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Evaluation of the position of impacted third molars using cone beam computed tomography (CBCT) images

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ABSTRACT

Purpose: To evaluate the impaction angulation and impaction depth of impacted third molars and their relation to age and gender.

Materials and Methods: Including 60 maxillary and 155 mandibular impacted third molars, 215 CBCT scans (71 males and 144 females) were studied. The three planes of CBCT were examined to evaluate the impaction angulation and impaction depth of each impacted molar. Then, Chi-square and Monte Carlo analyses were used to assess the statistical significance.

Results: Among 215 impacted third molars,the most common angulations were mesioangular and vertical, while the most common impaction depth was position B.

Conclusion: Correlation between impaction angulation and impaction depth of impacted third molars was detected**.**

Keywords: Impacted tooth,Third molars, Cone-beam computed tomography.

I. INTRODUCTION

Tooth impaction is defined as a pathological condition in which the tooth is unable to erupt through the overlying bone and/or mucosa for its normal functional position.[1] The most common impacted teeth are the third molars with prevalence ranges from 16.7% to 68.6%[2, 3]. This variation is due to differences in nationality and racial features[4] . Furthermore, third molars pose around 98% of all impacted teeth.[5]

Understanding the mechanisms generating impaction and the connection between impaction and other impacted third molar (M3) anomalies, such agenesis, requires first describing the pattern of prevalence globally.Even while third molar impaction and agenesis rates overall are relatively comparable, subsequent investigation revealed some variations in the patterns of existence. [6]

For instance, impaction was far more likely to occur in the mandibular dentition while third molar agenesis was more common in the maxillary dentition. Africa has the lowest rates of impaction and agenesis in relation to populations. For agenesis, there were several populations with obvious, severe differences, whereas there were few for impaction.[6]

Although the exact reason for the increased impaction risk in third molars is not yet fully understood, the most widely accepted view suggests that it is due to the third molars' late eruption time, which occurs between the ages of 17 and 21, when there is frequently insufficient room.[7]

However, it has been noted in numerous studies that the eruption of the third molar might last until age 25.[8] Physical obstacles like thick soft tissue or dense bone as well as additional pathologies such cysts, tumors, and systemic disorders can potentially induce impaction. [9-12]

Other explanations of third molar impaction have been proposed in the literature, such as the steady evolutionary shrinkage of the human jaw, which is therefore supposed to have prevented it from accommodating the corresponding molars.[13] Modern food contributes to insufficient masticatory effort, which reduces stimulation of maxillary growth and increases the prevalence of tooth impaction.[14, 15]

Some syndromes, including cleidocranial dysostosis, Gardner's syndrome, Gorlin-Sedano syndrome, and Yunis Varon syndrome, are linked to many impactions. [16-20] Additionally, a case of primary teeth impaction, which is uncommon in general, was recorded in a patient who also had monogynous twins with dental agenesis.[21]. There

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is some indication that impaction may have a strong genetic component. [6]

Actually, not every impacted third molar causes symptoms and pathological events. However, others can cause severe complications such as infection, atypical facial pain that can be confused with temporomandibular joint complaints, cystic lesions, and neoplasm. Besides, impacted teeth are often associated with pericoronitis, periodontitis, and detrimental effects on adjacent teeth such as root resorption or caries.[22, 23]

In this investigation, we aimed to evaluate the impaction angulation and impaction depthof impacted third molars and their relation to age and gender.

II. MATERIAL AND METHODS

Study design:

This is a cross sectional study which was approved by the ethical committee at the Faculty of Dentistry, Mansoura University according to the World Medical Association Declaration of Helsinki guidelines[24].

Sample selection:

A total of 300 CBCT scans, 215 images were included according to inclusion and exclusion criteria. Patients did CBCT scans for many diagnostic purposes as impacted tooth assessment, endodontic treatment, or implant planning, during the period between 2015 and 2022. All CBCT images were scanned using a X Mind trium device, (Acteon, Olgiate Olona, Italy) from a private radiological center in Mansoura city at 90 kVp, 8 mAs, 17.5 seconds scan time, and 8x8 cm or 11 x 8 cm field of view, and 0.08-0.125mm voxel size with full scan rotation (360 degrees).

Inclusion criteria were patients who are Egyptians,seventeen years old or older, presence of impacted third molar and adequate image quality. The exclusion criteria included defects in the quality of images, a follicular diameter of more than five mm in the impacted third molar, and cystic or tumor lesions involved with the impacted third molar.

Radiographic assessment:

First, Patients were divided into three groups according to age (17–24, 25–34, and 35–50 years old) and into two groups according to gender (males and females). Then, the CBCT images were manipulated in the axial, corrected sagittal, and coronal planes using OnDemand 3D software (Cybermed, Daejeon, Korea), in Digital Imaging and Communications in Medicine (DICOM) format.

Assessment of the impaction angulation:

In Winter classification[25], Based on the long axis of the second molar, the impacted third molar is classified into: vertical: the long axis of the impacted third molar was found to be parallel to the adjacent second molar, mesioangular: the long axis of the impacted third molar was directed towards the mesial direction in relation to the adjacent second molar, horizontal: the long axis of the impacted third molar was perpendicular to the adjacent second molar, distoangular: the long axis of the impacted third molar was directed to the distoangular position in relation to the adjacent second molar, inverted: The third molar crown was facing the base of the jaw, and the root was facing towards the occlusal direction.

Assessment of the impaction depth:

Impaction depth was assessed, according to the Pell and Gregory classification, impacted third molars are defined according to their relationship with the occlusal plane of the second molar. So, three positions are specified [26]: position A: the highest part of the impacted third molar is at or above the occlusal plane of the adjacent second molar,position B: the highest part of the impacted third molar is below the occlusal plane but above the cementoenamel junction (CEJ) of the adjacent second molar, and position C: The highest part of the impacted third molar is below the CEJ of the adjacent second molar.

Statistical analysis and data interpretation:

Data were collected in datasheets, and SPSS software (PASW statistics for Windows, version 25. Chicago: SPSS Inc.) was used for analysis. Then, Monte Carlo and Chi-Square tests were used to evaluate the significance level at ($p \leq 0.05$).

III. RESULTS

The mean age of patients was (25.68±3.85)years and 25 upper right, 35 upper left, 70 lower right, and 85 lower left impacted molars were included from 71 males and 144 females.

Impaction angulation of all of the studied cases was distributed as following; 17 cases (7.9%) disto-angular, 26 cases (12.1%) horizontal, 86 (40%) mesio-angular and 86 cases (40%) vertical as shown in figure (1).

Also, of the studied cases; 17 cases (7.9%) have impaction depth position A, 111 cases (51.6%) have impaction depth position B and 33 cases (15.3%) have position C as shown in figure (2).

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A statistically significant relation was detected between impaction angulation and impaction depth.Additionally,a statistically significant relation was present between age and impaction depth, while there was no detectable relation between age and impaction angulation.In contrast, a statistically significant relation was detected between gender and impaction angulation with no relation between gender and impaction depth.(Tables (1-3))

IV. DISCUSSION

In this research, vertical and mesio-angular orientations of impacted third molars were equally the most detectable among cases. Also, some other studies observed that vertical angulation is most common in upper and lower impacted third molars.[27, 28].

However, other investigations reported that mesioangular impaction was the most common pattern of angulation in both jaws.[29]Anywhere, these results are nearly to the results of this study.

This study found that the most common impaction depth was position B, which is compatible with the study of Primo et al.[30], Karina et al. [31], Hassan [32], and Kaomongkolgit and Tantanapornkul[12].

In contrast, in the study of Xavier et al.[33], they found that position A is the most common among cases, while the study of Lina et al.[34] detected that position C is the most popular. Actually, this difference between results can be related to the difference between the different selected samples from different populations.

Regarding the relationship between impaction angulation and impaction depth, it is detectable in this study that in position A, vertical orientation was the most common. Actually, this iscompatible with the study of Gümrükçü[35], when he found the mesioangulated and vertical types of Winter classification were clearly the most prevalent positions in position A when the occlusal plane of Pell and Gregory was examined. This could be related to the fact that when the impacted molar lies vertically, it will have the enough space to erupt up to the level of occlusion of the second molar.

In position B, the mesio-angulation was the most detectable here,while in Gümrükçü's study[35], The mesioangulated and distoangulated postures were the most common. This can be explained by that this malposed angulations limit the eruption of the impacted molar.

Finally, in position C, vertical angulations were more found in this study, which is not compatible with the study of Gümrükçü[35], when he found mesioangulated and horizontal locations were more detectable in this position. Actually, this can lead to the fact that there are some issues other than the impaction angulation that led to impaction. For example, lack of sufficient mesio-distal room for the third molar, presence of some systemic disorders or syndromes such as cleidocranial dysostosis, Gardner's syndrome, Gorlin-Sedano syndrome, and Yunis Varon syndrome, are linked to many impactions. [16-20] As this study found that although some molars were oriented vertically, but they were impacted deeply in the jaw.

Regard to the relationship between age and impaction depth, in older patients; 46.2% were position C, 42.3% position B and 11.5% position A.In contrast, in the study of Marks et al.[36], position A was recorded in patients who were older whereas position C was noted in individuals who were younger. Actually, this could be explained by the difference between the selected populations.

Next, the relationbetween the gender and impaction angulation was as following,among females; the most common impaction angulation was vertical (47.2%) and mesio-angular (33.3%) while for males; 53.5% mesio-angular and 25.4% vertical.

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Tables

Table (1): The relationship between impaction angulation and impaction depth.

Parameter		Impaction depth			Test of significance
		Position A n=71(33%)	Position B n=111(51.6%)	Position C n=33(15.4%)	
Impaction angulation	Disto-angular	1(1.4)	8(7.2)	8(24.2)	□^{2}=17.24 P=0.008*
	Horizontal	9(12.7)	14(12.6)	3(9.1)	
	Mesio-angular	30(42.3)	47(42.3)	9(27.3)	
	Vertical	31(43.7)	42(37.8)	13(39.4)	

□^{2}=Chi-Square test, *statistically significant

Table (2): The relationship between age and impaction angulation and impaction depth.

Parameter		age / years			Test of significance
		17-24 n=98(45.6%)	25-34 n=91(42.3%)	35-50 n=26(12.1%)	
Impaction angulation	Disto-angular	4(4.1)	10(11)	3(11.5)	□^{2MC}=5.23 p=0.515
	Horizontal	12(12.2)	12(13.2)	2(7.7)	
	Mesio-angular	38(38.8)	36(39.6)	12(46.2)	
	Vertical	44(44.9)	33(36.3)	9(34.6)	
Impaction depth	Position A	33(33.7)	35(38.5)	3(11.5)	□^{2MC}=23.44 P<0.001*
	Position B	54(55.1)	46(50.5)	11(42.3)	
	Position C	11(11.2)	10(11.0)	12(46.2)	

MC: Monte Carlo test, *statistically significant

Parameter		Gender		Test of significance
		Male n=71(33%)	Female n=144(67%)	
Impaction angulation	Disto-angular	5(7.0)	12(8.3)	□^{2}=10.97 P=0.012*
	Horizontal	10(14.1)	16(11.1)	
	Mesio-angular	38(53.5)	48(33.3)	
	Vertical	18(25.4)	68(47.2)	
Impaction depth	Position A	24(33.8)	47(32.6)	□^{2}=1.39 P=0.498
	Position B	39(54.9)	72(50.0)	
	Position C	8(11.3)	25(17.4)	

Table (3): The relationship between gender and impaction angulation and impaction depth.

□^{2}=Chi-Square test, *statistically significant

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Figure legends

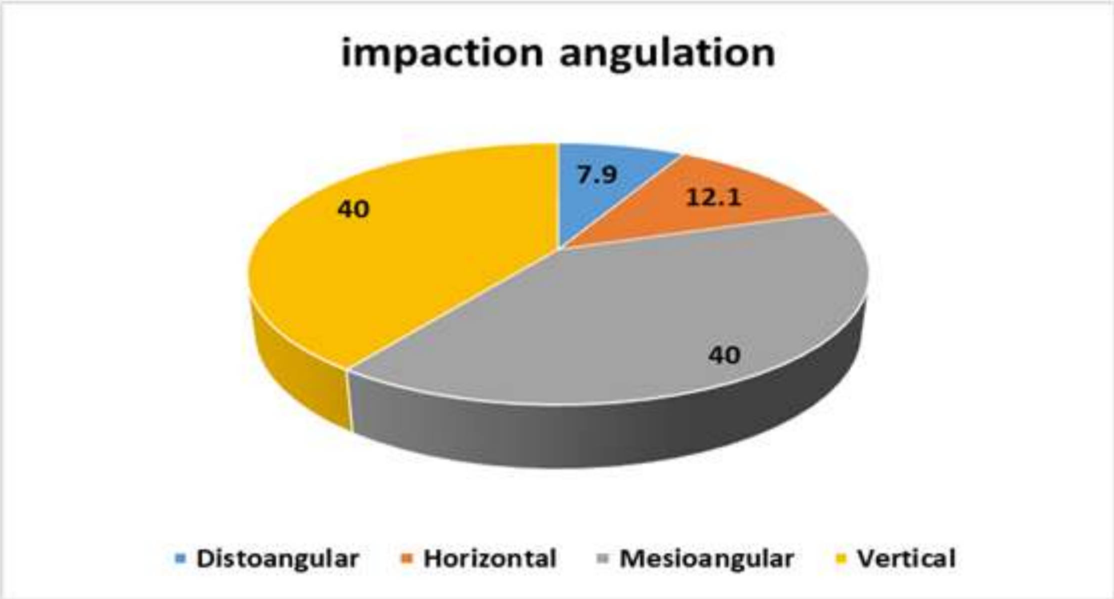

Figure (1): A pie chart shows the impaction angulation among the studied cases

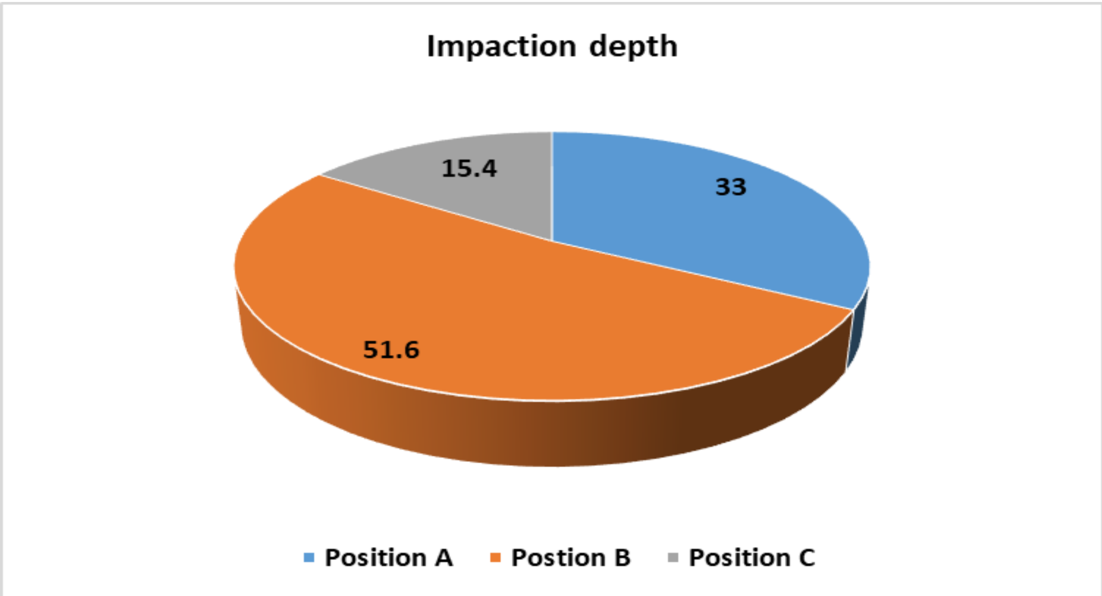

Figure (2): A pie chart shows the impaction depth among the studied cases