Prevalence of impacted third molars: A radiographic study among a North African population

Prévalence de l'inclusion des dents de sagesse: Etude radiologique auprès d'une population nord africaine

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Abstract

Introduction: Third molars are the most commonly concerned teeth with the impaction. Impacted third molar (ITM) can be associated to various clinical pathologies

Aim: To determine the prevalence of ITM, its pattern and associated affections in Tunisian patients.

Methods: The study reviewed panoramic radiographs of patients consulting the Fattouma Bourguiba University Hospital, Monastir (Tunisia). Orthopantomograms were analyzed to define the prevalence of ITM; its angulation, depth and relation with the anterior border of mandibular ramus. Associated pathologies were also assessed.

Results: Seven hundred and thirty patients were included (286 men and 444 women). The age ranged from 19 to 89 years. Half of the patients (50.3%) showed at least one ITM. The total number of ITM was 881 with a statistical difference between arches (respectively 34.3% and 65.7% in the maxilla and in the mandible). The most common number of ITM was two (35.4%). Level C of impaction was observed more frequently in the maxilla and level A in the mandible. The most common angulation was the vertical one for both arches. Seventy six percent of ITM were presented with class II in relation with the anterior border of mandibular ramus. There was no significant difference in the frequency of impaction between gender and sides. The number of ITM associated with pathological conditions was 199 (22.6%). The most frequently observed pathology was the distal caries on the second molars (11.7%) followed by the caries of the third molars (5.2%).

Conclusion: The prevalence of ITM among Tunisian patients was high.

Key words: Teeth, Denture retention, Orthopantomographs, Tunisia.

Résumé

Objectif: Déterminer la prévalence et les propriétés d'inclusion des dents de sagesses (M3M) et les pathologies qui lui sont associées chez une population Tunisienne.

Méthodes: Nous avons revu 730 panoramiques, parmi 6043 patients. Les informations suivantes ont été évaluées : la présence, l'angulation, la profondeur d'inclusion et les pathologies identifiées radiologiquement au niveau des dents de sagesse et des molaires adjacentes.

Résultats: Parmi les 730 patients, 367 (50,3%) ont présenté au moins une dent de sagesse incluse. La prévalence d'inclusion diminuait avec l'augmentation de l'âge. Le nombre total des dents de sagesses incluses était 881. Le nombre d'inclusions le plus frequent par patient était deux (35,7%). Le niveau d'inclusion le plus frequent au maxillaire était le niveau C et à la mandibule, le niveau A. L'angulation la plus fréquente était la verticale au maxillaire et à la mandibule. La plupart des M3M mandibulaires (76%) ont présenté la classe II en relation avec le ramus mandibulaire. 1,36% des deuxièmes molaires adjacentes à une dent de sagesse incluse ont montré une résorption radiculaire et 3,79% des M3M présentaient une pericoronite. 12,5% et 92,3% des deuxièmes molaires présentant des caries cervicales distales (DCC), respectivement au maxillaire et à la mandibule, sont adjacentes à dent de sagesse incluse. Les pathologies les plus associées aux dents de sagesse incluses étaient les caries distales des secondes molaires (11,7%) et les caries des troisièmes molaires (5,2%).

Conclusion: L'inclusion des dents de sagesse était observée chez 50,3% d'un groupe de patients tunisiens âgés de 19 à 88 ans. Il n'y avait pas de différence significative entre les sexes ou entre les côtés.

Mots clés : Dent de sagesse, Inclusion, Radio panoramique

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Introduction

The perturbation of permanent teeth eruption is among the most common dental anomalies, and tooth impaction is considered as one of these abnormalities (1). "An impacted tooth (dens retens) is a tooth with a fully formed root, with complete development, which is partially or completely covered by hard and/or soft tissues, being outside the physiological period of eruption" (2,3). Generally, the diagnosis of "impacted tooth" is retained when a tooth fails to erupt greater than one year after the usual age of eruption (4). Being the last teeth to erupt, third molars are the most impacted teeth with a prevalence fluctuating from 6.9 to 76.6% (5-7). This significant variation comes from ethnic and racial differences (5,6). Furthermore, wisdom teeth have the highest impaction rate making up 98% of all types of impacted units, especially in the mandible, followed by maxillary canine and mandibular second premolar (6,7).
Those teeth remain unerupted in the dental arch for various systemic and local reasons (7). For this case, several theories have been outed forward and still remain unproven (7). The most likely accepted hypothesis suggests that the impaction is caused by the late eruption time of impacted third molars (ITM) which is generally between 17 and 21 years, where space is not always available (5-7). In addition, ITM may remain impacted or semi-impacted due to other reasons like being surrounded by physical barriers such as dense bone or excessive soft tissue coverage or blocked by an eventual pathology like cysts, tumors and systemic diseases (3-5,7).
Once retained, ITM may be directly or indirectly related to numerous clinical affections in the mouth, jaw, and facial regions such as caries, pericoronitis, cystic lesions, periodontitis, neoplasms, root resorption , or atypical facial pain which can be confused with temporomandibular affections (3,7,8). For these raisons, the extraction of ITM is one of the most common surgical procedures for oral and maxillofacial surgeons that requires rigor during the intervention and before that, during clinical and radiological examination (3,5).
Many studies, worldwide, reported different prevalence of this phenomenon among the studied populations (3-7, 9-13). Similar studies regarding this subject were carried out in some Arab countries (14-19). However, to the best of authors' knowledge, the prevalence and properties (angulation, level of eruption, and associated pathological conditions) of ITM including has not been described before in Tunisia.
The purpose of this study was to determine the patterns of third molar impaction and associated pathological conditions among a Tunisian population.

Methods

Study design

This was a descriptive study carried out at the Department of Dental Medicine, Fattouma BOURGUIBA University Hospital, Monastir, Tunisia. It was planned on routinely taken orthopantomograms (OPG) of 6043 visiting the above cited department. The study was conducted following the guidelines established by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (20). Approval for the study was obtained from Sahloul Hospital Ethical Committee (approval number 12102015). This study was conducted in accordance with the declaration of Helsinki.

Study population

Patients aged 19 years and older, with complete root formation of the third molars were included from participants visiting the above cited department. The following non-inclusion criteria were applied: history of facial or dento-alveolar trauma, congenital disease such as Down's syndrome or cleidocranial dysplasia, OPG with inappropriate contrast or exposure values disturbing its analysis. The final sampling was selected by random sampling. This design was used to obtain a sample that properly represents the consultant at Department of Dental Medicine, Fattouma BOURGUIBA University Hospital, Monastir, Tunisia.

Sample size

The sample size was calculated using the following formula (21): $N= [(Z_{\alpha/2})^2 \times P \times (1-P) \times D]/E^2$; where "P" was the proportion of the main event of interest (ie; frequency of ITM), "E" was the margin of error, "$Z_{\alpha/2}$" was the normal deviate for two-tailed alternative hypotheses at a level of significance, and "D" was the design (= 1 for simple random sampling). In the literature, the frequency of ITM among Omani adult patients was estimated at 54.3% (p=0.543) (16). Assuming a 95% confidence interval ($Z_{\alpha/2}$ = 1.96) and a 0.05 margin of error (E), the total sample size was 382. Allowing OPG with bad image quality was of 50%, the adjusted sample size was 382/(1-0.50)=764 participants.

Radiographic analysis

Extraoral digital OPG (*Plamenca, Finland*) was performed for each participant by the same technician at the department of Radiology-Fattouma BOURGUIBA University Hospital, Monastir, Tunisia. There were analyzed by a one examiner (*MAH*) in a dark room using an appropriate X-ray viewer. "Third molar was considered impacted if it did not have functional occlusion and at the same time, its roots were fully formed" (18). The depth of ITM in relation to occlusal plan was recorded according to the classification of Pell and Gregory (22). The angulation of ITM was measured according to Winter's classification with reference to the angle formed between the intersected longitudinal axes of the second and third molars (22). The relationship to the anterior border of the mandibular ramus was recorded along with the distance or width between the vertical ascending ramus and the distal surface of the second molar according to the classification of Pell and Gregory (22). The occurrence

of occlusal, proximal or cervical caries in the third molar was determined radiologically. Only distal carious lesions were assessed in the second molars. All the cases of cystic lesions and pericoronitis associated with the ITM were recorded. The root resorption localized in the second molar adjacent to impacted third molar was determined.

Statistical analysis

Data were analyzed using SPSS software (*Statistica Package for the Social Sciences version 18; USA*). To assess normal distribution of numerical variables, Kolmogorov–Smirnov normality test was used. Data without a normal distribution were expressed as median [First quartile-Third quartile] and then compared by Mann Whitney test. Categorical variables were expressed as frequency and percentages. Chi^2 test was used to compare the qualitative data.

Results

Among the 6043 clinical records examined, non-inclusion criteria were found in 2178. Then, 764 clinical records were chosen after a simple random sampling. Thirty-four records were excluded for inappropriate OPG. Thus, the final sample included 730 (95.5 %) patients. Among them, 286 (39.9%) were males and 444 (60.1%) were females. The age ranged from 19 to 89 years with a median age [First Quartile-Third Quartile] equal to 30 years [24-41].

Third molar impaction

From the 730 OPG (2920 third molars analyzed), 367 (50.3%, $CI_{95\%}$ [48.5%-52.1%]) showed at least one ITM. A total of 881 ITM (30.2%, $CI_{95\%}$ [29.4%-31%]) were observed. Bilateral impaction was observed among 262 patients (71.4%): 18 (6.9%) in the maxilla, 150 (57.2%) in the mandible and 94 (35.9%) in both arches. A total of 94 (25.6%) patients had all the third molars impacted, 51 (13.9%) three ones, 130 (35.4%) two ones, and 92 (25.1%) only one. The prevalence of patients with ITM varied according to the age, but no significant difference between males and females was observed (Table 1).

Table 1. Distribution of impacted third molars by sex and age (n=730)

Patients with impacted third molar		Yes	No	p
		Data are Median [First Quartile-Third Quartile]		
Age		26 [23-33]	37 [28-50]	**<0.01***
		Data are number (percentage)		
Age classes	[19-30[	250 (67.5%)	119 (32.5%)	**<0.01†**
	[31-40[	74 (42.8%)	99 (57.2%)	
	[41-50[	30 (33%)	61 (67%)	
	[51-60[	6 (10.2%)	53 (89.8%)	
	≥ 60	7 (18.4%)	31 (81.6%)	
Sex	Male	132 (46.1%)	154 (53.9%)	0.07
	Female	235 (52.9%)	209 (47.1%)	

***p<0.05** Mann Whitney test

† p<0.05 Chi-2

A predilection for ITM in the mandible and no difference between the right and left sides within each arch were recorded (Table 2).

Table 2. Distribution of impacted third molars by side and arch (n=2920)

Impacted third molar		Yes	No	P
		Data are number (percentage)		
Arch	Maxilla	302 (20.7%)	1158 (79.3%)	**<0.01***
	Mandibule	579 (39.6%)	881 (60.4%)	
Side	Right	436 (29.9%)	1024 (70.1%)	0.31
	Left	445 (30.5%)	1015 (69.5%)	

***p<0.05** Chi-2

Impaction characteristics

Among the 579 lower teeth, 276 (47.7%) were positioned in level A. However, level C was the most prevalent (66%) in the maxilla (Table 3). In addition, the Class II ramus relationship occurred most frequently (76.3%) compared to other classes while the vertical impaction (n = 421, 47.8%) was the most common form for both arches (Table 3).

Table 3. Impaction properties distribution of the impacted third molars (n = 881)

Localization of impaction		Maxilla	Mandible	Total
		Data are number (percentage)		
Level	A	59 (19%)	276 (47.7%)	335 (38%)
	B	44 (15%)	196 (33.8%)	240 (27.3%)
	C	199 (66%)	107 (18.5%)	306 (34.7%)
Angulation	Vertical	157 (52%)	264 (45.7%)	421 (47.8%)
	Mesioangular	45 (14.9%)	185 (31.8%)	230 (26.2%)
	Distoangular	91 (30.1%)	12 (2.1%)	103 (11.7%)
	Horizontal	0 (0%)	114 (19.7%)	114 (12.9%)
	Buccolingual	6 (%)	4 (%)	10 (1.1%)
	Others	3 (%)	0 (%)	3 (0.3%)
Class	I	-	67 (11.6%)	67 (11.6%)
	II	-	442 (76.3%)	442 (76.3%)
	III	-	70 (12.1%)	70 (12.1%)

Associated pathologies

When all the results were considered together, it could be seen that 22.6% of the ITM were affected by at least one of these pathologic conditions: The most common pathology associated with ITM was the distal caries of second molar (11.7%). Fully erupted third molars were less likely to be associated with the increased risk of pericoronitis, cysts, root resorption and caries of second molar (Table 4).

Table 4. Frequency of pathologies associated to third molar impaction (n=2920)

		Impaction	No impaction	p	Odds Ratio [95% CI]
		Data are number (percentage)			
Pericoronitis	Yes	22 (2.5%)	0 (0%)	**<0.01***	**106 [6.5-1762]**
	No	859 (97.5%)	2039 (100%)		
Root resorption	Yes	12 (1.4%)	0 (0%)	**<0.01***	**58 [3.5-991]**
	No	869 (98.6%)	2039 (100%)		
Carious lesions of second molars	Yes	103 (11.7%)	51 (2.5%)	**<0.01***	**5.1 [3.6-7.3]**
	No	778 (88.3%)	1988 (97.5%)		
Carious lesions of third molars	Yes	46 (5.2%)	119 (5.8%)	0.51	0.9 [0.6-1.2]
	No	835 (9.8%)	1920 (94.2%)		
Cysts	Yes	16 (1.8%)	0 (0%)	**<0.01***	**77 [4.6-1297]**
	No	865 (98.2%)	2039 (100%)		

***p<0.05** Chi-2

These associated pathologies (except cysts) and root resorption were more frequent in the mandible compared to the maxilla (Table 5).

Table 5. Localization of pathologies associated to third molar impaction

	Maxilla	Mandible	Total	p
	Data are number (percentage)			
Pericoronitis	0 (0%)	22 (100%)	22 (100%)	**<0.01***
Root Resorption	3 (25%)	9 (75%)	12 (100%)	0.71
Carious lesions of second molars	6 (5.8%)	97 (94.2%)	103 (100%)	**<0.01***
Carious lesions of third molars	2 (4.3%)	44 (95.7%)	46 (100%)	**<0.01***
Cysts	3 (18.7%)	13 (81.3%)	16 (100%)	0.18

***p<0.05** Chi-2

Discussion

Third molar is the prevalent impacted tooth as it is the last to erupt (6, 7, 10). To the best of authors' knowledge, there are currently no data concerning the prevalence of ITM and associated pathologies in Tunisia. The purpose of this study was to investigate the prevalence of ITM in Tunisian patients from a single dental medicine department. The main result of the present study was that the third molars were reported to account for 50.3% of impactions.

Discussion of the methodology

This was a cross sectional and descriptive study. It included all eligible patients who consulted Department of Dental Medicine, Fattouma BOURGUIBA University Hospital, Monastir, Tunisia. The present study, like many similar previous ones dealing with this subject, used a hospital-based sample which is not representative of the whole population (9,12,14-17,22-25). However, there are three studies that opted for representative samples (4,13,26). Since OPG are needed, it is very difficult to evaluate the impaction of third molars in a representative randomized sample.

Patients with incomplete root formation and/or aged less than 19 years old were not included because that age seems to be the lower limit of third molar's root formation (3,5,22). In fact, it is known that tooth keeps erupting till the end of root formation process (27). No upper age limit was applied because it was reported that considerable radiographic changes involving depth and inclination may occur after the usual age of eruption (2,28). Records of patients with missing second and/or third molars were not included because the absence of the second molar may lead to different three dimensional movements of the third one (3,5-7,29). Therefore, wrong conclusions about ITM properties (angulation, depth, class) could be retained. On the other hand, the absence of the third molar may lead to wrong prevalence of impaction since the reason of its extraction could not be known (3,10). Patients with history of facial or dento-alveolar trauma were not also included because these situations can cause teeth impaction (3,6,16,24). Finally, congenital diseases were applied as non-inclusion criteria for the same reason.

As for radiographic examination which gives a better insight into the impacted tooth as well as the surrounding tissues, we opted for OPG since they are the most used type in prevalence studies in dentistry (1,6). Besides, it gives an idea about its status and its impaction properties (6,7,30). In addition, this radiological technique is a valuable diagnostic tool of associated pathologies to ITM such as dental caries, alveolar bone loss, root resorption, and cystic lesions (7,10). For more precision, all OPG were analyzed carefully by only one practitioner. In fact, the inter-examiner variability may influence the interpretation when determining the impaction properties (12,16).

Discussion of the results

In this study, 50.3% of the subjects had at least one ITM which is in agreement with prevalence observed at Hong Kong (31), Oman (16), India (24), and Iraq (6),(respectively 55.1%, 54.3%, 50.2%, and 34.7%). However, some studies reported lower ITM frequencies in Saudi Arabia (4,18) and Finland (13) (respectively 40.5%, 41.6% and 21.9%). On the other hand, higher prevalence was observed in Saudi Arabian, Nigerian and American populations (19,32,33). These discrepancies may be consecutive to ethnic differences, food habits, and genetic heritage which affect both jaw-tooth sizes and facial growth (5,6,25). In addition, different methodologies between studies were applied regarding inclusion criteria such as age limits.

This study showed that bilateral third molar impaction is more common than unilateral one. Bilateral impaction occurred in 262 (71.4%) cases, which is higher than that reported (63%) by Quek et al. (27). A similar result was also found by Mahmud Uz Zamanet al. (3). However, this result is still in agreement with their conclusion that the majority of bilateral ITM occur in the mandible.

The 19-30 years age group had the highest prevalence of ITM; the last diminishes with increasing age. This result was similar to that observed by Chaari et al. (6) and Khouri et al. (5) who reported the highest prevalence of respectively 79.6% and 59.2% ITM among the 20-29 age group. In addition, this study revealed that the impaction of third molar is not related to gender. This finding is in agreement with previous reports about the gender distribution (3,11,18). However, some other studies reported a significantly greater frequency of ITMs in women (2,4,6,7,34,35).

The proportions of mandibular (39.6%) and maxillary (20.7%) ITM were significantly different. These findings are conformed to the previous reports (3,5-7,10,13,19,27,35-37). In contrast, two other studies indicated the opposite (17,38); ITMs were observed more frequently in the maxilla than in the mandible.

In the current study, there was no significant difference between the right and left sides when considering ITM. These findings are in accordance with previous studies (3,16,19,22,24,25).

The most common angulation observed in the maxilla was the vertical one. This disagrees with the study carried out by Topkara et al. (25) who found that distoangular

angulation was the most frequently observed pattern of impaction in the maxilla. In mandibular arch, vertical impaction was also the most common type of angulation. This is in agreement with the Lybian study (15).
In addition, the most common level of impaction in the maxilla was level C which means that the third molar is completely buried in bone. This result is in line with the findings of Topkara et al. (25) and Kumar et al. (24) who reported a higher frequency of deeply ITM in the maxilla (46% and 78.3% respectively). In the mandible, the most common level of impaction was level A which means that the occlusal plane of the ITM is at the same level as the adjacent tooth. In agreement with these findings, Anqudi et al. (16) as well as Kumar et al. (24) also found that level A was the most common impaction level in the mandible. Moreover, in most of the investigated ITM, half of the crown was covered with the anterior border of the mandibular ramus (Class II). This was in compliance with the findings of previous studies (19,32,36,39).
The pathologic conditions, including caries on both the second and third molars, external root resorption of the second molar and cystic lesions were investigated. A total of 199 pathologic changes were recorded in this study. Most of them (93%) were located in the mandible while only 14 cases were recorded in the maxilla. The most frequently observed pathology was the distal caries of the second molars. These results were similar to those reported in previous study (40). The low prevalence of external root resorption of the second molar was also in agreement with previous report (31). However, Sejfija et al. (8) reported a higher prevalence of this associated pathology. These contradictory results can be explained by different definitions of root resorption.

Clinical implication

This study determined the prevalence of ITM and investigated their spatial location as well as their angulation. In one hand, by specifying the degree of impaction, it gave an idea about operational difficulties and helped to program the best surgical procedure like choosing the type of flap, and determining the amount of bone needed to be removed (3-5,41). In the other hand, prophylactic extraction of asymptomatic impacted molars can also be decided basing on clinical and radiological criteria that were discussed yet (8).
In addition, long-term retention of ITM is associated with little risk of pathological change in the tooth or of adverse affections on adjacent structures (bone, second molar, soft tissues….) (5). For these reasons, this study putted an insight on the importance of regular controls in order to decide to decide either abstention or prophylactic extraction (5,41).

Study limitations

This study had some limitations. The first one was the use of OPG to identify ITM. In fact, the spatial resolution of this radiological technique is limited and it usually fails to accurately precise the buccolingual orientation of the ITM. The golden standard for proximal caries diagnosis is the bite-wing radiograph (7). Otherwise, the use of cone beam computerized tomography (CBCT) scans offers more detailed evaluations, more accurate estimation of the risk of complications and prevents patients from extra doses of radiation (7). The second limitation was the lacking of clinical examination. Therefore, future studies, combining clinical examination and CBCT, should evaluate the frequency of ITM in Tunisia. The third limitation was that the studied sample does not represent the Tunisian population. Therefore, it cannot reflect the Tunisian reality.

Conclusion

This was the first study aiming to determine the prevalence of ITM among a North-African population. These results may be quite useful for practitioners. Future studies that investigate impaction distribution of the other teeth can be processed to further explore this phenomenon.

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