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Incidence and predictive factors for perforation of the maxillary antrum in operations to remove upper wisdom teeth: Prospective multicentre study

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Abstract

Background: Our aim was to evaluate the incidence of perforations of the sinuses and their related treatment after the removal of upper wisdom teeth depending on various anatomical and clinical variables.
Material and methods: A total of 1057 upper wisdom teeth were removed under local anaesthetic in the departments of oral surgery at the Universities of Bonn, Düsseldorf, Frankfurt and Mainz, Germany. Data were collected with the help of an anonymised questionnaire dealing with information about the patients, and the position and stage of the development of teeth, as well as the occurrence and size of an oro-antral communication and its treatment.
Results: Of 465 extractions and 592 osteotomies of the upper third molars, 134 interventions (13%) were related directly to the diagnosis of a perforated maxillary sinus. Acute oro-antral communication occurred as a result of the removal of completely impacted teeth in 88 of 370, (24%) by removal of partially impacted teeth in 23 of 222 (10%) and in fully erupted third molars in 23 of 465 (5%) of all cases. These differences are significant ($p < 0.001$). In 111 (83%), the diameter of the oro-antral perforation was less than 3 mm. In 25 (19%) of all sinus openings, a buccal sliding flap was used to close the extraction wound. We conclude that intraoperative fracture of the root, higher degree of impaction and higher age of the patient are associated with a greater likelihood of oro-antral perforation.

Keywords: Oro-antral communication; Sinus perforation; Intraoperative complications; Sinus opening; Wisdom tooth removal

Introduction

Operations to remove wisdom teeth are common,[1] both for therapeutic and prophylactic reasons. Prophylactic removal is particularly controversial, possibly because until now no clear advantage has been shown for prophylactic removal over retaining the tooth and regular follow-up. Retrospective demographic studies in isolated groups of patients have shown a high rate of postoperative complications compared with the problems associated with retaining the wisdom teeth.[2,3] In a recently published study in which complications of wisdom teeth treated in hospital were examined prospectively, most were postoperative complications.[4] Fifteen of 21 patients who took part in the study had a previous osteotomy. Only six of the patients needed in-patient treatment for

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primary severe pericoronitis within the follow-up period of a year.

Many studies have reported a significantly higher rate of complications among patients aged over 25 years.[5–7] Most recent studies have concentrated on complications after extraction of lower wisdom teeth, in particular damage to the inferior alveolar nerve or lingual nerve, in addition to jaw fractures during or after operation and also infections of the wound. The risk of lingual nerve damage as a consequence of the extraction varies from about 1 in 100 to 1 in 500, and most is temporary.[8–10] The risk of damage depends on the surgical technique and often occurs during treatment under general anaesthesia. Damage as a result of local anaesthesia is possible, and varies between 1 in 667 and 1 in 2000.[11,12]

During extraction of upper wisdom teeth, complications are less common. There are no large blood vessels or nerves that could be damaged by inappropriate surgical technique near the extraction site. The upper jaw bone is less dense than the lower jaw, which facilitates extraction. In 11% of all cases, an oro-antral communication is the most common operative complication during extraction of upper wisdom teeth.[13] Further complications are rupture of the maxillary tuberosity, fracture of the root, and partial or complete displacement of the tooth into the maxillary sinus. In a recent retrospective study, operative oro-antral communications were noted in 153 of 1596 interventions,[10] which corresponds to an incidence of 10%. The tuberosity was fractured during three of the interventions, and in one case a tooth was displaced into the maxillary sinus. The incidence of infections in the upper jaw was much less than in the lower jaw, which has also been noted in previous studies.[6,14,15] However, oro-antral fistulas are the most common dentogenic cause (56–70%) for the development of maxillary sinusitis.[16,17] Twenty hours after an oro-antral communication has been created, inflammatory infections of the mucosa of the sinus became evident in three quarters of cases.[18] In a study of patients with persistent infections, the most common radiological feature was polyps with mucosal thickening.[19]

Most recent studies are retrospective, and take the form of a cohort study of operative and postoperative complications. However, as many variables are recorded simultaneously, the statistical examination of single variables and their predictive factors is limited in most cases. We know of no study that has been published that specifically investigates the operative complications after extraction of upper wisdom teeth. The aim of the present study was to record prospectively the incidence and predictive factors of perforation of the maxillary sinus during extraction of upper wisdom teeth in a multicentre study.

Patients and methods

During the study period (January 2003–March 2004), 1057 upper wisdom teeth that were removed under local anaesthesia in the oral surgical wards of the Universities of Bonn, Dusseldorf, Frankfurt and Mainz, Germany, were included in the study. Data were recorded using a standard questionnaire that was subdivided according to various aspects including information about the patient's age, sex, and the professional experience of the dentist who would extract the tooth. Anatomical variables included the side being operated on, the type of impaction, and the stage of the root development evident on preoperative orthopantomographs. Operative variables recorded were accidental fracture of the root and signs of perforation of the sinus. An oro-antral communication was identified by nose blowing and by careful probing of the extraction socket using a blunt sinus probe. No pressure was used during probing to avoid opening the sinus or enlarging a pre-existing perforation. The approximate diameter of the perforation was estimated clinically by probing and inspection. Also recorded were preoperative complaints and the surgical treatment in case of an oro-antral communication. All patients were instructed to avoid physical effort, smoking, and hot food for at least 3 days, and, if they had a perforated sinus, not to blow the nose for 1 week. Different kinds of non-steroidal anti-inflammatory drugs were given for pain relief. Sutures were removed after 7 days.

Statistical analysis

The Statistical Package for the Social Sciences, version 12 (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. The Chi-square test was used for comparisons between groups. Probabilities of less than 0.05 were accepted as significant.

Results

Patients

Altogether, 684 patients aged between 11 and 83 years were treated. The mean (S.D.) age was 28 (12) years (Fig. 1). More or less the same number of men (47%) and women (53%) were operated on, and similar number of teeth was removed on the left (49%) and the right (51%) side (Table 1).

Perforation of the sinus

The maxillary sinus was perforated during the operation in 134 (13%) (Table 2). The treatment depended on whether the tooth was impacted and on the size of the perforation (Table 2). According to the clinical outcome, one patient whose 4 mm opening was treated by a buccal flap extension had a persistent perforation after a week. He had a second treatment to close the oro-antral communication under local anaesthesia.

Table 1
Frequency of occurrence and operative variables in cases of oro-antral communication

	Total number (%) ($n = 1057$)	Perforated sinus		p-value
		Yes ($n = 134$)	No ($n = 923$)	
Sex:				
Male	493 (47)	59 (44)	434 (47)	0.5
Female	564 (53)	75 (56)	489 (53)	
Age (years):				
<18	168 (16)	14 (11)	154 (17)	0.003
18–21	197 (19)	13 (10)	184 (20)	
21–25	263 (25)	36 (27)	227 (25)	
25–40	293 (28)	44 (33)	249 (27)	
>40	136 (13)	27 (20)	109 (12)	
Side:				
18	534 (51)	63 (47)	471 (51)	0.4
28	523 (49)	71 (53)	452 (49)	
Eruption:				
Fully impacted	370 (35)	88 (65)	282 (31)	0.000
Partially impacted	222 (21)	23 (17)	199 (22)	
Erupted	465 (44)	23 (17)	442 (48)	
Root development:				
1/2	47 (4)	9 (7)	38 (4)	0.3
2/3	82 (8)	7 (5)	75 (8)	
3/3 open foramen	123 (12)	12 (9)	111 (12)	
3/3 closed foramen	805 (76)	106 (79)	699 (76)	
Preoperative complaints:				
None	835 (79)	104 (77)	731 (80)	0.4
Pain	187 (18)	29 (22)	158 (17)	
Sinusitis	7 (1)	0 (0)	7 (1)	
Cyst	5 (0)	0 (0)	5 (1)	
Other	23 (2)	1 (1)	22 (2)	
Clinical experience:				
<3 years	570 (54)	74 (55)	496 (54)	0.8
3 years or more	487 (64)	60 (45)	427 (64)	
Intraoperative fracture of root:				
Yes	44 (4)	12 (9)	32 (4)	0.003
No	1013 (96)	122 (91)	891 (97)	

Data are given as number (%).

Statistical evaluation

The statistical evaluation of the data is presented in Table 1. There was a significant increase in perforations with advancing age, although we excluded patients under 18 years (Table 3), eruption status of the tooth and operative root fractures.

Table 2
Distribution of the diameter of sinus perforation and treatment

	Number (%)
Size of perforation (mm):	
<1	40 (30)
1–3	71 (53)
3–5	22 (16)
>5	1 (1)
Treatment:	
None	21 (16)
Simple suture	83 (62)
Buccal sliding flap	25 (19)
Other	5 (4)

Data are number (%).

Table 3
Incidence of oro-antral communication by age

Age (years)	Number (%)
<18	14 (8)
18–21	13 (7)
22–25	36 (14)
25–40	44 (15)
40 or more	27 (20)

Data are number (%).

Discussion

The incidence of sinus perforation of 13% in this study shows the importance of examining the extraction socket.

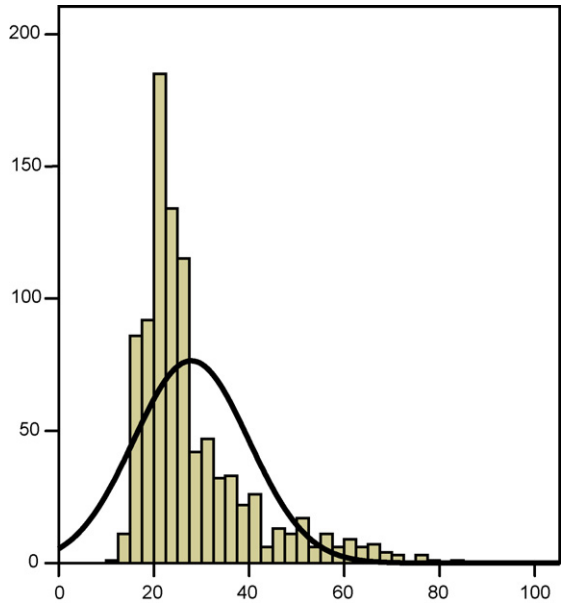

Fig. 1. Age distribution of the 1057 patients included in the study (mean (S.D.) 28 (12)).

It is comparable to the retrospective findings of Wachter and Stoll[13] though in some retrospective studies a much lower incidence was found. This contradiction may be explained by the assumption that in daily clinical work the perforation of the maxillary sinus after extraction of a wisdom tooth is regarded as clinically minor, not tested, or not appropriately documented. In a retrospective evaluation, this may lead to a low-rated incidence, and emphasises the advantage of a prospective approach and the need for multicentre, prospective studies.

In this study, the general complication rate was 5%.[13] Postoperative inflammatory incidents were most common, followed by operative bleeds. In another recent study, the incidence of perforation of the maxillary sinus was 10% for upper wisdom teeth, corresponding to an overall complication rate of 4%.[10] The data were recorded retrospectively and the rates were lower than in our study. One part of our evaluation method (probing the extraction socket using a blunt sinus probe) may have caused some perforations, by penetrating the bone of the sinus floor or Schneider's membrane. The size of the perforation may also have increased as a result of excessive probing. The evaluation of the size of the perforation was difficult because of the bleeding from the extraction socket, and should, therefore, be considered as an approximation of the actual size of the perforation (Table 2).

The recording of 3 fractures of the maxillary tuberosity in 1596 interventions in the upper jaw of the study mentioned above does not differ significantly from our experience. Most other studies do not discriminate between interventions under local or general anaesthesia, but as far as we know, no study has been published that shows differences between rates of perforation depending on type of anaesthetic.

Although the diagnosis of an oro-antral communication during an osteotomy does not influence the treatment (except in cases of pre-existing maxillary sinusitis), it does change the treatment in the case of an extraction. A buccal sliding flap with a consecutive flattening of the vestibulum and loss of the ceratinised gingiva, for example, could be necessary to cover the extraction socket.[20] In our study, the buccal sliding flap was required in 25 (19%) of the total maxillary perforations. This corresponds to the low incidence of 2% of all wisdom teeth removed, though for sinus openings after simple extractions of fully erupted teeth it increases to 35% (Table 1). In most other cases, simple suture without extending the flap was used together with haemostatic agents (mainly collagen or cellulose) when necessary.

It seems probable that an oro-antral perforation is more likely when a tooth is most impacted: in only 5% of all cases did a perforation develop around fully erupted teeth, followed by partially impacted teeth (10%) and completely impacted teeth (24%). This connection probably results from the relation to the maxillary sinus and from the increased difficulty of the removal. In 30% of all cases, the thickness of the floor of the sinus near the upper third molars was less than 0.5 mm.[21]

The perforation rate in relation to tooth development (Table 4) shows two peaks: for teeth with less root development (1/2: 19%), as well as fully developed teeth with complete closure of the apical foramen (1/1: 13%). Both have a higher incidence of perforation of the maxillary sinus than teeth at an intervening stage of development (2/3: 9%; 3/3 with an open apical foramen: 10%). However, this was not significant. There was a reduction in the thickness of bone between the tip of the root and the floor of the maxillary sinus as a result of bone resorption caused by chronic apical periodontitis. This was also seen during the follow-up examination of upper molars after apicectomy,[22] so when considering early and late removal of upper wisdom teeth, the risk of perforating the maxillary sinus is fairly high. The recommended age range for extraction of lower wisdom teeth is between the ages of 17 and 24 years.[23] The increase in the rate of oro-antral communication with operative root fracture from 12 to 27% could be caused by the increased amount of force required for removal. The immediate relation between the position of the tip of the root and the maxillary sinus is a predictive factor, and shows the advantage of atraumatic surgery.

The groups of patients in academic hospitals that we studied cannot be compared with patients in private practices,

Table 4
Oro-antral communications by development of teeth

Development of teeth	Number (%)
1/2	9 (19)
2/3	7 (9)
3/3 open foramen	12 (10)
3/3 closed foramen	106 (13)

Data are number (%).

where most extractions of wisdom teeth are for prophylactic purposes and for the lower age group. All wisdom teeth included in this study were removed under local anaesthesia, which may have an influence, although we know of no study that compares the complication rate after extraction of upper wisdom teeth under local anaesthesia with those removed under general anaesthesia.

However, within the limits of the present study, we may conclude that early and late removal of wisdom teeth, and the degree of impaction and operative root fractures, are associated with a greater likelihood of oro-antral perforation.

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