ORIGINAL PAPERS

Dent. Med. Probl. 2011, **48**, 4, 465–473
ISSN 1644-387X

Anna Zawilska, Rafał Koszowski, Joanna Śmieszek-Wilczewska

Comparison of Anatomical Structure with the Orthopantomographic Image of the Impacted Third Molar Teeth

Porównanie budowy anatomicznej z obrazem pantomograficznym zatrzymanych trzecich zębów trzonowych

Department of Oral Surgery in Bytom, Medical University of Silesia, Bytom, Poland

Abstract

Objectives. The aim of the study was to determine the correlation between the structure of impacted third molar teeth (ITMT) and their radiological image in orthopantomographic images.

Material and Methods. The material consisted of medical documentation and ITMT extracted from 100 patients. In orthopantomographic X-ray images taken using digital technology with SIEMENS – Orthopos DS device, location and structural features of ITMT were evaluated. After surgical extraction of ITMT, the analysis of their anatomical structure was conducted. The data obtained on the basis of orthopantomogram evaluation were compared with the results of the physical examination of the extracted ITMT.

Results. Higher values in orthopantomograms were observed in the case of height and mean mesial-distal dimension of the tooth's crown. One-root and two-root teeth roots were longer on an X-ray than in reality. In orthopantomograms, teeth with three roots were recognized less frequently. ITMT in the maxilla had straight and widely placed roots more often. In X-ray images, root bending was recognized more frequently. ITMT in the mandible had elongated roots more often. Root shortening was found more frequently in orthopantomograms. In mesial-angular diagonal retention type, the extracted ITMT presented a tendency of root elongation more often than those observed in orthopantomograms.

Conclusions. There is a statistically significant risk of misdiagnosis during the evaluation of the number, shape and placement of ITMT on the basis of orthopantomographic X-ray images. Wrong identification of the number of ITMT roots is related mainly to teeth with three or more roots. Wrong identification of ITMT root length is related mainly to diagonal – mesial third molar retention type, whereas in the maxilla, the error consists usually in elongation, and in the mandible – in shortening of root images in relation to their actual dimensions. On the basis of orthopantomographic analysis, there is a significant risk of misidentification of wide placement of ITMT roots in the maxilla (**Dent. Med. Probl. 2011, 48, 4, 465–473**).

Key words: impacted third molar teeth, anatomical structure, orthopantomogram.

Streszczenie

Cel pracy. Określenie korelacji między budową zatrzymanych trzecich zębów trzonowych (z.t.z.t.) a ich obrazem radiologicznym na zdjęciach pantomograficznych.

Materiał i metody. Materiał stanowiła dokumentacja lekarska oraz z.t.z.t. usunięte 100 pacjentom. Na rentgenogramach pantomograficznych wykonanych techniką cyfrową aparatem SIEMENS – Orthopos DS oceniano położenie oraz cechy budowy z.t.z.t. Po operacyjnym usunięciu z.t.z.t. przeprowadzono analizę budowy anatomicznej. Porównano dane uzyskane na podstawie oceny pantomogramów oraz w wyniku oględzin usuniętych z.t.z.t.

Wyniki. Większe wartości na pantomogramach obserwowano w przypadku wysokości oraz średniego wymiaru mezjalno-dystalnego korony zęba. Długość korzeni zębów jednokorzeniowych oraz dwukorzeniowych miały większe wartości w rzeczywistości. Na pantomogramach rzadziej rozpoznawano zęby z trzema korzeniami. Z.t.z.t. w szczęce częściej miały proste i szeroko rozstawione korzenie. Na rentgenogramach częściej rozpoznawano zakrzywienie korzeni. Z.t.z.t. w żuchwie częściej miały korzenie wydłużone. Skrócenie korzeni częściej stwierdzano na pantomogramach. W skośnym mezjalnokątowym typie zatrzymania usunięte z.t.z.t. wykazywały większą tendencję do wydłużenia korzenia niż obserwowano to na pantomogramach.

Wnioski. Istnieje statystycznie znamienne niebezpieczeństwo błędu diagnostycznego podczas oceny liczby, kształtu i rozstawienia korzeni z.t.z.t. na podstawie rentgenogramów pantomograficznych. Błędne rozpoznanie liczby korzeni z.t.z.t. dotyczy przede wszystkim zębów posiadających trzy lub więcej korzeni. Błędna ocena długości korzeni z.t.z.t. dotyczy przede wszystkim skośno-mezjalnego typu zatrzymania trzecich trzonowców, przy czym w szczęce błąd oceny polega na wydłużeniu, a w żuchwie na skróceniu obrazu korzeni w stosunku do ich wymiarów rzeczywistych. Opierając się na analizie pantomograficznej, istnieje znamienne niebezpieczeństwo nierozpoznania szerokiego rozstawienia korzeni z.t.z.t. szczęki (**Dent. Med. Probl. 2011, 48, 4, 465–473**).

Słowa kluczowe: zatrzymane trzecie zęby trzonowe, budowa anatomiczna, pantomogram.

An impacted tooth – *dens retens* is a fully developed tooth that remains in the bone after the physiological period of eruption. Tooth retention is a time-related developmental disorder – delayed dentition. It could be either partial or total and with regard to the number of teeth – single or multiple. Usually, third molar teeth, upper cuspids and lower premolar teeth are impacted. The impacted third molar teeth (ITMT) extraction is one of the most common surgical procedures. However, it often creates huge difficulties and entails a high risk of intra- and postoperative complications. Such difficulties are caused e.g. by the various structure of ITMT and their position. Whereas usually, the structure of the crown does not have much influence on the complexity of the procedure, the variability of root structure clearly influences its course. ITMT extraction is one of the most difficult procedures in dental surgery [1–18].

The basic examination allowing dentists to make the diagnosis and determine the course of treatment in case of ITMT is the X-ray examination. The most commonly used projection that enables dentists to find an ITMT and determine its location is orthopantomogram [8, 9]. This X-ray is the initial projection, on the basis of which a possible decision on further diagnostic imaging is made. However, a detailed evaluation of ITMT morphology based on orthopantomogram may be difficult at times. It results from the projection conditions of tomograms (which also include orthopantomograms). Anatomical details of ITMT are visible when they appear in the image layer and do not project onto other structures. However, orthopantomogram in most cases enables dentists to determine the location of an ITMT, its position in relation to the alveoral recess of the maxillary sinus or mandibular canal and to evaluate the inclination of the tooth's axis to the occlusal plane [10]. All the above features speak for the orthopantomograph imaging. In clinical practice, an X-ray does not always accurately reflect the tooth's structure and its location determined during the procedure. Therefore, orthopantomogram projection in disputable cases or in case of uncommon position of an impacted tooth shall be complemented by other imaging methods. Images of transverse cross-sections of mandible and maxilla may be also obtained by modern orthopantogram devices, enabling dentists to take trans-sector images [13, 14]. The development of radiology made imaging methods using computed tomography (CT) or volumetric tomography – (CBCT – Cone Beam Computed Tomography) available to dental surgeons [16]. However, CT and CBCT, despite their numerous advantages are still an expensive solution, unavailable in routine diagnosis of a patient admitted for dental treatment. Determining the probability of accordance of an X-ray image with anatomical structure of ITMT in their specific retention types is significant for planning the surgical procedure, as well as determining its complexity and possible complications.

The aim of the study is to determine the correlation between the anatomical structure of ITMT and their X-ray image in orthopantomograph pictures.

Material and Methods

The material for the study was clinical documentation (case history, orthopantomograph X-rays, case-books), as well as ITMT extracted from 100 patients treated at the Chair and Department of Oral Surgery in Bytom, Medical University of Silesia during 2004–2006. The impacted teeth were extracted in operating room conditions. In orthopantomograph X-rays, the location and structural features of ITMT were evaluated. After surgical extraction of ITMT, the analysis of their anatomical structure was conducted. Only teeth which had not been damaged in a way making the analysis impossible were qualified for the structure evaluation.

The analysis of radiological images of ITMT was conducted on the basis of orthopantomographic pictures taken using digital technology with Siemens – Orthophos DS device using p1 program (full standard picture) with magnification ratio of ca. 1:1.19 (the image is magnified by ca. 19% in relation to its actual size) and resolution of 0.09 mm. The analysis of digital orthopantomographic pictures was conducted using DIGORA 2.1 software. Full name and statistical number were entered in the patient card. Using Image and Import tools, the orthopantomogram was imported to Digora software. The X-ray images were calibrated using the following tools: Calibrate – Method – Distance measurement – End and then measurements were taken.

After determining the neck and the biggest convexity (equator) of a tooth, the measurement of crown and root height was conducted. Crown's height was determined as the segment between all the visible cusp peaks and the tooth neck and then, the arithmetic mean was calculated. The length of the root(s) was measured between the radiological root apex and the tooth neck (Fig. 1).

The next phase was the analysis of the third molar retention type. It consisted in determining the occlusion plane using Ganss method. A line was drawn through the cusp peaks of the first premolar tooth and the mesial cusp peak of the second molar tooth. In case of lack of the first premolar, the second premolar tooth and in case of lack of the second molar – the first premolar tooth were used. The longitudinal axis of the tooth was determined by linking two points. The first point was in the middle of a segment running through the biggest crown convexity (equator) and the second point – at the root bifurcation. In case the root was single or if the roots created one block, the second point was determined at the radiological root apex. In case the roots were bent or there were more of them, the longitudinal axis was drawn through the point halfway between the neck and the equator of the tooth. In case the ITMT was the only tooth in the arch or if there was no tooth from the molar and premolar group, the occlusion plane was determined by drawing a straight line through two points put on the ridge of the alveoral process of maxilla or alveoral part of mandible. Then, the angle created by crossing the occlusion plane with the longitudinal axis of the tooth was measured, on the basis of which the retention type was determined.

Retention types were classified using Tetsch and Wagner [19] classification identifying: vertical retention (I), mesial-angular horizontal retention (IIa), distal-angular horizontal retention (IIb), oblique retention (III) and retention as dislocation (IV).

The following criteria were taken into consideration during the evaluation of the anatomical structure of ITMT: height, mesial and distal dimension, buccal and lingual/palatal dimension of the tooth crown, number of cusps, as well as number, length, shape and placement of roots. The measurements were taken using Topex slide caliper with the measurement accuracy of 0.1 mm. Each measurement was taken three times and the result being the arithmetic mean was entered into Microsoft Excel spreadsheet. The tooth crown height was calculated as the arithmetic mean of the distance between the tooth neck and the peak point on the labial, mesial, palatal/lingual and distal surfaces. The mesial and distal dimension was calculated as the distance between the points of biggest convexity on the mesial and distal surface. The buccal and lingual/palatal dimension was obtained by measuring the distance between the points of biggest convexity on the buccal and lingual/palatal surfaces. Root length was the distance between the tooth neck and the root peak.

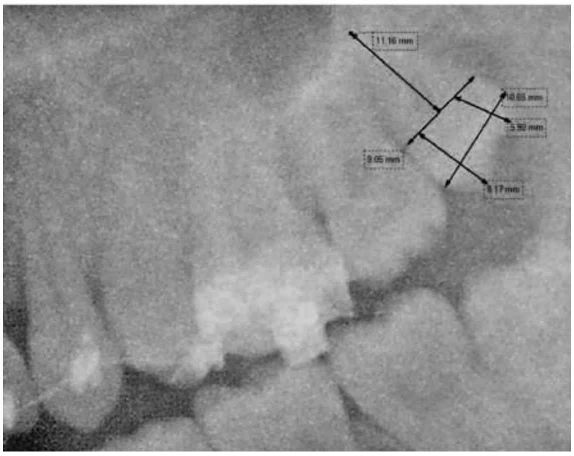


Fig. 1. Measurement of height and mesial-distal dimension of the crown, as well as the root length of ITMT in an orthopantomographic image

Ryc. 1. Pomiar wysokości i wymiaru mezjalno-dystalnego korony oraz długości korzenia/korzeni z.t.z.t. na zdjęciu pantomograficznym

Considering the number of roots, one-, two-, three- and multiple root teeth were identified. Classification by Sękalska and Kosmowska with author's [5] modifications was used to analyze the root morphology. This classification takes into consideration the length (1), shape (2) and placement (3) of the impacted teeth roots. The length of the roots is considered in the following categories: normal length (1), elongation (1.a) and shortening (1.b). The length of the roots was analyzed in relation to the crown height. Elongated teeth were teeth that were at least 1.5 times longer in relation to the crown and shortened teeth – shorter than 1.5 of the dimension of the crown height. As far as the shape is concerned, straight (2.a) and bent (2.b) roots were identified. The placement (3) of the roots was identified as: wide (3.a), narrow (3.b) and straight (3.c). They were related to the biggest crown convexity. Wide placement was determined when they exceeded the dimension of the biggest tooth crown convexity. Narrow placement – when they were clearly proximal and their placement did not exceed the biggest crown dimension and straight – when the root placement did not exceed the tooth's equator.

After the above analysis of the anatomical structure, pictures of each tooth were taken using a digital camera in three projections (masticatory, buccal and palatal/lingual surfaces). The photographs were stored in the computer memory. The obtained results were entered into Microsoft Excel software, and the X-ray image with measurements were archived using Screenshot Pilot software.

The obtained data were subject to statistical analysis using Statistica 7.1 PL software. The values calculated for measurable variables were presented as the arithmetic mean with the standard deviation (SD) or the standard error of the mean (SEM). The normal distribution was checked using Shapiro-Wilk test and the equality of variance – using Levene test. A comparative analysis for more than two groups was conducted using variance analysis, Kruskal-Wallis ANOVA rank test and *post-hoc* tests (NIR and multiple comparisons test), and for the comparison of two groups – test for independent samples and U Mann-Whitney test. For the evaluation of qualitative variables, Chi-square test, Yates-corrected Chi-square test and Fisher test were used. For correlation evaluation, Spearman test was used. Changes with significance level of $p < 0.05$ were considered as statistically significant.

Results

Among the 100 extracted ITMT, there were 23 upper and 77 lower teeth. 81 teeth were extracted from female patients and 19 from male patients. In women (n = 81), 18 teeth were extracted from the maxilla and 63 from the mandible and in men (n = 19), 5 from the maxilla and 14 from the mandible. Statistical analysis showed that the studied group was identical as far as the proportional distribution of ITMT occurrence in the maxilla and the mandible in patient of both sexes is concerned.

Statistically significant higher values than in reality were observed in the orthopantomograms in case of tooth crown height (X-ray mean = 7.84 ± ± 1.17 vs. tooth mean = 7.02 ± 2.28; $p < 0.002$) and the mean mesial and distal tooth crown dimension (X-ray mean = 13.1 ± 2.23 vs. tooth mean = 11.2 ± 1.03; $p < 0.001$). The length of one-root teeth (tooth mean = = 12.2 ± 2.75 vs. X-ray mean = 10.2 ± 4.85; $p < 0.036$) and the length of both roots of two-root teeth (tooth mean = 11.5 ± 2.96 vs. X-ray mean = 8.8 ± 4.69, $p < 0.001$ and tooth mean = 11.9 ± 2.86 vs. X-ray mean =

Table 1. Comparing ITMT dimensions with the dimensions of their radiological image

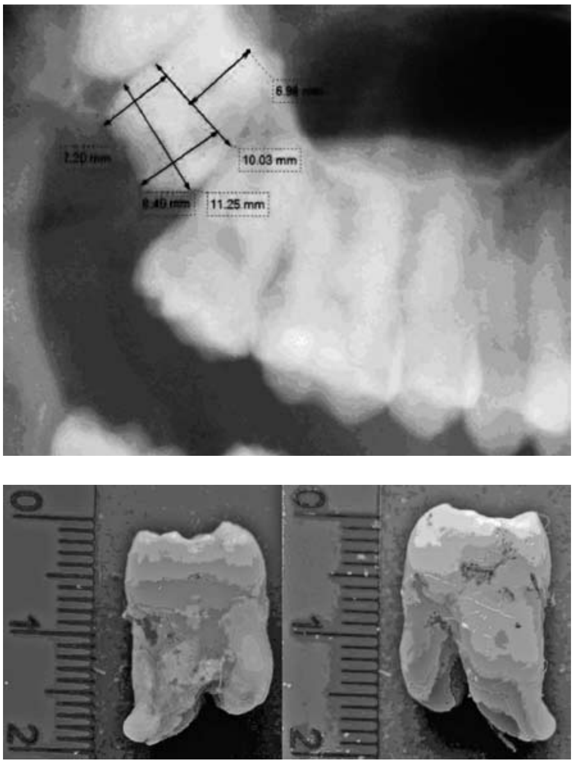
Tabela 1. Porównanie wymiarów z.t.z.t. z wymiarami ich obrazu radiologicznego

Evaluated dimension (Oceniany wymiar)	Tooth (Ząb)		Orthopantomogram (Pantomogram)		p value (Istotność statystyczna)
	mean (mm)	SD	mean (mm)	SD	
Crown height (Wysokość korony)	7.02	2.28	7.84	1.17	0.002
Mesial-distal crown dimension (Wymiar mezjalno-dystalny korony)	11.2	1.03	13.1	2.23	< 0.001
Root length of one-root teeth (Długość korzeni zęba jednokorzeniowego)	12.2	2.75	10.2	4.85	0.036
Root length of two-root teeth – root 1 (Długość korzeni zęba dwukorzeniowego – korzeń 1)	11.5	2.96	8.8	4.69	0.001
Root length of two-root teeth – root 2 (Długość korzeni zęba dwukorzeniowego – korzeń 2)	11.9	2.86	9.5	4.37	0.002
Root length of three-root teeth – root 1 (Długość korzeni zęba trzykorzeniowego – korzeń 1)	12.0	3.20	7.8	5.52	0.211
Root length of three-root teeth – root 2 (Długość korzeni zęba trzykorzeniowego – korzeń 2)	10.7	1.96	9.6	4.09	0.387
Root length of three-root teeth – root 3 (Długość korzeni zęba trzykorzeniowego – korzeń 3)	15.2	5.37	8.3	1.05	0.369
Root length of the teeth with more than three roots (Długość korzeni zęba z więcej niż 3 korzeniami)	7.51	1.57	–	–	–

Table 2. Comparing the number of the extracted ITMT roots with the number of roots visible in orthopantomograms

Tabela 2. Porównanie liczby korzeni usuniętych z.t.z.t. z liczbą korzeni widocznych na pantomogramach

Number of roots (Liczba korzeni)	Tooth (Ząb)	Orthopantomogram (Pantomogram)	p value (Istotność statystyczna)
1	33	40	0.304
2	51	58	0.321
3	14	2	0.002
↑ 3	2	0	0.156

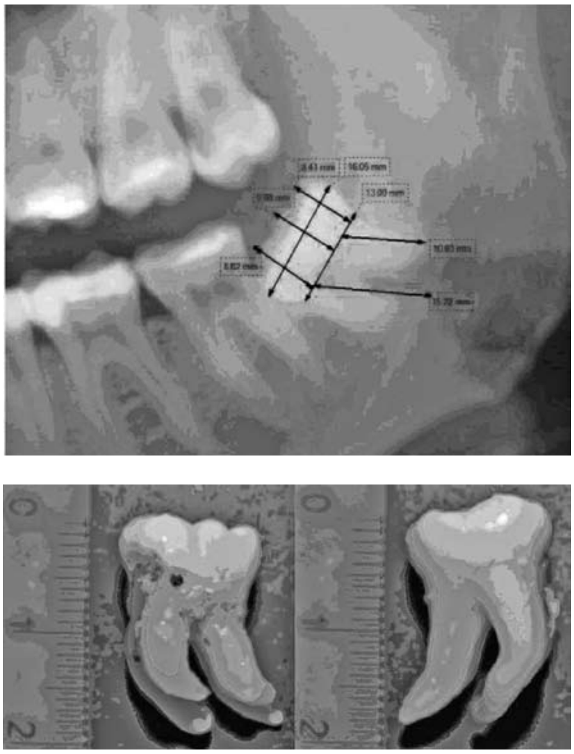


a)

b)

Fig. 2. ITMT 18 in a distal-angular diagonal position: a) orthopantomogram, ITMT 18 in a distal-angular diagonal position, one root is visible as a fused/merged system; b) ITMT 18 after extraction, widely placed two roots of a simple type, both as fused/merged root systems

Ryc. 2. Z.t.z.t. 18 w położeniu skośnym dystalnokątowym: a) pantomogram, z.t.z.t. 18 w położeniu skośnym dystalnokątowym, widoczny jest jeden korzeń jako zlany/zrośnięty system; b) z.t.z.t. 18 po usunięciu, obecne rozstawione dwa korzenie o typie prostym, oba jako zlane/zrośnięte systemy korzeniowe



a)

b)

Fig. 3. ITMT 38 in a mesial-angular diagonal position: a) orthopantomogram, visible ITMT 38 in a mesial-angular diagonal position with two roots; b) ITMT 38 after extraction, four bent, elongated roots were found

Ryc. 3. Z.t.z.t. 38 w położeniu skośnym mezjalnokątowym: a) pantomogram, widoczny z.t.z.t. 38 w położeniu skośnym mezjalnokątowym z dwoma korzeniami; b) z.t.z.t. 38 po usunięciu, stwierdzono cztery korzenie zakrzywione i wydłużone

= 9.5 ± 4.37; $p < 0.002$) were of higher values in reality than in the orthopantomographic images (Tab. 1).

Three-root teeth were identified in the orthopantomograms less frequently than in reality and no teeth with more than three roots were identified. The actual number of ITMT roots was determined in such cases only after tooth extraction (Tab. 2, Fig. 2).

ITMT in the maxilla had straight (2.a) and widely placed (3.c) (7 vs. 0, $p < 0.001$) roots more often than it was found in the orthopantomograms (19 vs. 12, $p < 0.025$), whereas on X-ray images, root bending (2.b) was found more often than in reality (12 vs. 5, $p < 0.030$). Those discrepancies were statistically significant (Tab. 3).

ITMT In the mandible had elongated roots (1.a) more often in reality than in the orthopantomograms (48 vs. 26, $p < 0.001$). Root shortening (1.b), however, was more often found in the orthopantomograms (51 vs. 29, $p < 0.001$). Those differences were statistically significant (Tab. 3).

In mesial-angular diagonal retention type, the extracted ITMT roots were more often elongated in reality than in the orthopantomograms (31 vs. 16;

Table 3. Length, shape and placement of ITMT roots in the maxilla and the mandible. Comparison of anatomical structure with radiological image

Tabela 3. Długość, kształt i rozstawienie korzeni z.t.z.t. w szczęce i żuchwie. Porównanie budowy anatomicznej i obrazu radiologicznego

Maxilla (Szczęka) n = 23	Tooth (Ząb)	Orthopantomogram (Pantomogram)	p value (Istotność statystyczna)
1.a	8	11	0.368
1.b	15	12	0.369
2.a	19	12	0.025
2.b	5	12	0.030
3.a	2	0	0.090
3.b	4	2	0.377
3.c	7	0	< 0.001

Mandible (Żuchwa) n = 77	Tooth (Ząb)	Orthopantomogram (Pantomogram)	p value (Istotność statystyczna)
1.a	48	26	< 0.001
1.b	29	51	< 0.001
2.a	58	63	0.326
2.b	42	30	0.052
3.a	2	2	1.000
3.b	23	32	0.130
3.c	31	23	0.177

1.a – elongated root, 1.b – shortened root, 2.a – straight root, 2.b – bent root, 3.a – widely placed roots, 3.b – narrowly placed roots, 3.c – straight placed roots.

1.a – korzeń wydłużony, 1.b – korzeń skrócony, 2.a – korzeń prosty, 2.b – korzeń zakrzywiony, 3.a – korzenie szeroko rozstawione, 3.b – korzenie wąsko rozstawione, 3.c – korzenie prosto rozstawione.

$p < 0.004$). This difference was statistically significant (Tab. 4).

In the mesial-angular diagonal retention, root elongation was observed more often in radiograms than it was found after the extraction of maxillary ITMT (4 vs. 0; $p < 0.024$), whereas the extracted ITMT had a tendency of root shortening (5 vs. 1; $p < 0.024$) (Tab. 4). In distal-angular diagonal retention, the extracted maxillary ITMT had simple root placement more often in reality than in radiograms (4 vs. 0; $p < 0.046$). In mesial-angular diagonal retention of the extracted mandibular ITMT, root elongation was more frequent than it was found in the orthopantomograms (31 vs. 12; $p < 0.001$), whereas the orthopantomograms showed their shortening (41 vs. 22; $p < 0,001$) (Tab. 4).

Discussion

The analysis of third molar teeth retention types on the basis of orthopantomographic pictures is a necessary diagnostic tool preparing the surgeon for performing a surgical procedure and anticipating probable difficulties that they may encounter during the surgery. Such type of analysis is also useful for orthodontists to anticipate third molar eruption or their possible influence on the patient's occlusion norm [10]. The own studies showed that the most common retention type is diagonal retention (n = 73), where as distal-angular type was more frequent in the maxilla (n = 12) and mesial-angular – in the mandible (n

Table 4. Length, shape and placement of ITMT roots in their specific retention types

Tabela 4. Długość, kształt i rozstawienie korzeni z.t.z.t. w poszczególnych typach zatrzymania

Retention type (Typ zatrzymania)	Tooth (Ząb) ret.-I n = 23	X-ray (RTG) ret.-I n = 23	p value (Istotność statystyczna)	Tooth (Ząb) ret.- II.1 n = 58	X-ray (RTG) ret.-II.1 n = 58	p value (Istotność statystyczna)	Tooth (Ząb) ret.- II.2 n = 15	X-ray (RTG) ret.- II.2 n = 15	p value (Istotność statystyczna)
1.a	15	12	0.549	31	16	0.004	7	8	0.715
1.b	8	11	0.369	27	42	0.004	8	7	0.715
2.a	19	17	0.473	44	45	0.826	12	10	0.407
2.b	9	8	0.760	29	26	0.577	6	7	0.712
3.a	0	0	1.000	3	2	0.646	1	0	0.233
3.b	7	10	0.358	18	19	0.842	1	3	0.273
3.c	7	4	0.279	24	19	0.336	6	0	0.022

Ret. – retention: I – vertical, II.1 – mesial-angular diagonal, II.2 – distal-angular diagonal.
1.a – elongated root, 1.b – shortened root, 2.a – straight root, 2.b – bent root, 3.a – widely placed roots, 3.b – narrowly placed roots, 3.c – straight placed roots.

Ret. – retencja: I – pionowa, II.1 – skośna mezjalnokątowa, II.2 – skośna dystalnokątowa.
1.a – korzeń wydłużony, 1.b – korzeń skrócony, 2.a – korzeń prosty, 2.b – korzeń zakrzywiony, 3.a – korzenie szeroko rozstawione, 3.b – korzenie wąsko rozstawione, 3.c – korzenie prosto rozstawione.

= 53). Those observations are also confirmed by Tetsch and Wagner's studies [19]. In the own material, the second most frequently occurring retention was vertical retention (n = 23), whilst it was more frequently found in the maxilla (n = 18) than in the mandible (n = 5). Tetsch and Wagner [19] report that the distribution of such retention type for the maxilla and the mandible is 62.9% and 38.2%, respectively. Cieślińska-Wilk et al. [20], however, report that the vertical retention type is most common. In the own studies, horizontal retention type was reported by the author as very rare and related to mesial-angular subtype (n = 3) and no distal-angular horizontal retention was found. The own studies showed mesial-angular horizontal retention in the mandible only in two cases, whereas only in one case in the maxilla. Tetsch and Wagner [19] also state that such retention type is uncommon and related rather to the mandible than to the maxilla. They also report that there is no distal-angular subtype at all in the mandible, and no mesial-angular subtype in the maxilla. Cieślińska-Wilk et al. [20] also describe such type as the most uncommon. In the own study, the author found only one case of retention as dislocation and it was related to the mandibular angle area. Tetsch and Wagner [19] describe such retention as uncommon, they think, however, that it is related to the maxilla more often than to the mandible. Those authors stress that in case of dislocation in the maxilla, such teeth are located mostly in the maxillary sinus, and in case of mandible – near its ramus.

In the literature available, there are not many studies related to the evaluation of discrepancies between X-ray images and anatomical structure of ITMT. Such studies were conducted by Grzesiak-Janas et al. [7], showing that determining tooth structure on the basis of an X-ray image taken before the procedure is important for the surgeon. The above authors state that X-ray pictures not always reflect anatomical structure of teeth faithfully and unequivocally. In the studies conducted, they showed that only in 54% of cases, there was a conformity between the orthopantomographic image and the actual number of teeth roots determined after the extraction. They also observed that the probability of misinterpreting the number of roots in the orthopantomograms increases in case of parallel placement of multi-root teeth and the occurrence of anomalies in their structure. In the own study, the author also reported the non-conformity of the number of ITMT roots visible in orthopantomograms in relation to their number reported after the extraction, in case of teeth with three or more roots. Grzesiak-Janas et al. [7] also point out that in 4.08% of cases, roots were not visible at all in the radiological image. Therefore, we may say that the more complicated the structure of ITMT, the higher probability of misdiagnosis using the orthopantomogram. Michalska, Kociński and Różyło [21] stress the advantages of an alternative method of taking orthopantomographic images using digital radiography. They include significant reduction of radiation dose (up to 10 times lower in comparison with an orthopantomogram taken using the traditional method) and the possibility of post-processing, i.e. processing of the obtained image. Processing of images taken using digital method allows us to analyze the obtained image, conduct measurements and evaluate changes in distribution of grey. An important advantage of digital X-ray images is the possibility to make slight retouching that may prove helpful in their interpretation. However, this functionality cannot be used when the X-ray image is hardly legible.

In the own studies, a comparative analysis of the extracted ITMT morphology with their X-ray image was conducted. It proved that on the basis of the analysis of the orthopantomograms, there is a statistically significant danger of making a diagnosis error concerning the dimension, as well as the number, shape and placement of the ITMT roots. Wrong identification of root number is related mostly to teeth having three or more roots. In the X-ray images, statistically significantly more often, fewer number of roots is found. Wrong evaluation of ITMT root length is related mostly to the diagonal-mesial retention type. In the maxilla, the error consists in elongation and in the mandible – in shortening of the ITMT root image in relation to their dimensions observed after the extraction. The own studies also showed that on the basis of orthopantomographic analysis, there is a significant risk of misdiagnosing the wide placement of ITMT roots in the maxilla.

It should be remembered that the orthopantomographic image is magnified. The magnification range depends on the device used to take the pictures. In the conducted studies, Siemens – Orthophos DS device was used with the magnification ratio of 1.19. Incorrect information concerning ITMT structure provided by the orthopantomogram result in many cases from the fact that it is a layer projection. The object in front of or behind the projected layer in such study may be blurred or even not visible. Localization of a given structure behind the projected layer may also lead to its undetection or incorrect evaluation. Such problem was also observed in the own material. During the analysis of an X-ray picture it should be also remembered that in the situation of projecting different anatomical structures, as in the case of tooth root, their image overlaps and gives an impression of single element, which may also lead to misdiagnosis [22–26].

Despite its advantages, orthopantomographic projection entails many faults, influencing significantly the probability of misdiagnosing in relation to ITMT. Failure to identify all the structural features of ITMT makes the surgical procedure more difficult, which may result in intraoperative complications. Because the third molar retention is frequent, this problem is of great importance, therefore there is a need for using other imaging method. One of such methods could be computed tomography. However, because of the radiation dose, costs and availability of equipment, this method is not always recommended or possible to use. It seems that in the nearest future, volumetric imaging, CBCT, could become an alternative [27]. This technique is classified as layer method. Single dose, to which a patient is exposed is ten times lower than the dose absorbed during computed tomography and it is comparable with the exposure during an orthopantomographic examination. Such projection gives a possibility to make 3D reconstructions, as well as trans-sector and occlusion projections [28–32].

The authors may assume that wider availability of this imaging method in the nearest future will be a breakthrough in radiological diagnostics in dentistry, especially in dental surgery.

In conclusion: there is a statistically significant risk of misdiagnosis during the evaluation of the number, shape and placement of ITMT on the basis of orthopantomographic X-ray images. Wrong identification of the number of ITMT roots is related mainly to teeth with three or more roots. Wrong identification of ITMT root length is related mainly to diagonal – mesial third molar retention type, whereas in the maxilla, the error consists usually in elongation, and in the mandible – in shortening of root images in relation to their actual dimensions. On the basis of orthopantomographic analysis, there is a significant risk of misidentification of wide placement of ITMT roots in the maxilla.

References

[1] Skorek A., Narożny W., Stankiewicz C.: Retencja zębów w szczęce. Otolaryngol. Pol. 2000, 54, 607–610.

[2] Różyło T.K.: Najczęstsze przyczyny występowania zębów zatrzymanych u dzieci. Prz. Stomatol. Wieku Rozw. 1995, 2, 42–46.

[3] Michalik J.: Trudności diagnostyczne w przypadku transpozycji dolnego zęba mądrości. Czas. Stomatol. 1991, 44, 461–464.

[4] Różyło T., Walawska B., Różyło-Kalinowska I.: Zjawisko migracji zębów zatrzymanych. Prz. Stomatol. Wieku Rozw. 2000, 3/4, 32–36.

[5] Sękalska E., Kosmowska B.: Zniekształcenia korzeni zębów trzonowych trzecich szczęki i żuchwy. Mag. Stomatol. 2005, 15, 56–57.

[6] Morris C.R., Jerman A.C.: Panoramic radiographic survey: a study of embedded third molars. J. Oral Surg. 1971, 29, 122–125.

[7] Białkowska-Głowacka J., Grzesiak-Janas G., Ratajek-Gruda M.: Ocena rozbieżności w obrazie klinicznym i radiologicznym liczby korzeni zębów stałych z nieprawidłową budową anatomiczną. Mag. Stomatol. 2005, 15, 60–62.

[8] Zawilska A., Koszowski R., Puchała P.: Zatrzymane zęby trzonowe trzecie – usuwać czy pozostawiać? Przegląd piśmiennictwa. Mag. Stomatol. 2006, 16, 18–20.

[9] Lewandowski B.: Analiza wskazań do operacyjnego usuwania zatrzymanego dolnego zęba mądrości. Czas. Stomatol. 1984, 37, 4, 239–243.

[10] Kozakiewicz M., Kolasa E., Arkuszewski P.: Analiza wskazań do usuwania zębów trzonowych trzecich. Mag. Stomatol. 2002, 12, 58–62.

[11] Plakwicz P., Popowiski W., Wieczorek P., Wychowański P., Juszczyk-Popowska B.: Powikłania po chirurgicznym usuwaniu dolnego trzeciego trzonowca w materiale Zakładu Chirurgii Stomatologicznej IS AM w Warszawie. Nowa Stomatol. 1999, 4, 36–40.

[12] Nowak E., Waśkowska J.: Powikłania po usuwaniu zębów trzonowych trzecich wymagających leczenia szpitalnego. Mag. Stomatol. 2000, 10, 46–48.

[13] Łopatyńska-Kawko J.: Rola trzeciego trzonowca w występowaniu trzeciego stłoczenia zębów. Czas. Stomatol. 1987, 40, 339–346.

[14] Śmiech-Słomkowska G.: Usuwanie zębów w leczeniu nieprawidłowości zgryzowych. Mag. Stomatol. 1994, 4, 20–23.

[15] Szczepańska I., Młynarska-Zduniak E.: Przydatność zdjęć pantomograficznych do analizy pomiarowej. Czas. Stomatol. 1978, 31, 1069–1075.

[16] Dos-Santos D.T., Costa-e-Silva A.P., Vannier M.W., Cavalcanti M.G.: Validity of multislice computerized tomography for diagnosis of maxillofacial fractures using an independent workstation. Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod. 2004, 98, 715–720.

[17] Koszowski R., Raczkowska-Siostrzonek A., Morawiec T.: Przydatność radiografii cyfrowej w chirurgii stomatologicznej. Przegl. Lek. 2002, 59 suppl. 4, 48–51.

[18] Hassfeld S., Muhling J.: Computer assisted oral and maxillofacial surgery – a review and an assessment of technology. Int. J. Oral Maxillofac. Surg. 2001, 30, 2–13.
[19] Tetsch P., Wagner W.: Die operative Weisheitszahnentfernung. Munchen, Wien, Hauser, 1982.
[20] Cieślińska-Wilk G., Marcickiewicz E.: Korelacja badań klinicznych i radiologicznych patologii stałych trzonowców. Pol. Prz. Radiol. 1989, 53, 2/4, 84–88.
[21] Michalska A., Kiciński M., Różyło T.K.: Radiografia cyfrowa. Mag. Stomatol. 2008, 18, 12–16.
[22] Dominiak M., Mierzwa-Dudek D., Zawada A.: Anomalia rozwojowe zębów – przegląd piśmiennictwa. Czas. Stomatol. 2003, 56, 687–690.
[23] Widawska-Stachurska J.: Niektóre problemy zębów mądrości. Czas. Stomatol. 1985, 38, 551–553.
[24] Ratajek-Gruda M., Grzesiak-Janas G., Janas A.: Różnorodność budowy anatomicznej korzeni dolnych trzecich zębów trzonowych w obrazie radiologicznym. Mag. Stomatol. 2006, 16, 68–70.
[25] Szczepańska I., Młynarska-Zduniak E.: Przydatność zdjęć pantomograficznych do analizy pomiarowej. Czas. Stomatol. 1978, 31, 1069–1075.
[26] Pawelzik J., Cohnen M., Willers R., Becker J.: A comparison of conventional panoramic radiographs with volumetric computed tomography images in the preoperative assessment of impacted mandibular third molars. J. Oral Maxillofac. Surg. 2002, 60, 979–984.
[27] Angelopoulos C., Thomas S., Hechler S., Parissis N., Hlavacek M.: Comparison between digital panoramic radiography and cone-beam computed tomography for the identification of the mandibular canal as part of presurgical dental implant assessment. J. Oral Maxillofac. Surg. 2008, 66, 2130–2135.
[28] Maal T.J., Plooij J.M., Rangel F.A., Mollemans W., Schutyser F.A., Berge S.J.: The accuracy of matching three-dimensional photographs with skin surfaces derived from cone-beam computed tomography. Int. J. Oral Maxillofac. Surg. 2008, 37, 641–646.
[29] Howerton W.B. Jr., Mora M.A.: Advancements in digital imaging: what is new and on the horizon? J. Am. Dent. Assoc. 2008, 139 Suppl, 20–24.
[30] Parkinson C.R., Sasov A.: High-resolution non-destructive 3D interrogation of dentin using X-ray nanotomography. Dent. Mater. 2008, 24, 773–777.
[31] Ludlow J.B., Ivanovic M.: Comparative dosimetry of dental CBCT devices and 64-slice CT for oral and maxillofacial radiology. Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod. 2008, 106, 930–938.
[32] Tipton W.L., Metz P.: Three dimensional computed technology – a new standard of care. Int. J. Orthod. Milwaukee 2008, 19, 15–21.

Address for corespondence:

Anna Zawilska
Department of Oral Surgery in Bytom
Medical University of Silesia
Plac Akademicki 17
41-902 Bytom
Poland
Tel.: +48 32 282 74 78 (Secretary's Office)
E-mail: chirstom@slam.katowice.pl

Received: 25.07.2011
Revised: 24.08.2011
Accepted: 3.10.2011

Praca wpłynęła do Redakcji: 25.07.2011 r.
Po recenzji: 24.08.2011 r.
Zaakceptowano do druku: 3.10.2011 r.