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Pre-Operative Assessment of the Relationship between Mandibular Third Molar and Mandibular Canal in Tunisian Population

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Abstract: Preoperative radiographic examination of mandibular third molars (MTM) is essential to prevent inferior alveolar nerve injury during extraction. The purpose of this study was to assess the reliability of panoramic signs of the relation between the roots of mandibular third molars (MTM) and the mandibular canal (MC), and to compare panoramic signs with 3D exploration findings. A prospective study performed in the department of oral medicine and oral surgery at the university dental clinic of Monastir during one year, from April 1st 2014 to March 31st 2015. An information sheet was completed for each patient who underwent an extraction of MTM. A sample of these patients benefited from an anatomo-radiological study of their extracted MTM. The representative sample included 1679 patients with a mean age of 31 ± 13 years and a sex ratio of 0.61. The most common cause of MTM extraction is pericoronitis (67.85%). Panoramic radiography of 224 mandibular third molars was evaluated to determine the relation of the MTM roots to the MC. The most radiographic sign was the interruption of the white line (56%) and darkening of the roots (19.64%). A 3D exploration was requested for 12.5% of the cases 67.85% of which showed contact between the MC and the root tip of the MTM. Interruption of the white line and darkening of the roots on panoramic radiographs might be highly suggestive of the risk of nerve injury.
Keywords: Cone-beam computed tomography; Conventional computed tomography, panoramic radiography, Mandibular third molar, Mandibular canal, Inferior alveolar nerve injury

INTRODUCTION

Extraction of mandibular third molars (MTM) is a routine procedure in oral surgery, with several possible postoperative complications [1]. Neurological injury is a rare but serious complication undergoing the operation. The incidence of inferior alveolar nerve (IAN) injury ranges from 0.4 to 6% [2-4]. Some authors have reported that the most important factor for IAN injury is the anatomical relationship between the MTM and the mandibular canal (MC) [5, 6]. Before planning extraction of MTM, the proximity between the MC and the MTM should be assessed to minimize the risk of IAN using imaging examination [7, 8].

Panoramic radiography is most commonly used as the standard diagnostic imaging method for this purpose in clinical practice [9]. The presence of certain radiographic signs on panoramic radiograph indicates a raised risk of IAN involvement [10]. In many cases, panoramic images are sufficient for preoperative assessment of MTM; however, panoramic radiography produces two-dimensional images; it cannot provide information in axial, coronal and sagittal planes [11]. 3-D exploration modalities imaging with conventional computed tomography (CCT) and cone-beam computed tomography (CBCT) provide cross-sectional (buccolingual) that can be used to assess in detail the relationship between the IAN and the MTM [12].

The aim of this study was to examine the anatomo-radiological profile of the MTM as well as to compare between 3D exploration and panoramic radiography findings in detecting the relationship between panoramic signs and the presence of contact between the MTM and the MC. This study provides also information to assist clinicians in deciding when 3D exploration is required in the preoperative examination of MTM.

METHODS

Patients

It is a prospective study conducted in the department of oral medicine and oral surgery at the university dental clinic of Monastir from April 1st 2014

to March 31st 2015. An information sheet was completed for each patient (Population A). Then, we were interested in the patients who underwent an extraction of MTM. A sample of these patients benefited from an anatomo-radiological study of their extracted MTM (population B).

Informed consent was obtained from all volunteers. This study included 11894 patients with a mean age of 39 ± 13 years and a sex ratio of 0.84. The patients underwent preoperative radiographic examination to evaluate the relationship between MTM and the MC. Extractions represent the highest percentage (53.55%) of the performed acts, in which 26.35% are those of MTM. 224 molars benefited from an anatomo-radiological study.

Imaging

The position of the 224 extracted third molars was documented according to the classifications of Pell and Gregory [13], and winter [14], together with the type of mucosal and bony coverage involved. These tooth position parameters were radiologically assessed by tracing 4 lines on the previously scanned ortho-panoramic radiographs of the patients (Figure 1) to provide (1) the line of the occlusal plane, established by the occlusal surfaces of the lower first and second molars; (2) the cervical line, delimited by the cementoenamel junction (these first 2 lines allow third molar classification according to depth [Pell and Gregory positions A (the occlusal plane of the impacted tooth is the same level as the occlusal plane of the second molar), B(The occlusal plane of the impacted tooth is between the occlusal plane and the cervical line of the second molar), and C (The impacted tooth is below the cervical line of the second molar)]; (3) the line of the lower margin of the ascending mandibular ramus, indicating the degree of third molar impaction with respect to the ascending ramus (Pell and Gregory classes I (there is sufficient space between the ramus and the distal part of the second molar for the accommodation of the mesiodistal diameter of the third molar), II (The space between the second molar and the ramus of the mandible is less than the mesiodistal diameter of the third molar), and III (all or most of the third molar is in the ramus of the mandible), and the absence or presence of partial or total bony coverage; and (4) the longitudinal axis of the third molar, which forms an angle with the occlusal plane delimiting its inverted, horizontal, mesioangular, vertical, or distoangular angulation (Winter classification).

Obtainment of the angle α between the occlusal plane or line parallel to it and the longitudinal axis of the impacted third molar, in turn, allowed objective classification of the third molars within the Winter subclasses, as follows: (1) third molars with negative angles (0°) were considered to be inverted, (2) third molars with an angle between 0° to 30° were considered to be horizontal, (3) third molars with an angle between 31° to 60° were considered to be mesioangular, (4) third molars with an angle between 61° to 90° were considered to be vertical, and (5) third molars with an angle 90° were considered to be distoangular. Mucosal coverage was used to divide MTM into teeth without mucosal coverage, third molars with partial mucosal and third molars with total mucosal coverage. In the same way, the third molars were distributed according to bony coverage into 3 subtypes: molars without bony coverage, molars with partial bony coverage, and teeth with total bony coverage.

The relationship between the MTM and the MC was evaluated on panoramic images according to criteria established by Rood and Shehab [15] and included the following (Figure2): Sign1.Dark and bifid apex (Fig. 2a); Sign2: Interruption of the white line(s) of the canal (Fig.2b); Sign 3: Diversion of the canal (Fig. 2c); Sign 4: Narrowing of the canal: (Fig. 2d); Sign 5: Narrowing of the root (Fig. 2e); Sign 6: Deflection of the root (Fig. 2f); Sign7: Darkening of the root (Fig. 2g). In 3D exploration, the buccolingual relationship between the MTM and the MC was classified as buccal, lingual, interradicular or inferior [10, 16] . The position of the MC with respect to the third molar was classified as contact (no bone between the MC and the MTM) or no contact (bone between the MC and MTM) [17].

DATA ANALYSIS

Obtained data were statistically analyzed with descriptive statistics using WinDev software (this software was made at our request by a computer engineer.

RESULTS

The study population included 11894 patients with a mean age of 39 ± 13 years and a sex ratio of 0.84. Extractions represent the highest percentage (53.55%) of the performed acts, in which 26.35% are those of MTM. The study population B included 224 teeth in 222 individuals. The age of patients varies from 19 years to more than 90 years. A total of 71 (31.7%) MTM were horizontal, 65 (29 %) MTM were vertical, 56 (25 %) MTM were mesioangular, and 31 (13.85%) MTM were distoangular.

The predominant position according to the Pell and Gregory classification was IIB (32.89%), followed by IB (23.68%) and IA (15.78%). No third molar was found to be in position IIIA. About third of the molars (31.61%) were horizontal and more than two thirds (67.41%) MTM with partial mucosal coverage (Table 1) .The MTM belonging to Pell and Gregory classification categories IIB and IB were the teeth with the greatest number of infectious raison of extraction. The most common cause of MTM extraction is pericoronitis (67.85%). The most radiographic sign observed on panoramic images was the interruption of

the white line (56%) and darkening of the roots (19.64%) (Figure 3). A 3D exploration was requested for 12.5% of the cases in wich panoramic radiographic sign were the interruption of the white line (67.85%).

In the present study, contact between the third molar roots and the MC was most often detected on 3D exploration images in cases with interruption of the white line of the MC and darkening of the roots on panoramic images (67.85%) (Table 2) .The MC was most often located on the apical side of the MTM, and there was often contact between the MTM and the MC (28.58%) (Table 3).

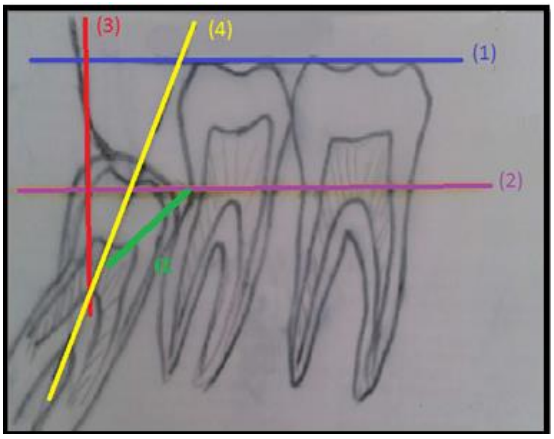

Fig-1: Lines tracing

(1: blue) the line of the occlusal plane; (2: purple) the cervical line; (3: red) the line of the lower margin of the ascending mandibular ramus ;(4: yellow) the longitudinal axis of the third molar and angle α (green).

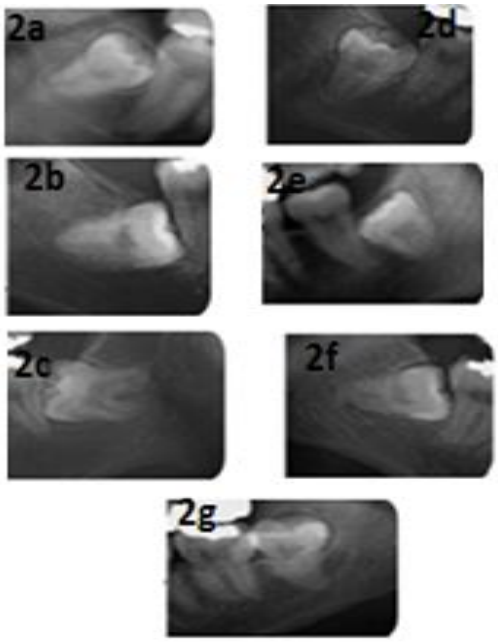

Fig-2: Schematic drawings of the panoramic radiographic risk factors of IAN injury during mandibular third molar surgery

2a: Dark and bifid apex; 2b: Interruption of the white line(s) of the canal; 2c: Diversion of the canal; 2d: Narrowing of the canal; 2e: Narrowing of the root; 2f: Deflection of the root; 2g: Darkening of the root.

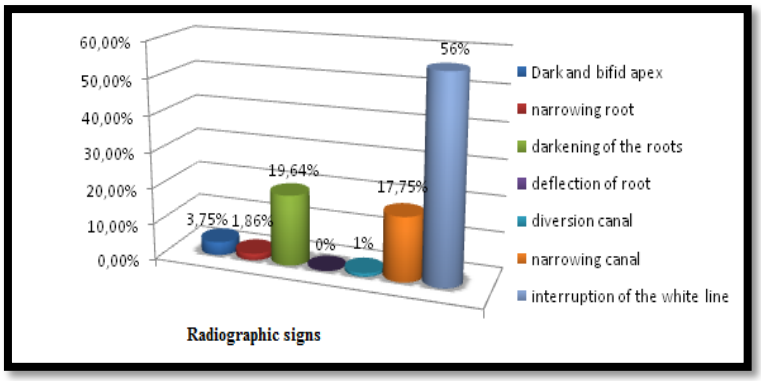

Fig-3: Histogram of radiographic signs observed on panoramic images

Table-1: Comparison between panoramic radiographic signs and position of mandibular canal with mandibular third molar in 3D exploration

Panoramic radiographic sign 2D	Position of mandibular canal with mandibular third molar in 3D exploration		Total
	No contact	Contact	
No specific signs	0	0%	0%
Dark and bifid apex	0	3,57%	3,57%
Narrowing root	0	3,57%	3,57%
Darkening of the roots	7,15%	14,29%	21,42%
Deflection of root	0	0%	0%
Diversion canal	0	0%	0%
Narrowing canal	0	3,57%	3,57%
Interruption of the white line	25%	42,85%	67,85%
Total	32,15%	67,85%	100%

Table-2: Distribution of mandibular third molar position according to their proximity to the mandibular canal on 3D exploration

	Buccolingual relationship between mandibular canal and mandibular third molar					
Position of mandibular canal with mandibular third molar	No Contact	Buccal	Interradicular	Inferior	Lingual	Total
		0%	0%	28,57%	3,58%	32,15%
	Contact	10,71%	7,14%	28,58%	21,42%	67,85%
Total		10,71%	7,14%	57,15%	25%	100%

Table-3: Distribution of MTM position according to their proximity to the IMC on 3D exploration examination

		Buccolingual relationship IAC/ MTM				
		Buccal	Interradicular	Inferior	Lingual	Total
Position IAC / MTM	No contact	0	0	28.57%	3.58%	32.15%
	Contact	10.71%	7.14%	28.58%	21.42%	67.85%
Total		10.71%	7.14%	57.15%	25%	100%

DISCUSSIONS

Extraction of MTM is a routine procedure in oral surgery, with several possible postoperative complications [18]. The exploration of the type and/or angle of IMTM before surgery is important to select appropriate operation procedures [19]. Several studies have classified the MTM as vertical, horizontal or angular, based on its orientation to the mandible [17, 20]. In the present study, horizontal type was the most frequent (31.7 %) followed by vertical (29 %) mesioangular (25%), distoangular (13.85%) and reversed (0.45%).

This finding was in agreement with the results of several studies. Tantanapornkul et al. reported that the horizontal type was the most frequent (52%),

followed by angular (32%) and vertical (16%) [20]. Momin *et al.* reported similar results, with 42% horizontal, 37% angular and 21% vertical [17]. Msagati *et al.* and Syed *et al.* found that the mesioangular type was the most common (76%) in Msagati's study and 50.75% in Syed's study) [21,22]. Lübbers et al. reported that mesially angulated (40.2%) and vertical (29%) were the most common types [23]. A Difference between studies may arise from different study samples. IAN injury is a serious complication during extraction of mandibular third molars [24]. It has been reported that the most important factor for IAN injury is the anatomical relation-ship between the impacted third molar and the MC [25]. Accurate preoperative evaluation is necessary for successful [24]. Panoramic radiography is a standard diagnostic tool for initial assessing the relationship of the MTM root and MC [19].

Several studies have reported that the risk of IAN injury increases when specific findings are observed on panoramic images taken to determine the relationship between third molars and the MC [19, 20, 26-28]. These findings include interruption of the white line and darkening of the roots [29]. A close proximity between MTM roots and the MC was higher in cases with the abovementioned signs on panoramic radiography [30, 31]. Gomes *et al*. reported the absence of association between the presence of panoramic radiographic signs and IAN injury after MTM extraction [28]. However, Ghaeminia *et al*. found that there was an association between panoramic radiographic signs and a close proximity between MTM and MC [31]. In the present study, contact between MTM roots and the MC was most often detected on 3D exploration in cases with interruption of the white line of the IAC and darkening of the roots on panoramic images, a finding in agreement with several previous studies [19, 27, 32-34].

Mandibular canal diversion and deflection of root have the least frequency to predicting association between MC and MTM, which was in contrast with many studies [28, 32, 35]. 3D exploration allows the clinician to know the location of the MC, therefore IAN and to perform comprehensive treatment planning and surgical method selection during preoperative assessment [16]. Previous studies have reported that the MC is most frequently positioned on the lingual side of impacted third molars and that contact between the MC and the impacted teeth was generally observed in those cases [19, 24]. In the present study, the MC was most frequently located on the apical side of the MTM and they were commonly in contact which was in contrast with many studies.

CONCLUSIONS

In this study, the contact between mandibular third molar roots and the mandibular canal was higher in cases with interruption of the white line and darkening of the roots as signs on panoramic images. 3D exploration is required in the preoperative assessment of mandibular third molar when this two signs are observed on panoramic images. This study was subsidized by the Oral Health and Oral Rehabilitation Research Laboratory (LR12ES11).

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