge approach.

Once patients had been identified, individual charts and preoperative cone-beam CT examinations were evaluated, and the following data were recorded: date, sex, age and medical history at the time of operation, smoking history, thickness of the sinus membrane, type of operation, and number of perforations during operation. Before operation all cone-beam CT images were evaluated by an otolaryngologist to assess patency of the ostium.

Surgical technique

Before and after operation we followed the same procedure as previously described.[8] After a ridge and bilateral oblique releasing incision, the surgical areas was exposed by raising a full-thickness mucoperiosteal flap. After exposure of the alveolar ridge, effective bone width was measured. For the lateral wall technique the maxillary sinus was entered using piezoelectric instruments (Piezotome, Satelec, Bordeux, France) (n = 100).[10] For the ridge approach (n = 100) we entered through the ridge. A full-thickness flap was raised and the bed prepared using drills and osteotomes worked to within 1 mm of the floor of the maxillary sinus. An osteotome tip on the piezoelectric hand-piece (Intra-lift kit, Piezotome, Satelec, Bordeux, France) was then inserted, and gentle tapping applied to allow controlled fracture of the cortical layer of the sinus. The integrity of Schneider's membrane was evaluated by the Valsalva manoeuvre.[10]

In both cases, the Schneiderian membrane that covers the bony sinus was gently separated from the sinus floor and raised to contain graft material that was placed inferiorly. After the membrane has been raised, we look to see if there was a perforation or not. If there are any, they were repaired with resorbable collagen membrane (Lyoplant, B. Braun Aesculap AG, Germany). The best position for the implant was marked using a round bur. The initial and serial drillings of the area in which the implant will be placed was made with a surgical stent by using an implant burr sequence on an implant's motors (Implacenter, Satelec, Bordeaux, France).

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