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Research Article

Predicting Third Molar Removal Difficulty: Radiological Assessment

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Abstract

Introduction: The avulsion of the maxillary and mandibular wisdom teeth is an act of current practice in oral and maxillofacial surgery, but the position and the relationships of this teeth with the adjacent anatomical elements, could make the avulsion difficult.

Objectives: Through our study, we tried to assess radiological predictive factors of operating difficulty during the avulsion of the third molar, by the evaluation of the frequency of the anatomical situations likely to complicate the third molar removal.

Materials and Methods: Our work is a cross-sectional study concerning all patients over 16 years old, consulting with the oral surgery department of the center for consultation and dental treatment in Rabat (Morocco), for 3rd molar complication and needing surgical removal. The study was based on the assessment of conventional radiography.

Results: The sample of the study consisted of 107 upper and lower wisdom teeth, at 60 patients. The most frequent third molar, were in Level B impaction 66 (61.7%), and in a mesioangular position 51 (47.7%). 28 (26.2%) third molars were related to the presence of caries on the distal surface of the second molar. 11(33.3%) superior wisdom teeth had a relationship with the maxillary sinus. 17 (23%) lower wisdom teeth presented at least one radiological marker of tooth root proximity to the mandibular canal.

Conclusion: The study allowed knowing the frequency of the positions and the angulations which can engender additional difficulties during the avulsion of wisdom teeth, and the adjacent anatomical structures which could be at the origin of several complications, if they were not respected during the avulsion.

Keywords: Third Molar Surgery; Difficulty Predictor; Radiological Assessment; Cross Sectional Study

Introduction

Although the removal of third molars is a common procedure, in some cases it can be difficult [1]. The hope for both the clinician and the patient is to have an uneventful curse of the procedure. Most researchers agree that postoperative complications are more commonly associated with more difficult extractions. Prediction of operative difficulty is therefore important for correct management [2]. A number of classification systems have been proposed for estimating the surgical difficulty of third molar extraction, based on preoperative assessment of panoramic radiographs [3]. Historically, there have been those of Pell and Gregory [4] and Winter [5], based on the depth of the third molar, the relation to the mandibular ramus and the anatomical position in relation to the longitudinal axis of the adjacent second molar. And then Pederson [6] proposed a modification of the scale of Pell and Gregory that contemplated an additional factor: the position of the molar [3]. Recent literature may have reduced the dearth of information on the estimation of third molar surgical difficulty. Still, there are conflicting reports and wide variations of factors that complicate this removal [7]. A systematic review by Akadiri., *et al*. in 2009 on this subject pointed out most relevant radiologic variables. These include depth of impaction, angulation, and root morphology [7]. The present study is interested in evaluating the frequency of these radiologic variables factors. It is also interested in assessing the third molars relationship with their anatomical environment, as it happens, the second molar, the maxillary sinus and the mandibular canal. These anatomical structures could be at the origin of complication to happen if not respected.

Materials and Methods

To fulfill the aim of the study, we carried out a cross-sectional radiographic study on patients consulting with our oral surgery department in Rabat. Patients were recruited using a convenience sampling. The radiological evaluation was based on standard radiography (orthopantomogram and periapical radiograph).

All patients over 16 years old, consulting for third molar complication and needing surgical removal were included in the study. Patients consulting for other reasons or presenting third molars

needing simple removal or with non-edified root apex were excluded.

Overall, 107 maxillary and mandibular 3rd molar from 60 patients were evaluated. The collected data was recorded on a pre-established operating report.

A total of 11 parameters were analyzed in each patient and tooth (Table 1). All parameters except the epidemiological information regarding age, gender and reason for consultation were derived from the radiographs: tooth notation and condition, root shape, depth, inclination in the sagittal plane, relationship to the 2nd molar, upper 3rd molar relationship to the maxillary sinus and lower 3rd molar relationship to the mandibular canal.

The FDI-scheme was applied for tooth notation. Thus, upper third molars were classified as either 18 or 28, and lower ones were classified as either 38 or 48.

Third molars conditions were classified on: healthy, carious or obturated. While for root shape, we distinguished 5 classifications: crooked, conical, bulbous, convergent and divergent.

With respect to the depth, we considered the A, B and C Pell and Gregory's classification witch specify the depth of impaction (Figure 1). By ascending order of surgical difficulty, we describe level A in which the occlusal surface of the 3rd molar is situated in the occlusal plane of the second molar; level B where the occlusal surface of 3rd molar is between the occlusal plane and the anatomical collar of the second molar and the level C where the occlusal surface of the third molar lies under the anatomical collar of the second molar.

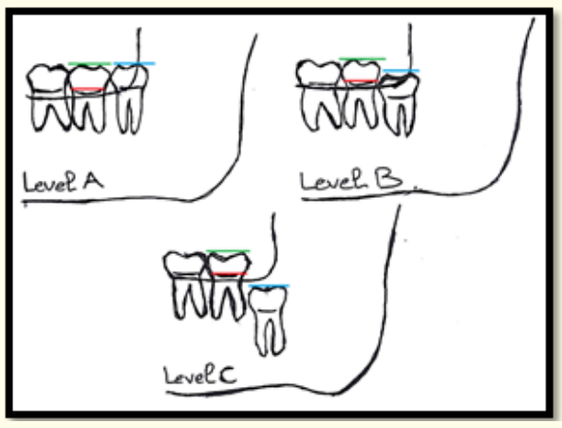

Figure 1: Pell and Gregory classification. (Blue line: occlusal surface of the 3rd molar. Green line: occlusal plane of the 2nd molar. Red line: anatomical collar of the second molar).

The inclination of the third molars in the sagittal plane was considered using winter's classification which takes into account the angle determined by the corono-radicular axis of the wisdom tooth and that of the second molar (Figure 2). By ascending order of surgical difficulty, four types of positions are described: mesio-angular, horizontal, vertical and disto-angular. This latter type is therefore the most difficult case. Finally, exceptionally, the tooth may be in an inverse position.

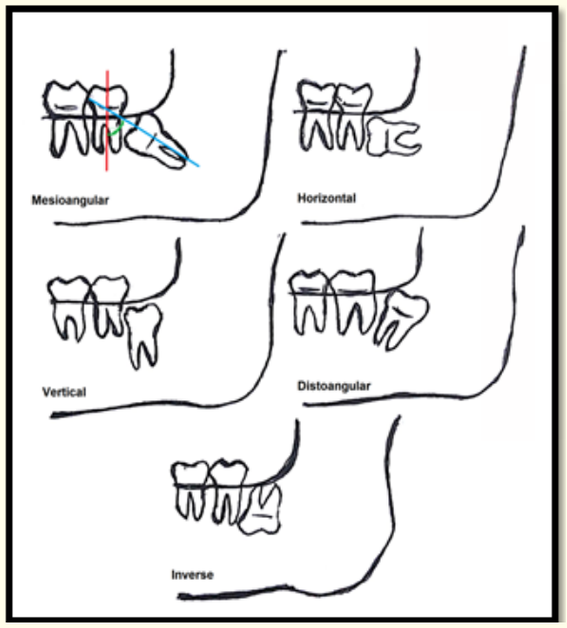

Figure 2: Winter's classification based on the angle (green) determined by the corono-radicular axis of the third molar (blue line) and that of the second molar (red line).

The third molars relationship to the second molar was categorized as normal, absent, or at the origin of caries on the distal surface of 2nd molar.

The relationship between the upper third molar and the maxillary sinus was assessed semi quantitatively. Two categories were defined: no relationship to the maxillary sinus (category I); presence of superimposition between 3rd molar's and sinus images (category II).

For the relationship between the lower third molar and mandibular canal, we relied on radiological markers of tooth roots proximity to inferior alveolar nerve described by Rood and Shehab that are [8]: darkening of roots, deflection of root, narrowing of roots, bifid apex of root, interruption of the white line of canal, diversion of canal and narrowing of the canal.

Darkening of root apex: Usually the density of root in radiograph appears to be uniform throughout, but when the inferior alveolar canal impinges on the root, then there is loss of density and is interpreted as darkening.

Deflection of root: When the root reaches the inferio alveolar canal, sometimes it may get deflected to mesial or distal aspect and is interpreted as deflection.

Narrowing of root apex: It implies to the grooving/perforation of the canal.

Bifid root apex: When the inferior alveolar canal crosses the apex of the root, the shadow of periodontal ligament appears as bifid apex.

Narrowing of canal: While crossing the apex of the root, if the diameter of the inferior alveolar canal narrows, then it is interpreted as narrowing of the canal.

Deviation of mandibular canal: When the inferior alveolar canal crosses the mandibular third molar, if it changes its direction and gets displaced, then it is interpreted as deviation.

Interruption of white line: White lines which appear on the radiograph are the roof & floor of the inferior alveolar canal. Any interruption of one or both lines is considered to indicate perforation or deep grooving of the root.

Qualitative variables were expressed in number and percentage. The comparison between the upper and lower third molars with respect to caries frequency, relationship to second molar, and depth and inclination in the sagittal plane of third molars were performed using the chi-square test or the exact Fischer test. The comparison between third molars with or without normal relation to the second molar with respect to the mesio angular impaction was performed using the chi-square test. The descriptive statistical evaluation as well as the bivariate data analysis for the identification of significant associations was made using the program SPSS software, the significance level was set at $p < 0.05$.

Results

Overall, 107 teeth from 60 patients were evaluated. Among the 60 patients, there were 17 (28.30%) males and 43 (71.70%) females. 25 (41.70%) patients were between 20 and 30 years old. 54 (50.50%) patients complained about pain, 30 (28%) complained about functional reason, for 14 (13.10%), the reason for consultation was orthodontic treatment, and 9 (8.40%) complained for other non-specified reasons (Table 1).

General data		Entire sample (N = 60)
Gender	Male	17 (28.30%)
	Female	43 (71.70%)
Age	20 - 30y	25 (41.70%)
	31 - 40y	19 (31.70%)
	41 - 50y	14 (23.30%)
	51 - 60y	2 (3.30%)
Reason for consultation	Pain	54 (50.50%)
	Functional reasons	30 (28%)
	Orthodontique treatment	14 (13.10%)
	Others	9 (8.40%)

Table 1: General data.

From all third molars examined (Table 2), 33 (30,9%) were located on the maxilla and 74 (69,1%) on the mandibule, 76 (71%) were healthy, 28 (26.20%) were carious and 3 (2.80%) were obturated. The multivariate statistical analysis revealed that the presence of caries in third molars was significantly associated with their position in oral cavity. Thus, there were more carious lower third molar 25 (33.80%) thane upper ones 3 (9.10%) ($p = 0.008$).

		Tooth		Entire sample (N = 107)
		Lower 3rd molar (N = 74)	Upper 3rd molar (N = 33)	
3rd molar condition	Healthy			76 (71%)
	Carious	3 (9.10%)	25 (33.80%)	28 (26.20%)
	Obturated			3 (2.80%)
Root shape	Crooked			30 (28%)
	Conical			59 (55.10%)
	Bulbous			18 (16.30%)
	Convergent			52 (48.60%)
	Divergent			24 (22.40%)
Depth	Level A	0 (0%)	7 (9.50%)	7 (6.50%)
	Level B	10 (30.30%)	56 (75.70%)	67 (61.70%)
	Level C	23 (69.70%)	11 (14.90%)	33 (31.80%)
Inclination in the sagittal plane	Mesio-angular	11 (33.30%)	40 (54.10%)	51 (47.70%)
	Horizontal	0 (0%)	13 (17.60%)	13 (12.10%)
	Vertical	8 (24.20%)	19 (25.70%)	27 (25.2%)
	Disto-angular	14 (42.20%)	1 (1.40%)	15 (14%)
	Inverse	0 (0%)	1 (1.40%)	1 (0.90%)
Relationship to the 2nd molar	Normal			55 (51.40%)
	Absent			24 (22.40%)
	Caries on the distal surface	7 (21.2%)	21 (28.40%)	28 (26.20%)
Upper 3rd molar relationship to the maxillary sinus	No relationship	22 (66.70%)		
	Superimposed	11 (33.30%)		
Lower 3rd molar relationship to the mandibular canal	No relationship		57 (77.0%)	
	Presence of radiological markers of tooth roots proximity		17 (23.0%)	

Table 2: Descriptive statistics of all 107 teeth examined.

Thirty third molars (28%) presented crooked roots. Conical roots were observed in 59 (55.10%) third molars. Bulbous roots existed in 18 (16.30%) third molars. In 52 third molars (48.60%), the roots were convergent while in 24 (22.40%), they were divergent.

Concerning the depth, and according to the A, B and C Pell and Gregory's classification, the majority 67 (61.70%) of third molars exhibit a level B. third molars presenting level C were 33 (31.80%), and those presenting level A were 7 (6.50%). While for the inclination in the sagittal plane, and according to Winter's classification, 51 (47.70%) exhibit a Mesio-angulation. Disto-angulated third molars were fifteen (14%). Thirteen third molars (12.10%) were horizontal, and twenty seven (25.2%) were vertical. One third molar (0.90%) showed an inverse inclination. The difference between upper and lower wisdom teeth is also statistically significant (p = 0.001) for depth and Inclination in the sagittal plane. The level B 56 (75.7%) and the mesio-angulation 40 (54.1%) were the most common for lower wisdom teeth, while for the upper ones, the level C 23 (69.7%) and disto-angulation 14 (42.4%) were the most common.

Fifty five third molars (51.40%) exhibited a normal relationship to the second molar. the contact point wasn't present between twenty four wisdom teeth (22.40%) and the second molar. Twenty eight third molars (26.20%) were at the origin of caries on the distal surface of the second molar.

The radiological image of eleven upper third molar (33.30%) were superimposed to the radiological image of maxillary sinus. The radiological markers of tooth roots proximity to the mandibular canal were present in seventeen lower third molars (23.0%). Among them (Figure 3), ten third molars (41.70%) showed interruption of the white line of canal, nine of them (37.50%) showed darkening of roots and three of them (12.50%) showed deflection of roots. The diversion of canal and the narrowing of the canal were present in one third molar (4.10%) for each. No third molar showed neither narrowing of roots nor bifid apex of roots.

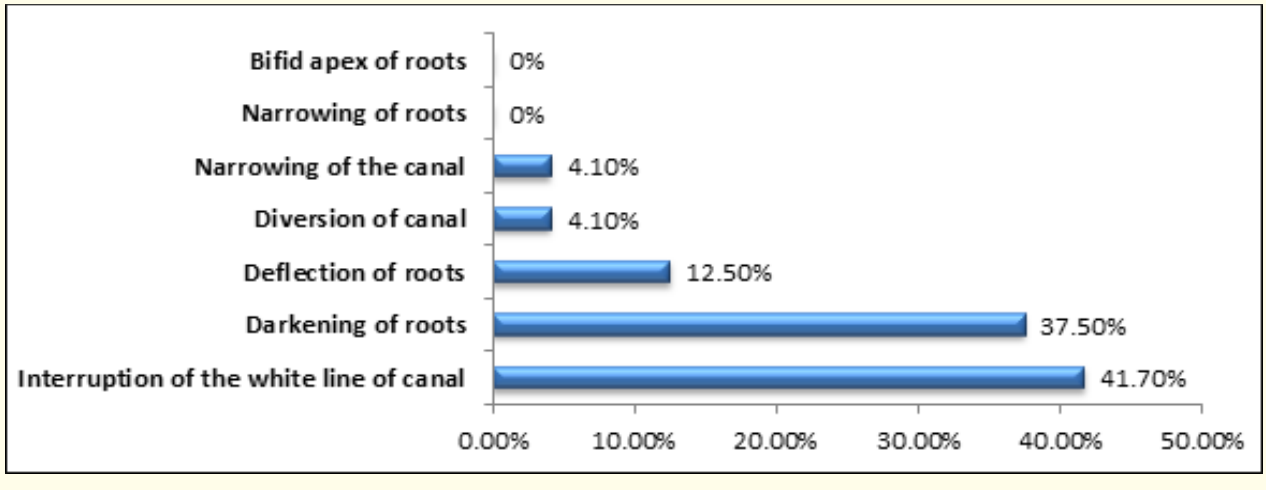

Figure 3: Radiological markers of tooth roots proximity to the mandibular canal (N = 17).

Discussion

The surgical difficulty affects the surgery duration. The greater the surgical difficulty, the longer the time needed. The capacity to predict the surgical difficulty of extraction of the lower third molar is thus essential when planning a treatment aimed to minimize complications, optimize the preparation of the patient, and decrease postoperative pain [9,10].

Our aims in the present study were to describe the frequency of anatomic variation of wisdom teeth being able to increase the removal difficulty and to assess the relationship of wisdom teeth with their anatomical environment. We revealed that, in general, most third molars were mesio-angular and in level B concerning the depth with mostly conical and convergent root. Our study also allowed us also to identify the neighboring anatomical structures which may be, if not respected during the removal, at the origin of several complications. We are here talking about the mandibular canal and the maxillary sinus, which present a close contact with several third molars.

In this study, the fact that the majority of patient were women, with a percentage of 71.7%, was in correlation with the MA Hashemipour., *et al*. study [11] published in 2013 which found that (62.7%) were female. In one hand, we could not say that third molars' complications are related to the gender. In the other hand, some authors explain that the higher frequency reported in females is due to the consequence of difference between the growth of males and females. Females usually stop growing when the third molars just begin to erupt, whereas in males, the growth of the jaws continues during the time of eruption of the third molars, creating more space for third molar eruption [12].

The age of patients is an important factor to study in predicting the surgical removal difficulty, as found in the systematic review by Akadiri., *et al.* in 2009. In our study, the majority of third molar complications were recorded in the youngest patients (20 - 30 years), with a percentage of nearly 42%. Similar results were observed in the Almendros-Marqués., *et al.* [13] Study in 2006, showing that 80% of patients consulting for wisdom teeth complications are between16 and 30 years old. Even in M-A. Hashemipour., et al. study [11] published in 2013, more than the half of patients were in the third decade.

As in Yilmaz., *et al*. (2016) [14] study, the majority of patients complained about pain. This would be because of repeated pericoronitis episodes and 3rd or 2nd molar carious or pulp implications.

Evaluation of the distribution of impactions between maxilla and mandible showed that the number of third molars needing surgical removal in maxilla at 30.9% was much less than in the mandible which is 69.1%. This was in correlation with Ajay., *et al.* [15] and Hashemipour., *et al*. [11] study results.

While for third molar condition, 26.2% of all third molars studied were carious, this is higher but nearly similar to Allen., *et al.* [16] and Smith [17] studies results. This is surely due to the insufficient brushing at this level, because of 3rd molar depth which is mostly at level B. Another reason is the 3rd molar mesio-angulation preventing the eviction of food and bacteria [17]. It would be interesting to mention that lower 3rd molar were more carious than upper ones, with a percentage of 33.8%.

The systematic review by Akadiri., *et al.* 2009, pointed out the most relevant radiologic variables predicting removal difficulty. These include root morphology, depth of impaction, and angulation [7]. Most of 3rd molar studied presented conical and convergent root. But still 28% have crooked root, 16.3% have bulbous ones and 22.4% present divergent root. Those three presentations increase the removal difficulty

The level of impaction assessed based on the Pell and Gregory classification showed that level B impaction was the most common when considering both upper and lower third molars, similar to the study of Almendros-Marqués., *et al.* [13] from spain, Blondeau and Nach [18] from Canada. These findings conflict with most of the previous studies that identified the most common position as level A [11,19,20]. However, if considering upper third molars apart, we found that level C impaction was the most common while the study of Hassan [21] found that level B was more frequent in the maxilla.

Concerning the angulation based on the Winter's classification, the present work showed a high prevalence rate of third molar impaction in a mesio angulated position (47.7%) followed by a vertical position (25.2%). This finding confirmed the previous study of Chaparro-Avendaño., *et al* [22]. However, other studies of Almendros-Marqués., *et al.* [13] and Bataineh., *et al.* [23] had shown that the most common type was vertical impaction. It would be interesting to mention that, in our study, when studying upper third molars apart, the most common position was the disto-angular one. In contrast to Hashemipour., *et al.* study [11] which showed that the most common angulation of impaction in the maxilla was the vertical (45.3%).

These differences in angulation and level of impaction could be due to the difference in race, patient selection criteria and study population [14].

A prospective study of V. Toedtling demonstrates that the prevalence of distal caries in second molars was significantly higher in patients with partially erupted third molars positioned below the amelocemental junction ($P < 0.05$) of the adjacent second molar and in patients who presented with mesioangular impactions ($P < 0.001$) [24]. These carious lesions often remain difficult to detect and restore, sometimes resulting in the extraction of the second molar. In our study, 26.2% of third molars are associated with caries on the second molar. The Allen RT., *et al.* study [16] showed similar result with a percentage of 19.3%. In addition, Syed., *et al*. [25] showed that a total of 39% patient's with impacted third molars had distal cervical caries in second molar, and that mesioangular impaction was the most prominent type. However, in our study, the multivariate statistical analysis assessing the impact of the mesioangular impaction in the prevalence of distal caries in second molars was not statistically significant.

The relation between the maxillary sinus and dental roots should be considered during extraction and was a significant determinant of surgical difficulty in several studies [26]. The hypoth-

esis is that, when the white line of the maxillary sinus is absent or the dental root is indistinct on radiographic images, osteotomy is required owing to the fear of displacing the tooth to the interior of the sinus [26]. Moreover, this could be a risk for an oro antral fistula to happen needing a surgical closure, increasing consequently the surgery duration. In the present study, the assessment of the upper 3rd molar relationship with the maxillary sinus noted that 33,3% were radiologically superimposed to the sinus. Martin Lanzer., *et al.* study [27] based on cone beam computed tomography (CBCT), showed a much higher incidence, with 75% of upper third molars protruding into the maxillary sinus.

The accurate preoperative prediction of direct contact between inferior alveolar nerve and impacted third molar is very useful for the choosing the accurate surgical removal technique, warning patients of the potential risk of postoperative dysesthesia and obtaining informed consent. Radiological assessment is essential in evaluating the relationship between these 2 structures, and panoramic images are most commonly used for this purpose [28]. It allows, through radiological markers, to suspect tooth roots' proximity to inferior alveolar nerve. In this study, we relied on radiological markers of tooth roots proximity to inferior alveolar nerve described by Rood and Shehab (1993) [8]. Among 74 lower wisdom teeth, 17 (23%) presented at least one radiological marker of tooth roots proximity to inferior alveolar nerve. The more frequent radiological markers reported are interruption of white line of canal, and darkening roots. Huang CK., *et al.* (2015) [29], in a similar study, showed similar results concerning the interruption of white line of canal, darkening roots, however they showed that canal narrowing was also as much as frequent.

Conclusion

In summary, an analysis of the surgical difficulty of third molar extraction is essential for treatment planning. The results obtained in this study were in agreement overall with those of other studies. Most of third molar assessed present predictors of low surgical difficulty. However, the incidence of third molars with a high degree of difficulty is substantial. Indeed, we found that upper 3rd molars are more frequently in level C impaction and disto angular, position and angulation which present the most surgical difficulties. In addition, several third molars of our study presented a close contact with the neighboring anatomical structures, as it happens: the mandibular canal and the maxillary sinus. This relationship could at the origin of several complications needing specific management, increasing thus the surgical duration. The identification of predictor variables may be useful for students and inexperienced clinicians to consider the decision not to execute the procedure, thus avoiding complications that often require complex management.

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