

Prevalence of impacted mandibular third molars and its association with distal caries in mandibular second molars using cone beam computed tomography.

Prevalencia de terceros molares mandibulares impactados y su asociación con caries distales en segundos molares mandibulares mediante tomografía computarizada de haz cónico.

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Abstract: This study evaluated the prevalence and eruption's pattern of impacted mandibular third molars (IMTM) and the influence of their eruption status on the distal caries of mandibular second molars (MSM) using cone-beam computed tomography (CBCT). Material and methods: CBCT images taken for different purposes in private dental practices were analyzed retrospectively. Radiographic assessment included: prevalence of IMTM, degree of angulation, level of impaction and type of IMTM. Furthermore, the distance between the cement-enamel junctions (CEJ) of second and third molars and the occurrence of caries lesion on the distal surface of MSM was also evaluated. Data were analyzed by chi square test and logistic regression was used to find the association between distal caries of MSM and eruption status of IMTM. Results: Three hundred and eight CBCTs were screened, the prevalence of IMTM was 36.88% and their angulation degree were mostly less than 90° (mesioangular). Amongst those with impaction, 58 subjects (43%) had distal caries on MSM, 29.6% in females and 30.4% in the age group 19-27 years. Caries on the distal side of MSM were significantly associated with age, level and type of impaction, angulation degree and CEJ distances ($p < 0.05$). Conclusions: The prevalence of IMTM is high (36.88%) and there are significant relationships between angulation degree, level and type of impaction, and CEJ distances with caries on the distal side of MSM.

Keywords: *Impacted mandibular third molar; mesioangular; iraqi kurds; distal caries; cone beam computed tomography.*

Resumen: Introducción: Este estudio evaluó la prevalencia y el patrón de erupción de terceros molares mandibulares impactados (TMMI), y la influencia de su estado de erupción en la caries distal de los segundos molares mandibulares (SMM) mediante tomografía computarizada de haz cónico (TCHC). Material y métodos: se analizaron retrospectivamente las imágenes de TCHC tomadas para diferentes fines en prácticas dentales privadas. La evaluación radiográfica incluyó: prevalencia de TMMI, grado de angulación, nivel de impacto y tipo de TMMI. Además, también se evaluó la distancia entre la unión amelocementaria (UAC) de los segundos y terceros molares y la aparición de lesión de caries en la superficie distal de SMM. Los datos se analizaron mediante la prueba de chi cuadrado y se usó la regresión logística para evaluar asociaciones entre la caries distal de SMM y el estado de erupción de TMMI. Resultados: Se examinaron 308 TCHC, la prevalencia de TMMI fue de 36.88% y su grado de angulación fue mayoritariamente menor a 90° (mesioangular). Entre aquellos con impacto, 58 sujetos (43%) tenían caries distales en los SMM, 29.6% eran mujeres y 30.4% pertenecieron al grupo de edad de 19-27 años. Las caries en el lado distal de MSM se asociaron significativamente con la edad, el nivel y el tipo de impactación, el grado de angulación y las distancias UAC ($p < 0.05$). Conclusiones: la prevalencia de TMMI es alta (36.88%) y existen relaciones significativas entre el grado de angulación, el nivel y el tipo de impacto, y las distancias UAC con presencia de caries en el lado distal de los SMM.

Palabras Clave: *Tercer molar mandibular impactado; mesioangular; kurds iraquíes; caries distales; tomografía computarizada de haz cónico.*

INTRODUCTION.

The third molar, also known as the “wisdom tooth,” is the last tooth to erupt in the mouth during adolescence or sometimes later, in adulthood. Factors such as abnormal eruption process, abnormal position in the arch or lack of space in the arch leads to partial or complete impaction of wisdom teeth.¹

Impacted teeth have been reported to be associated with several oral and dental problems such as ectopic tooth buds, early loss and ankylosed primary teeth, tooth crowding, fibrous tissue covering the tooth, supernumerary teeth, cysts and odontogenic tumors, traumatic injuries during tooth formation and dietary habits that demand very little from the stomatognathic system.²

Mandibular third molars develops in ramus at age 7 years, and are the most prevalent impacted teeth (ranging from 16.7% to 68.8%) with no differences reported between genders.³ Race has not effect on sequence of teeth eruption in general; however, racial and cultural factors such as variation in facial growth, jaw and teeth size, nature of diet, extent of generalized tooth attrition, degree of use of masticatory apparatus and genetic inheritance have been shown to have impact on eruption pattern, impaction status and agenesis of third molars.⁴

Impacted mandibular third molars have been classified either at the level of impaction and relation between CEJ on the impacted tooth and associated bone level,⁵ or on the relation between anterior border of ramus to the long axis of the second molar and the angulations of the third molars.⁶

Several complications and disorders have been associated with IMTM including tooth caries, dental crowding, pericoronitis, root resorption and periodontal diseases. Furthermore, serious complications such as osteomyelitis of the mandible and development of cysts and tumors have been reported in relation to impacted third molars as well.⁷

Dental caries is most common hard tissue lesion (prevalence range from 13.4% to 30.1%)⁸ associated with impacted third molars and this could be related to the position and inclination of third molars and the gap with adjacent teeth that facilitate biofilm accumulation

and break down of the integrity of the distal surface of the adjacent second molar.^{9,10}

Carious lesion in the distal surface of MSM is difficult to detect and can lead to pulpitis or apical periodontitis, which requires endodontic therapy or even extraction in severe cases.

Thus, the removal of asymptomatic IMTM before leading to dental caries on the distal surface of MSM has been suggested.¹¹ However, the criteria used to make this decision are not yet clear. Periapical and panoramic radiographs have widely been used to assess the correlation between IMTM and caries on the distal surface of adjacent MSM.¹² However, these types of radiograph are not as accurate and precise as CBCT in determining smaller details.¹³

Therefore, this retrospective clinical study was designed to determine the prevalence of IMTM and the effect of their eruption status (level, type and angulation of impaction and CEJ distance) on the development of distal caries on the MSM using CBCT.

MATERIALS AND METHODS.

Study group

This retrospective clinical study included CBCTs taken for various purposes from June 2017 to March 2018, gathered from the archives of the privately operated B&R Dental Center in Sulaimani, Kurdistan Region of Iraq. The study investigation was approved by the Science Ethics Committee of the College of Dentistry, University of Sulaimani.

The CBCTs were screened by two investigators and evaluated for inclusion and exclusion criteria before being included in the study. The inclusion criteria were: individuals at least 19 years old and presence of mandibular second molar. The exclusion criteria were poor quality of CBCT image, incomplete patient record, incomplete root formation of IMTM, presence of any craniofacial anomalies, congenital deformities or syndromes, and presence of any cyst, tumor, or other pathological condition that might affect radiographic measures.

Demographical and radiographic measures

Age and gender of the patients were obtained from the patients' health records at the B&R dental center.

Subjects aged between 19 to 27 years were enrolled in one group and those 28 and over were enrolled in another group.

All the CBCT images were acquired with a GALILEOS Sirona comfort PLUS unit (Sirona Dental Systems GmbH, Bensheim, Germany). Performance features are: 15.4cm spherical imaging volume, 0.25/0.125mm isotropic voxel size, 98 kVp, 3-5mA and exposure time of 14s. The CBCT images were analyzed with GALILEOS Implant software. One oral and maxillofacial imaging expert and one image analysis expert determined the radiographic measures. In case of disagreement, a third investigator involved.

Mandibular third molar was considered impacted if the roots were fully formed and it was not in functional occlusion regardless of the cause of impaction. The type of impaction was identified according to the Archer¹⁴ and Kruger¹⁵ classification into mesioangular, distoangular, horizontal, vertical and others.

The depth of impaction was determined in sagittal planes of CBCT according to the Pell *et al.*,⁵ classification as follows: position A (the highest portion of the mandibular third molar is above or at level with the occlusal plane of the mandibular second molar), position B (the highest portion of the mandibular third molar is between the occlusal plane and the cervical line of the mandibular second molar) and position C (the highest portion of the mandibular third molar is below the cervical line of the mandibular second molar); also the side of impaction (right or left) was recorded. (Figure 1)

Angulation of the mandibular third molar was determined by obtaining the average of three different sagittal planes through measuring the angle of the intersection between the mandibular occlusal plane and the occlusal plane of the mandibular third molar according to the classification of Shiller,¹⁶ these two planes were drawn along the tips of the cusps of both the MSM and the third molar. (Figure. 2)

Four groups based on the angulation (0°-45°, 46°-90°, 91°- 135° and ≥ 136°) were created. The distance between the mandibular second and third molars was determined by measuring the distance of their CEJs in three sagittal planes and the average was recorded as reported by the

classification of Leone *et al.*¹⁷ (Figure 3)

Those with 0 to 4mm distance were enrolled in one group, those with 5 to 9mm enrolled in another group and finally, those with ≥10mm were enrolled in a third group. The presence of distal caries in MSM was determined independently by each investigator observer in the axial, coronal, and sagittal planes. A carious lesion was considered present when radiolucency could be seen in the enamel or dentine in the sagittal or axial plane.

Statistical analysis

Prevalence of IMTM was calculated by dividing the number of impaction by the total number of third molars (both right and left). Furthermore, the prevalence of impaction according to gender and side were determined by dividing the number of impaction for each variable (male, female, right and left) by the total number of samples in each variable.

Chi-square test was used to assess the differences between caries and non caries on distal side of MSM in those with IMTM for all the tested variables. (Table 1) Logistic regression was used to determine the association of each variable with the presence or absence of caries as the dependent variable. (Table 2)

Statistical significance was defined as $p \leq 0.05$ and all calculations were conducted using the SPSS software package version 22 (SPSS Inc., Chicago, IL, USA). The null hypothesis was that none of the above variables were associated with caries.

RESULTS.

Three hundred and eight CBCTs were evaluated (140 female and 168 male), a total of 366 third molars were evaluated, and the mean age of the patients was 30.28±10 years. The total number of IMTM was 135 (right and left) in 86 subjects (prevalence 36.88%). There was no statistically significant difference in the number of IMTM between right (70, 19.12%) and left side (65, 17.76%) using chi-square test ($p=0.38$). However, there was a statistically significant difference between females (54, 17.53%) and males (32, 10.38%), (Chi square=14.4, $p=0.0001$).

The most prevalent IMTM was mesioangular (69, 51.1%) followed by horizontal (28, 20.7%), and vertical (22, 16.2%). Furthermore, 76 IMTM (56.2%) were

located between the occlusal plane and cervical line of the second molar (Level B), 41 IMTM (30.4%) were at or above the occlusal plane of MSM (Level A) and the remaining were below the cervical line of MSM level C. (Figure 4)

The prevalence of distal caries on MSM was 43% (n=58) and there are significant differences between the presence and absence of caries regarding age, type and angulation degree of IMTM, and CEJ distance between IMTM and MSM. Whereas, there were no significant differences in gender, side and level of impaction. (Table 1)

Logistic regression showed that the presence of caries on the distal surface of the MSM was significantly associated with the age group of 19-27 (OR=2.77), level A (OR=4.318) and B (OR=4.4) of impaction, mesioangular type of impaction (OR=17.11), angulation degrees of zero to 90° (OR for zero to 45=8.037, OR for 46-90=5.793) and CEJ distance of 5 to 9mm (OR=7.423). Whereas, age group of 28-65, gender, side, level C impaction, angulation greater than 90° and CEJ distance of zero to 4mm and ≥10mm were not associated with caries on the distal surface of MSM. (Table 2)

Figure 1. Impaction level of mandibular third molar according to the classification of Pell and Gregory.⁵



Figure 2. Angulation degree of mandibular third molar according to the classification of Shiller.¹⁶

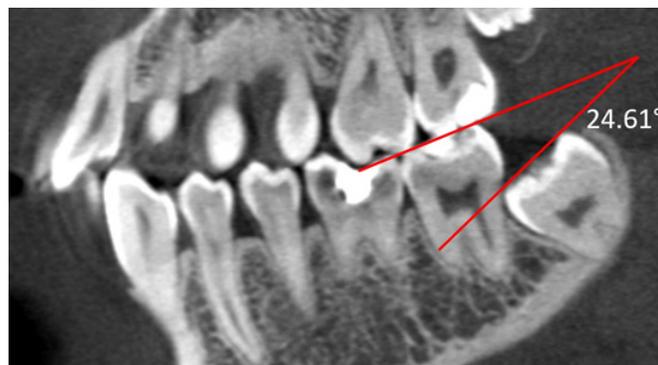


Figure 3. Cemento enamel junction distance between distal surface of mandibular second molar and mesial surface of mandibular third molar according to the classification by Leone *et al.*¹⁷



Figure 4. Level and type of IMTM (n= 135).

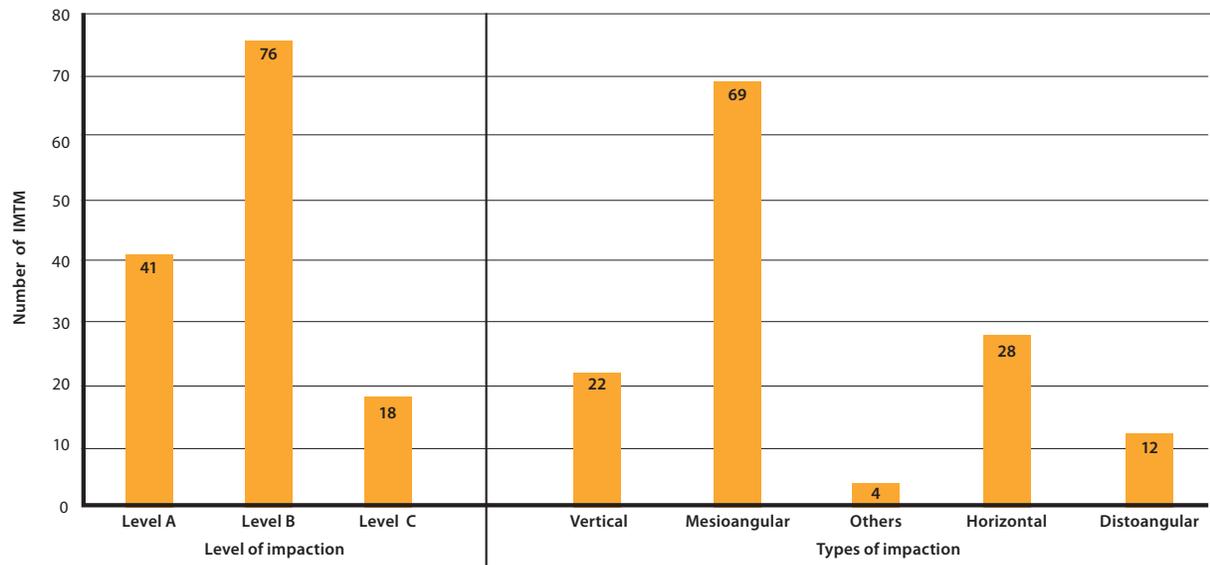


Table 1. Association between distal caries in the MSM, demographical data and eruption status of IMTM.

Variable		Caries status			Chi square (<i>p</i> -value)
		No caries N (%)	Caries N (%)	Total N (%)	
Age	19-27	35 (25.9)	41 (30.4)	76 (56.3)	$\chi^2= 8.56$ (<i>p</i> =0.003)
	28-65	42 (31.1)	17 (12.6)	59 (43.7)	
Gender	Female	46 (34.1)	40 (29.6)	86 (63.7)	$\chi^2=1.21$ (<i>p</i> =0.270)
	Male	31 (23)	18 (13.3)	49 (36.3)	
Side of Impaction	Right	39 (28.9)	31 (23)	70 (51.9)	$\chi^2= 0.1$ (<i>p</i> = 0.74)
	Left	38 (28.1)	27 (20)	65 (48.1)	
Type of Impaction	Vertical	14 (10.4)	8 (5.9)	22 (16.3)	$\chi^2=21.11$ (<i>p</i> =0.000)
	Mesioangular	27 (20%)	42 (31.1)	69 (51.1)	
	Others	3 (2.2)	1 (0.7)	4 (3.0)	
	Horizontal	22 (16.3)	6 (4.4)	28 (20.7)	
	Distoangular	11 (8.1%)	1 (0.7)	12 (8.9)	
Level of Impaction	Level A	22 (16.3)	19 (14.1)	41 (30.4)	$\chi^2=5.87$ (<i>p</i> =0.053)
	Level B	40 (29.6)	36 (26.7)	76 (56.3)	
	Level C	15 (11.1)	3 (2.2)	18 (13.3)	
Degree of Angulation	0-45	27 (20)	31 (23.0)	58 (43.0)	$\chi^2=11.80$ (<i>p</i> =0.008)
	46-90	29 (21.5)	24 (17.8)	53 (39.3)	
	91-135	7 (5.2)	1 (0.7)	8 (5.9)	
	≥136	14 (10.4)	2 (1.5%)	16 (11.9)	
Distance (mm)	0-4	20 (14.8)	9 (6.7)	29 (21.5)	$\chi^2=20.18$ (<i>p</i> =0.000)
	5-9	28 (20.7)	43 (31.9)	71 (52.6)	
	≥10	29 (21.5)	6 (4.4)	35 (25.9)	
Total		77 (57)	58 (43)	135 (100)	

Table 2. Summary of Logistic Regression for each individual explanatory variable to detect distal caries.

Variable		Odds Ratio	95% for Confidence Interval	p-value
Age	19-27	2.778	1.14 – 6.77	0.025
	28-65	1		
Gender	Female	1.498	0.73 - 3.07	0.27
	Male	1		
Side of Impaction	Right	1.11	0.56 – 2.12	0.74
	Left	1		
Type of Impaction	Vertical	6.286	0.680 -58.1	0.105
	Mesioangular	17.11	2.088- 140.1	0.008
	Others	3.667	0.173- 77.5	0.404
	Horizontal	3	0.320 28.1	0.336
Level of Impaction	Distoangular	1		
	Level A	4.318	1.08 – 17.22	0.038
	Level B	4.5	1.2 – 16.82	0.025
Degree of Angulation	Level C	1		
	0-45	8.037	1.67 – 38.58	0.009
	46-90	5.793	1.19 – 28.04	0.029
	91-135	1	0.07 – 13.01	1
Distance (mm)	≥136	1		
	0-4	2.175	0.66 – 7.07	0.19
	5-9	7.423	2.73 – 20.16	0.0001
	≥10	1		

DISCUSSION.

Caries on the distal side of the MSM are associated with the presence of IMTM, illustrating why the prophylactic removal of IMTM has been proposed in certain cases.¹⁸ Several clinical features of IMTM should be considered when prophylactic removal of IMTM is proposed, such as age and eruption status (level, degree of angulation). This study aimed to find the prevalence of IMTM and their eruption status, and to identify risk factors associated with distal caries on MSM using CBCT.

The prevalence of IMTM in the studied population was 36.88% which is less than that reported in Nigeria (72.09%)¹⁹ and USA (65.5%),²⁰ while it is slightly higher than of what has been reported in Sweden (33%)²¹ and in a Saudi population.²² This can be explained by ethnic differences as well as the definition used for impaction. Furthermore, statistically significant differences between

males and females were found, with a higher prevalence in females. This is in accordance with Quek *et al.*,²³ and Hashemipour *et al.*²⁵

This could be related to the fact that in females the jaw stops growing at an earlier age.²⁵ However, this study is not in line with Mwaniki *et al.*,²⁶ and Bui *et al.*,²⁷ who reported a higher prevalence of IMTM in males. The most prevalent type and level of IMTM were mesioangular and level B, respectively. These are in agreement with other studies,²⁸⁻³⁰ and not in accordance with others.³¹⁻³⁴ The differences with other studies might be related to differences inherent to the studied populations.

The overall prevalence of distal caries on MSM was 43%, which is higher than what has been reported in previous studies.^{35,36} This could be due to the higher sensitivity of CBCT for detecting caries lesion,¹³ or that regular dental checkups are less common in Iraq

and people seek dental treatment only when symptoms are present. Amongst the variables tested, age, type and angulation of IMTM, as well as distance between CEJs were statistically significant different between the groups with and without caries. (Table 1) Logistic regression showed that the age group of 19-27 years was significantly associated with caries (OR= 2.778). (Table 2)

This finding could be related to the fact that the peak age for caries is 25 years,¹⁸ and the caries prevalence remains constant thereafter,³⁷ however, this is not in line with data reported by other studies.^{38,39} The possible explanation could be the technique used for caries detection, as CBCT is more sensitive than panoramic and periapical radiographs¹³ that were used in these two studies.^{38,39} Although there was no statistically significant different in the level of eruption between the groups with and without caries (chi-square=5.87, *p*-value=0.053), (Table 1) the level of eruption of the IMTM was associated with caries on the distal side of MSM.

The data in this study revealed that level A and B were significantly associated with caries on the distal side of MSM (OR= 4.3 and 4.5, respectively), (Table 2) and these results are similar to those found by Blondeau and Nach⁴⁰ and Yilmaz *et al.*⁴¹ A likely explanation for that is the A and B levels have contact with the oral cavity and provide a niche for cariogenic bacteria. Angulation of IMTM is another factor that closely associated with distal caries of MSM. Angulation degrees of $\leq 90^\circ$ were associated with caries, those with angulation degree of $\leq 45^\circ$ correlated with caries (OR=8.037) more than those with angulation degree of 46° to 90° (OR=5.793). (Table 2)

In brief, the smaller the degree of angulation, the

greater the risk of caries. This is comparable with studies by McArdle *et al.*,³⁹ and Kang *et al.*⁴²

Chang *et al.*,¹² and Falci *et al.*,⁴³ showed that a CEJ distance of 7-9mm and 3-10mm were a risk factor for distal caries in MSM. These are comparable with the results of this study that show that CEJ distances of 5-9mm increase the likelihood of distal caries (31.9%) in MSM.

CONCLUSION.

This study has demonstrated that young subjects (≤ 27 years) with mesioangular (angulation degree $< 90^\circ$) IMTM and at level B and A, and a 5-9mm CEJ distance are at a higher risk of developing caries on the distal side of MSM. Therefore, further attention and regular check-ups are required in these patients. Further prospective longitudinal studies with a larger sample size that take the cost-benefit effect on the prophylactic removal of IMTH need to be carried out to draw guidelines for the prophylactic removal of IMTM.

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