Research · Science
Forschung · Wissenschaft
Recherche · Science

Publisher
Herausgeber
Editeur

Schweizerische Zahnärzte-Gesellschaft SSO
Société Suisse d'Odonto-Stomatologie
CH-3000 Bern 7

Editor-in-chief
Chefredaktor
Rédacteur en chef

Prof. Adrian Lussi
Klinik für Zahnerhaltung, Präventiv- und Kinderzahnmedizin
Freiburgstrasse 7
3010 Bern

Articles published in this section have been reviewed by members of the Editorial Review Board.

Jede im Teil «Forschung und Wissenschaft» des SDJ eingereichte Arbeit wird von zahnärztlichen Fachpersonen begutachtet. Diese genaue Begutachtung macht es möglich, dass die Publikationen einen hohen wissenschaftlichen Standard aufweisen.

Ich bedanke mich bei den unten aufgeführten Kolleginnen und Kollegen für ihre wertvolle Mitarbeit, die sie in den vergangenen zwei Jahren geleistet haben.

Adrian Lussi

Martin Lanzer[1]
Rada Pejicic[1]
Astrid L. Kruse[1]
Thomas Schneider[2]
Klaus W. Grätz[3]
Heinz-Theo Lübbers[1]

[1] Polyclinic of Cranio-Maxillofacial Surgery, Clinic of Cranio-Maxillofacial Surgery, Center of Dental Medicine, University of Zurich, Zurich, Switzerland
[2] Polyclinic of Oral Surgery, Clinic of Cranio-Maxillofacial Surgery, Center of Dental Medicine, University of Zurich, Zurich, Switzerland
[3] Dean's Office of the Faculty of Medicine, University of Zurich, Zurich, Switzerland

CORRESPONDENCE
PD Dr. med. Dr. med. dent.
Heinz-Theo Lübbers
Clinic of Cranio-Maxillofacial Surgery
Center of Dental Medicine
University of Zurich
Plattenstrasse 11
8032 Zurich
Switzerland
Tel. 044 255 50 64
Fax 044 255 41 79
E-mail: t.luebbers@gmail.com

SWISS DENTAL JOURNAL SSO 125: 555–562 (2015)
Accepted for publication: 29 September 2015

Anatomic (positional) variation of maxillary wisdom teeth with special regard to the maxillary sinus

KEYWORDS
Retained tooth,
wisdom tooth,
cone beam computed tomography,
computer tomography,
norm variants

SUMMARY

The removal of wisdom teeth is one of the most common interventions in oral surgery. In order to avoid complications, a profound knowledge of the anatomy of teeth and adjacent tissues is crucial. In the case of maxillary wisdom teeth, their relationship to the maxillary sinus, to the pterygoid fossa, to the maxillary tuber and the adjacent venous plexus is particularly important. Three-dimensional (3D) imaging, for example by means of cone beam computed tomography (CBCT), is increasingly utilized in practice. However, the necessity of CBCT imaging is still a matter of intensive debate. The aim of this study was to describe the anatomic (positional) variation of maxillary wisdom teeth and, based on these findings, to elucidate the additional benefit of such imaging.

A retrospective case study was performed using patients examined by means of CBCT imaging in the Department of Dento-Maxillofacial Radiology during the period from 2008 to 2013. Primary study variables comprised the spatial relationship of the teeth to the maxillary sinus, the degree of retention and root development, the covering of the root with bone and mucosa, the root configuration, and the developmental stage of the tooth. In addition, the association of the inclination of teeth in the transversal and sagittal plane with the above variables was evaluated. Descriptive statistical parameters were calculated for all results of the examination.

In total, CBCT recordings of 713 maxillary wisdom teeth from 430 patients were evaluated. Their mean age was 29.8 years, and the proportion of male patients slightly prevailed (54.4%). Most teeth exhibited fully developed roots (64.1%). Overall 22.9% of third molars were impacted, 32.3% were retained, and 6.5% were erupting. In more than a third of the patients, wisdom teeth were in occlusion. The inclination of the third molars both in the transversal and sagittal plane was significantly associated with the distance of the root from the maxillary sinus as well as with the bony covering of the root.

Owing to the possibility of evaluating preoperatively the relationship of a wisdom tooth to the maxillary sinus and to other anatomic structures, we recommend the use of CBCT, whenever conventional radiography fails to provide adequate information about the critical anatomic circumstances of maxillary third molars. However, CBCT should, at least nowadays, not be utilized as the standard radiographic examination.

Introduction

Apart from implant-related procedures, the surgical removal of wisdom teeth is the most frequent intervention in oral surgery (Lübbers et al. 2012). It can be carried out for therapeutic reasons, but also prophylactically (Rothamel et al. 2007). Knowledge on the anatomy of the teeth and their surrounding structures obviously is of critical importance for the avoidance of complications. The age of the patient, the experience of the surgeon, and the impaction depth of the tooth have been described as further influencing variables (Haug et al. 2005; Blondeau & Daniel 2007; Baqain et al. 2008).

In the maxilla, complications occur more rarely than in the mandible. On the one hand, there are no relevant nerves in the nearby vicinity which could be damaged, and on the other hand, the bone of the maxilla is less compact and better supplied with blood. The most frequent intraoperative complication related to the removal of maxillary third molars is the opening of the maxillary sinus (Wächter & Stoll 1995). Additional complications in the maxilla include avulsion fractures of the maxillary tuber, the dislocation of teeth or parts thereof into the antrum, and intraoperative bleeding from the venous plexus in the area of the pterygoid fossa. Postoperatively, infections, secondary hemorrhages, disturbances of wound healing, and the formation of oroantral fistulas associated with an odontogenic maxillary sinusitis are of primary significance (Arrigoni & Lambrecht 2004).

Owing to the implementation of cone beam computed tomography (CBCT), the three-dimensional (3D) representation of retained wisdom teeth became possible in dental practice. Previously, this had been reserved to imaging by means of complex computed tomography. CBCT was used primarily for evaluating the position of the inferior alveolar nerve and its relationship to mandibular wisdom teeth (Nakagawa et al. 2007; Susarla & Dodson 2007; Nakamori et al. 2008; Tantanapornkul et al. 2009; Lübbers et al. 2011a), but today it serves for more varied diagnostics.

The aim of this study was to evaluate the frequency of anatomic variations of maxillary third molars using the technique of cone beam computed tomography.

Materials and Methods

The entire study was carried out monocentrically at one university dental clinic. The CBCT scans analyzed retrospectively for the purpose of this investigation were taken from the data bank of the Department of Dento-Maxillofacial Radiology of the Center of Dental Medicine. The selected study design corresponded to a retrospective radiographic data collection.

Included in the study were all patients from which CBCT scans of maxillary third molars were available in the data bank. Images were recorded in the years from 2008 to 2013 and had to completely represent the wisdom teeth. Insufficient image quality from a radiological point of view, which prevented an exact assessment of the study variables, constituted the only exclusion criterion. No patients were excluded for epidemiological and clinical reasons. This eliminated as well as possible an unwanted selection bias of the sample examined. Since the present study was a retrospective analysis, the indication for CBCT imaging could not be determined in all cases.

Overall 430 patients were included in the study. In 283 of these, maxillary third molars were present on both sides, yielding a total of 713 teeth. No recording had to be excluded.

All individuals included in the study were examined using the KaVo 3DeXam CBCT device of the company KaVo Dental GmbH (Biberach an der Riß, Baden-Wuerttemberg, Germany). The proprietary image viewing software (eXamVision, version 1.9.3.13), which is also routinely applied in the clinic, was used for the evaluation of the scans.

A total of 16 parameters were analyzed in each patient and tooth (Tab. I). All parameters except the epidemiological information regarding age and gender were derived from the radiographs: tooth notation, stage of root development, degree of retention, inclination in the sagittal plane, inclination in the transversal plane, number of roots, relationship to maxillary sinus, bony covering between root tip and sinus floor, mucosal covering between root tip and sinus floor, presence of caries, pericoronal alterations, periapical radiolucencies, crown-root bends, and the occurrence of distomolars.

The FDI-scheme was applied for tooth notation. Thus, upper third molars were classified as either 18 or 28.

Root development was divided semiquantitatively into five stages: only the crown formed (stage I, germ, by definition no roots, see number of roots); root trunk present prior to formation of a furcation (stage II, by definition number of roots = 1, see number of roots); two thirds of the expected root length formed (stage III); entire root formed and apical foramen open (stage IV) or closed (stage V). This classification corresponded to that of Rothamel et al. (2007).

The number of roots was counted, yielding values from zero to four. By definition, the number of roots associated with stage I of root development was zero, while that associated with stage II was one. As a result, numbers of roots from two to four occurred only after the formation of a furcation corresponding to the stages of root development III to V.

With respect to the degree of retention, four categories were distinguished: impacted (category I), tooth completely surrounded by bone; retained (category II), the surrounding bone exhibits a perforation; erupting (category III), tooth not entirely in occlusion yet; in occlusion (category IV), tooth has reached its final position in the dental arch.

The inclination of the third molars in both the sagittal and transversal plane was measured using an angle scale superimposed on the image (Figs. 1 and 2). A vertical position perpendicular to the occlusal plane was defined as 0°. In the sagittal plane, a mesial inclination was indicated as a positive and a distal inclination as a negative value. In the transversal plane, a positive and negative value was used to denote a vestibular and palatal inclination, respectively.

The relationship between the third molar and the maxillary sinus was assessed semiquantitatively. Five categories were defined: no relationship to the maxillary sinus (category I); the root tip protrudes at most 2 mm into the maxillary sinus (category II); up to half of the root protrudes into the sinus (category III); more than half of the root protrudes into the sinus (category IV); the crown or coronal portions bear a relation to the sinus (category V).

Using the distance measurement tool integrated in the image viewing software, the space between the root tip and the sinus floor was determined quantitatively in millimeters. If no bone plate could be recognized radiographically, the value was defined as 0 mm. In an analogous way the thickness of the mucosa between the root tip and the sinus floor was measured.

Radiographs were also examined concerning an angle between the crown and root axis as a sign for a crown-root bend.

Tab. I Descriptive statistics of all 713 teeth examined

		Tooth		Entire sample	
		18	28		
		Number	Number	Number	Relative frequency
Gender	Male	188	197	385	54.0%
	Female	171	157	328	46.0%
Root development	Germ	57	59	116	16.3%
	Halfway complete	50	40	90	12.6%
	To two thirds complete	23	27	50	7.0%
	Open apical foramen	48	47	95	13.3%
	Closed apical foramen	181	181	362	50.8%
Degree of retention	Impacted	84	79	163	22.9%
	Retained	124	106	230	32.3%
	Erupting	19	27	46	6.5%
	In occlusion	132	142	274	38.4%
Inclination in the sagittal plane	from −25°	40	30	70	10.0%
	−10° to −25°	56	65	121	17.3%
	−10° to +10°	239	236	475	67.9%
	+10° to +25°	5	7	12	1.7%
	from +25°	13	9	22	3.1%
Inclination in the coronal plane	from −25°	6	2	8	1.1%
	−10° to −25°	9	13	22	3.1%
	−10° to +10°	221	220	441	61.9%
	+10° to +25°	65	69	134	18.8%
	from +25°	58	50	108	15.1%
Number of roots	0	56	56	112	15.7%
	1	112	98	210	29.5%
	2	36	35	71	10.0%
	3	142	142	284	39.8%
	4	13	23	36	5.0%
Relationship to maxillary sinus	No relationship	90	89	179	25.1%
	1–2 mm of root in sinus	147	137	284	39.8%
	Up to half of root in sinus	56	54	110	15.4%
	Up to entire root in sinus	19	23	42	5.9%
	Crown portion in sinus	47	51	98	13.7%
Bone covering of roots to max. sinus	0 mm	153	172	325	45.6%
	1 mm	136	130	266	37.3%
	2 mm	39	33	72	10.1%
	>2 mm	31	19	50	7.0%
Carious lesion	no	322	305	627	87.9%
	yes	37	49	86	12.1%
Apical lesion	no	359	350	709	99.4%
	yes	0	4	4	0.6%
Crown–root bend	no	307	300	607	85.1%
	yes	52	54	106	14.9%
Distomolar	no	355	350	705	98.9%
	yes	4	4	8	1.1%

However, this angle was not determined quantitatively. Furthermore, attention was directed to distomolars (clinically often referred to as 19 or 29) distal of the third molar. As far as pericoronal radiolucencies were concerned, only the presence or absence of an osteolytic pericoronal zone was recorded.

The descriptive statistical evaluation as well as the bivariate data analysis for the identification of significant associations was made using the program IBM SPSS Statistics version 22 (Armonk, New York, USA). Specifically, the following three parameters were related as dependent variables to all other parameters examined: (1) bone layer between the maxillary sinus and the tooth root, (2) positional relationship of the teeth to the maxillary sinus, and (3) mucosal covering of the maxillary sinus.

Informed consent of the patients or their legal representatives was obtained prior to the start of treatment as part of the medical history and recorded explicitly on the respective form. This consent applied to the disclosure of data in anonymized form for research and publication purposes, without the possibility of inference regarding the individual. Patients were also informed about their right to object to the utilization and disclosure of their data. Since at the start of the study patient data did not exist in anonymized form, a request for a special permit was submitted to the Federal Expert Committee for Professional Secrecy in Medical Research. The respective special permit for the disclosure of non-anonymized data exists (reference 035.0001-132/203). Thus, the study design complied with the guidelines (version 2013) of the Declaration of Helsinki concerning Ethical Principles for Medical Research Involving Human Subjects.

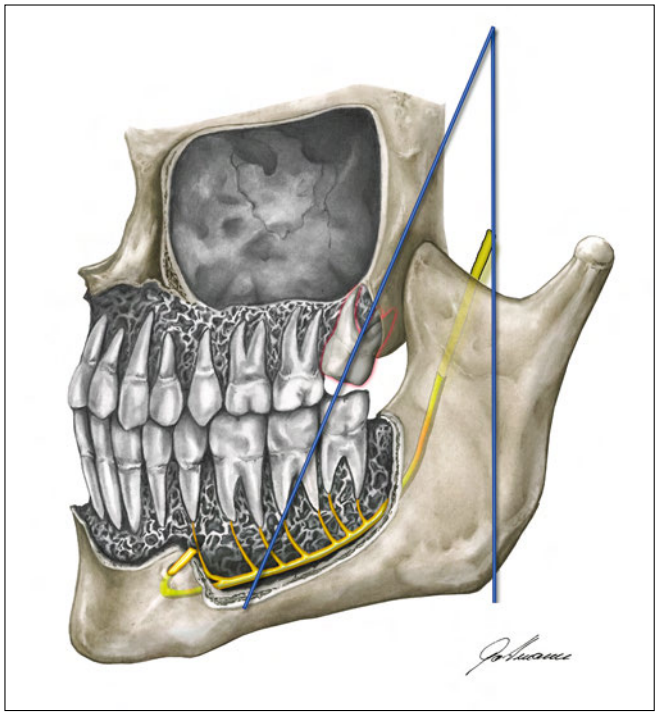

Fig. 1 Determination of the inclination in the sagittal plane. The angle between the tooth axis and a line perpendicular to the occlusal plane is measured

Results

Overall 713 teeth from 430 patients were evaluated (Tab. 1). In 238 patients, both maxillary wisdom teeth were examined. Among the 430 patients, 234 (54.4%) were males and 196 (45.6%) females. Their average age was 28.02 years (SD 15.163 years). The youngest patient was 10 years and the oldest 84 years old (Fig. 3). From all third molars examined, 359 (50.1%) were located on the right and 354 (49.9%) on the left side.

Among the grand total of 713 teeth examined, 116 (16.3%) were present only as germs. In 90 third molars (12.6%), the root trunk existed and in 50 (7.0%), two thirds of the root were formed. Over two thirds of the root were present in 457 teeth (64.1%), of which 95 (13.3%) revealed an open and 362 (50.8%) a closed apical foramen (Fig. 4). Altogether 163 third molars (22.9%) were impacted, 230 (32.3%) retained, 46 (6.5%) erupting, and 274 (38.4%) in occlusion.

Two hundred and twenty teeth (30.9%) did not exhibit an inclination in the sagittal plane. Mesially inclined were 91 (12.5%) and distally inclined 402 (56.6%) teeth. Among the latter, an inclination of –10° predominated. In the transversal

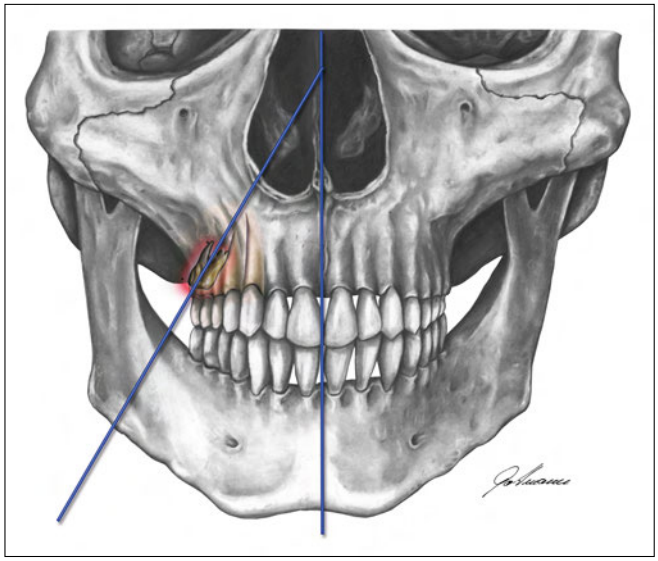

Fig. 2 Determination of the inclination in the coronal plane. The angle between the tooth axis and a line perpendicular to the occlusal plane is measured.

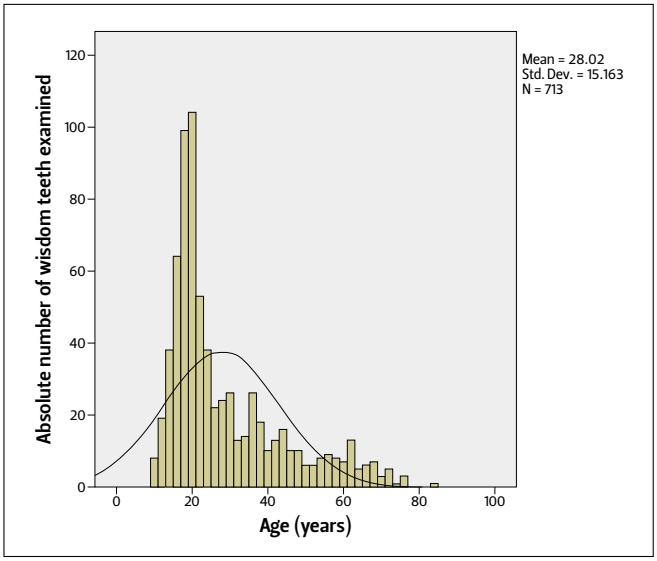

Fig. 3 Frequency distribution of examined wisdom teeth as a function of age

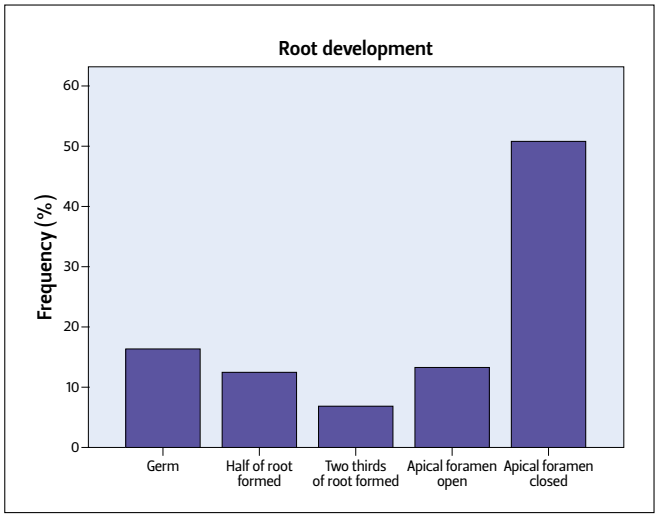

Fig. 4 Frequency distribution of the stages of root development

plane, 158 teeth (22.2%) were not inclined. A vestibular inclination was observed in 469 third molars (65.8%). It showed a peak at about 10°. Palatally inclined were 86 teeth (12.0%).

The bivariate statistical analysis revealed that the inclination of the third molars was significantly associated with their relationship to the maxillary sinus. Thus, with increasing inclination in the sagittal plane both to the mesial and distal, the positional relationship to the sinus became closer, insofar as larger portions of the tooth exhibited a direct contact with the antrum. In nearly 50% of the patients with mesially inclined third molars, the crown had a direct connection to the maxillary sinus ($p < 0.001$). In cases of inclinations in the transversal plane, a particularly large percentage (45.5%) of palatally inclined teeth revealed a direct contact of crown portions with the antrum, whereas vestibularly inclined third molars revealed a less close relationship to the sinus ($p < 0.001$; Tab. II).

One hundred and twelve teeth (15.7%) did not reveal any root. One root was observed in 210 third molars (29.5%). Two roots existed in 71 (10.0%), three in 284 (39.8%), and four in 36 (5.0%) teeth. One hundred and seventy nine third molars (25.1%) did not protrude into the antrum. In 284 teeth (39.8%), up to 2 mm and in 110 (15.4%), half of the root protruded into the sinus. Protrusion of the entire root and of crown portions were found in 42 (5.9%) and 98 (13.7%) third molars, respectively.

Overall no bony covering between the root tip and the maxillary sinus could be recognized in 325 teeth (45.6%). The more third molars were inclined to the vestibular, the more bone was present between the root and the antrum. As far as the sagittal plane was concerned, roots of distally inclined teeth were separated from the sinus by a thicker bone layer (Tab. III). No bony covering was detectable in 75% of teeth exhibiting a marked palatal inclination ($p < 0{,}001$). Overall no measurable mucosal coating of the maxillary sinus was found in 581 third molars (81.5%).

In 86 teeth (12.1%), caries was detected radiographically. Pericoronal radiolucencies were observed in 18 teeth (2.5%), and in four cases (0.6%), an apical lesion was noted. This value constituted the lowest prevalence among all parameters examined in this study. One hundred and six (14.9%) of all evaluated third molars exhibited a crown-root bend, and in eight cases (1.1%), a distomolar could be demonstrated.

Discussion

From this retrospective data evaluation, several relevant conclusions can be derived. One of the most frequent complications of maxillary third molar removals is the accidental opening of the maxillary sinus. If recognized intraoperatively and treated adequately, this hardly constitutes a burden for the patient. In contrast, a persistent oroantral communication which may also be accompanied by an acute or chronic inflammation of the sinus is very inconvenient and time-consuming for the

Tab. II Association between the relationship of teeth to the maxillary sinus and their inclination in the transversal and sagittal plane

		Relationship of tooth to maxillary sinus									
		No positional relationship		1–2 mm of root in sinus		Up to half of root in sinus		Up to entire root in sinus		Crown portion in sinus	
		Absolute[1]	Relative[2]	Absolute[1]	Relative[2]	Absolute[1]	Relative[2]	Absolute[1]	Relative[2]	Absolute[1]	Relative[2]
Inclination in the transversal plane	from −25°	2	25.0%	3	37.5%	0	0.0%	2	25.0%	1	12.5%
	−10° to −25°	3	13.6%	6	27.3%	2	9.1%	1	4.5%	10	45.5%
	−10° to +10°	102	23.1%	180	40.8%	71	16.1%	31	7.0%	57	12.9%
	+10° to +25°	46	34.3%	55	41.0%	17	12.7%	2	1.5%	14	10.4%
	from +25°	26	24.1%	40	37.0%	20	18.5%	6	5.6%	16	14.8%
Inclination in the sagittal plane	from −25°	8	11.4%	25	35.7%	9	12.9%	4	5.7%	24	34.3%
	−10° to −25°	21	17.4%	51	42.1%	18	14.9%	8	6.6%	23	19.0%
	−10° to +10°	142	29.9%	200	42.1%	73	15.4%	23	4.8%	37	7.8%
	+10° to +25°	3	25.0%	1	8.3%	3	25.0%	3	25.0%	2	16.7%
	from +25°	4	18.2%	4	18.2%	0	0.0%	4	18.2%	10	45.5%

[1] Absolute number of teeth [2] Relative frequency

patient. Correspondingly the relationship of the antrum floor to the root tip is of crucial importance. As described above, only every fourth maxillary wisdom tooth lacked a direct relationship to the sinus. On the other hand, in almost half (325/45.6%) of the teeth, a radiographically visible bone lamella between root and sinus was missing. It should be mentioned, however, that these problems are significant only in partially retained third molars, as openings of the antrum resulting from the removal of fully retained or impacted teeth are sufficiently treated by an adequate wound closure. This, in turn, points to the importance of a correct incision for the removal of impacted or retained maxillary wisdom teeth, since based on the available data, an accidental opening of the antrum has to be taken into account in at least one of two interventions.

Inclinations of maxillary third molars in the sagittal and coronal plane occurred in 69.1% and 77.8% of the cases, respectively. We could demonstrate that the inclination of the teeth allows conclusions as to their relationship with the maxillary sinus.

Also the prevalence of crown-root bends has clinical implications, because these hamper a tooth extraction. Thus residual bone lamellae covering the roots to the maxillary sinus can be torn off if third molars with such a bend of the root are improperly removed. The same is true for fractures of the maxillary tuber. Their frequency certainly increases with increasing forces required for the removal of the tooth.

As far as the relationship of the root tips to the maxillary sinus is concerned, we compared our findings with data reported in a publication of Kilic et al. (2010). In the latter study, most values regarding the protrusion of the roots into the antrum varied between 0.81 mm and 1.63 mm, depending on the root examined. In the present study, however, measurements below 2 mm were obtained in only 39.8% of the cases.

Although Rothamel et al. (2007) found a comparable frequency of erupted third molars (44%), they reported an inverse prevalence of impacted and retained teeth. Whereas in the study of Rothamel et al. (2007) impacted teeth were observed significantly more often than retained teeth, the opposite was true in our investigation. This has clinical consequences, as it is assumed that the removal of impacted third molars more often leads to an accidental opening of the maxillary sinus (Rothamel et al. 2007). Frequencies regarding the stages of root development showed similar distributions in both studies. Also in the work of Rothamel et al. (2007), teeth with a closed apical foramen constituted the largest group with 76% of cases.

Evaluations of the bone thickness between root and antrum are scarce. Bouquet et al. (2004) observed absence of a bone layer in four of 34 cases. Thicknesses up to 1 mm were reported in 22 and values above 1 mm in eight of 34 cases. In our study, we did not find a radiographically recognizable bony boundary between root portions and maxillary sinus in 45.3% of all teeth. Thicknesses up to 1 mm and values above 1 mm were observed in 24.5% and 30.2% of cases, respectively. Apart from the small sample (n=34), it should also be noted that Bouquet et al. (2004) used CT imaging for the representation of the bone layer. Thus, although data of the two studies are comparable, they cannot be mutually substantiated. This is relevant insofar as in cases of a bone thickness of less than 0.5 mm, accidental openings of the maxillary sinus are particularly abundant (Harrison 1961).

In comparison with the prevalence of caries in maxillary wisdom teeth observed in the study of Jung & Cho (2013), the value of 12.1% recorded in our investigation was many times higher. In the same work, Jung & Cho also reported the frequency of apical lesions. The respective value of 0.7% was similarly low as that found in our population. However, the prevalence of distomolars of 0.2% determined by Jung & Cho in a sample of 3,799 patients was considerably lower than our value of 1.1%.

Especially relevant for clinical application is the prevalence of periapical lesions. Using CBCT these are recognized with markedly higher precision than using any other methods (Estrela et al. 2008; Low et al. 2008; de Paula-Silva et al. 2009). In contrast, CBCT plays only a negligible role in the diagnostics of caries. In

Tab. III Association between the bone covering of the roots and the inclination of teeth in the transversal and sagittal plane

		Thickness of the bone covering of the root							
		0 mm		1 mm		2 mm		>2 mm	
		Absolute[1]	Relative[2]	Absolute[1]	Relative[2]	Absolute[1]	Relative[2]	Absolute[1]	Relative[2]
Inclination in the transversal plane	from −25°	6	75.0%	1	12.5%	1	12.5%	0	0.0%
	−10° to −25°	10	45.5%	12	54.5%	0	0.0%	0	0.0%
	−10° to +10°	180	40.8%	192	43.5%	38	8.6%	31	7.0%
	+10° to +25°	65	48.5%	35	26.1%	22	16.4%	12	9.0%
	from +25°	64	59.3%	26	24.1%	11	10.2%	7	6.5%
Inclination in the sagittal plane	from −25°	28	40.0%	39	55.7%	1	1.4%	2	2.9%
	−10° to −25°	53	43.8%	49	40.5%	12	9.9%	7	5.8%
	−10° to +10°	213	44.8%	166	34.9%	56	11.8%	40	8.4%
	+10° to +25°	10	83.3%	0	0.0%	2	16.7%	0	0.0%
	from +25°	17	77.3%	4	18.2%	0	0.0%	1	4.5%

[1] Absolute number of teeth [2] Relative frequency

this respect, it only yields secondary findings from otherwise justified indications of the recordings.

Among all selected CBCT scans, none had to be excluded for quality reasons or because it could not be assessed. This was somewhat surprising, since the spatial resolution of 0.4 mm voxel edge length chosen for reasons of radiation hygiene was rather low for CBCT operating conditions. Access to the volume associated with the possibility of the viewer to select individual section planes based on the specific problem should nowadays be standard (Lübbers et al. 2011b). Absolutely necessary is the volume data set in the standardized data format if this is to be processed further using third-party software, for instance for planning of implants.

Distributions of gender as well as of left and right sides were markedly balanced in the present investigation. The age distribution approximately corresponded to what appears typical for questions related to wisdom teeth. Even in the absence of a detailed evaluation of this issue, such questions certainly were the most frequent reason for referral. Overall, the study population can, therefore, be considered representative for clinical daily routine.

In what circumstances can imaging using CBCT be helpful? The stage of root development and the character of the retention in the sagittal plane can easily be identified by means of conventional radiographs (Almendros-Marques et al. 2008). Therefore, these aspects cannot be considered particularly relevant for the indication and clinical application of CBCT. Somewhat different is the situation regarding the inclination in the transversal (palatal-vestibular) plane. This is inadequately represented by conventional imaging, because it concerns an inclination perpendicular to the film plane. The vast majority of the teeth examined in the present study revealed a vestibular axial tilt, and the variation of inclinations in the transversal plane was considerably higher than in the sagittal plane.

Based on the present retrospective work, no conclusions can be drawn regarding clinical daily routine, as it is not an interventional study. However, it could be demonstrated in which situation the anatomic positional relationship of maxillary wisdom teeth to the maxillary sinus changes. Hence, danger points could be described. For clinical work and in accordance with various established guidelines on this topic, we recommend additional 3D-imaging if conventional imaging is unable to adequately shed light on the anatomic circumstances. This recommendation is supported by the present study, which demonstrates a marked variability of the anatomic situation in maxillary wisdom teeth.

Résumé

L'extraction des dents de sagesse est l'une des interventions de chirurgie buccale les plus courantes. Pour éviter des complications, une connaissance détaillée de l'anatomie de la dent et des tissus en proximités est primordiale. Dans le cas de la dent de sagesse de la maxillaire supérieure, il est ici particulièrement à mentionner le sinus maxillaire, la fosse pterygoidea et le tubercule maxillae avec le plexus veineux. Une image tridimensionnelle (3D), comme par exemple à travers une tomographie digitale, est de plus en plus utilisée dans la pratique. La nécessité d'un DVT fourni encore d'intenses discussions. But de l'étude était de décrire les variations anatomiques des dents de sagesse supérieures sur la base de l'utilisation supplémentaire d'une telle imagerie.

Une étude rétrospective, rassemblant des cas de patients de la division de radiologie dento-maxillofaciale sur la période 2008–2013, a été créé. Les variables d'évaluation principale sont: la relation spatiale avec le sinus maxillaire, le niveau de rétention, le développement des racines, la couverture osseuse ainsi que de la muqueuse de la racine, la configuration de la racine et le stade de développement de la dent. De plus, l'angulation de la dent dans le plan transversal et sagittal a été comparé aux variables ci-dessus. La statistique descriptive a été calculée pour toutes les variables mentionnées.

Un total de 713 dents de sagesse supérieures de 430 patients a été évalué. L'âge moyen des patients était de 29,8 années, les patients masculins prédominaient légèrement (54,4%). La plupart des dents montraient un développement complet des racines (64,1%). 22,9% des dents étaient incluses, 32,3% impactées et 6,5% des dents étaient en train de percer. Chez plus d'un tiers des patients, les dents de sagesse étaient (38,4%) en occlusion. Une association entre l'angulation dentaire dans un plan transversal ainsi que sagittal et la distance de la racine de la dent au sinus maxillaire a pu être montré. Aussi l'os recouvrant la racine de la dent était proportionnel à l'angulation de la dent.

References

Almendros-Marques N, Berini-Aytes L, Gay-Escoda C: Evaluation of intraexaminer and interexaminer agreement on classifying lower third molars according to the systems of Pell and Gregory and of Winter. J Oral Maxillofac Surg 66: 893–899 (2008)

Arrigoni J, Lambrecht J T: Komplikationen bei und nach operativer Weisheitszahnentfernung. Schweiz Monatsschr Zahnmed 114: 1271–1286 (2004)

Baqain Z H, Karaky A A, Sawair F, Khraisat A, Duaibis R, Rajab L D: Frequency estimates and risk factors for postoperative morbidity after third molar removal: a prospective cohort study. J Oral Maxillofac Surg 66: 2276–2283 (2008)

Blondeau F, Daniel N G: Extraction of impacted mandibular third molars: postoperative complications and their risk factors. J Can Dent Assoc 73: 325 (2007)

Bouquet A, Coudert J L, Bourgeois D, Mazoyer J F, Bossard D: Contributions of reformatted computed tomography and panoramic radiography in the localization of third molars relative to the maxillary sinus. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 98: 342–347 (2004)

de Paula-Silva F W, Wu M K, Leonardo M R, da Silva L A, Wesselink P R: Accuracy of periapical radiography and cone-beam computed tomography scans in diagnosing apical periodontitis using histopathological findings as a gold standard. J Endod 35: 1009–1012 (2009)

Estrela C, Bueno M R, Leles C R, Azevedo B, Azevedo J R: Accuracy of cone beam computed tomography and panoramic and periapical radiography for detection of apical periodontitis. J Endod 34: 273–279 (2008)

Harrison D F: Oro-antral fistula. Br J Clin Pract 15: 169–174 (1961)

Haug R H, Perrott D H, Gonzalez M L, Talwar R M: The American Association of Oral and Maxillofacial Surgeons age-related third molar study. J Oral Maxillofac Surg 63: 1106–1114 (2005)

Jung Y H, Cho B H: Prevalence of missing and impacted third molars in adults aged 25 years and above. Imaging Sci Dent 43: 219–225 (2013)

Kilic C, Kamburoglu K, Yuksel S P, Ozen T: An Assessment of the relationship between the maxillary sinus floor and the maxillary posterior teeth root tips using dental cone-beam computerized tomography. Eur J Dent 4: 462–467 (2010)

Low K M, Dula K, Burgin W, Von Arx T: Comparison of periapical radiography and limited cone-beam tomography in posterior maxillary teeth referred for apical surgery. J Endod 34: 557–562 (2008)

Lübbers H T, Kruse A L, Obwegeser J A, Grätz K W, Eyrich G: Oblique high resolution tomography: The ideal plane for visualization of the gonial section of the mandibular canal and its related structures? J Healthc Eng 3: 87–104 (2012)

Lübbers H T, Matthews F, Damerau G, Kruse A L, Obwegeser J A, Grätz K W, Eyrich G K: Anatomy of impacted lower third molars evaluated by computerized tomography: is there an indication for 3-dimensional imaging? Oral Surg Oral Med Oral Pathol Oral Radiol Endod 111: 547–550 (2011a)

Lübbers H T, Matthews F, Damerau G, Kruse A L, Obwegeser J A, Grätz K W, Eyrich G K: No plane is the best one – the volume is! Oral Surg Oral Med Oral Pathol Oral Radiol Endod (2011b)

Nakagawa Y, Ishii H, Nomura Y, Watanabe N Y, Hoshiba D, Kobayashi K, Ishibashi K: Third molar position: reliability of panoramic radiography. J Oral Maxillofac Surg 65: 1303–1308 (2007)

Nakamori K, Fujiwara K, Miyazaki A, Tomihara K, Tsuji M, Nakai M, Michifuri Y, Suzuki R, Komai K, Shimanishi M, Hiratsuka H: Clinical assessment of the relationship between the third molar and the inferior alveolar canal using panoramic images and computed tomography. J Oral Maxillofac Surg 66: 2308–2313 (2008)

Rothamel D, Wahl G, d'Hoedt B, Nentwig G H, Schwarz F, Becker J: Incidence and predictive factors for perforation of the maxillary antrum in operations to remove upper wisdom teeth: prospective multicentre study. The British journal of oral & maxillofacial surgery 45: 387–391 (2007)

Susarla S M, Dodson T B: Preoperative computed tomography imaging in the management of impacted mandibular third molars. J Oral Maxillofac Surg 65: 83–88 (2007)

Tantanapornkul W, Okochi K, Bhakdinaronk A, Ohbayashi N, Kurabayashi T: Correlation of darkening of impacted mandibular third molar root on digital panoramic images with cone beam computed tomography findings. Dentomaxillofac Radiol 38: 11–16 (2009)

Wächter R, Stoll P: Komplikationen nach operativer Weisheitszahnentfernung im Oberkiefer. Eine klinische und röntgenologische Studie an 1013 Patienten mit statistischer Auswertung. Fortschr Kiefer Gesichtschir 40: 128–133 (1995)