Cone-Beam Computed Tomographic Evaluation of Third Molar Status among Al-Hasa population, eastern province, Saudi Arabia: A Retrospective Cross-sectional Study

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Abstract

Third molar teeth have the highest incidence among all impacted teeth in oral cavity. This study is to evaluate Cone-beam computed tomography (CBCT) for the Status of maxillary and mandibular third molar position based on winter, Pell & Gregory classification systems. In addition, association of mandibular third molar with the inferior alveolar nerve(IAN).

A retrospective cross sectional study including 500 Cone-beam computed tomography (CBCT) images of the patients who reported to the Dental clinic complex, college of dentistry, king faisal university, Al-Ahsa, Saudi Arabia between 2018 to 2022 were evaluated for the status, Angulation, level of eruption, available space for eruption and assessment of association of impacted mandibular third molar to IAN.

Among 500 individuals, 285 were male and 215 were female patients. Of the 500 CBCT images evaluated, 431 third molars were noticed impacted, 794 erupted and 775 third molars were missing. The most common angulation of impaction in the mandible was mesioangular position 55.5% followed by vertical impaction 22.4% and the most common angulation of impaction in the maxilla was the vertical 80.8% followed by mesioangular impaction 9.6%.The level of eruption of mandibular third molar was found to be 118 (46.5%)at position A,60 (23.6%) at position B and 76(29.9%) at position C. Association of mandibular third molars with inferior alveolar nerve was found in 29.53% of teeth. The level of eruption of maxillary third molars found to be 6(3.4%) teeth with position A, 20(11.3%) teeth were in position B followed by 151(85.3%) teeth in position C.

The status of third molar in the Eastern region of Saudi Arabia within the study sample was characterized by 21.6% impactions which were more commonly in the mandible. The most common angulation was mesioangular in the mandible, vertical in the maxilla. The most common level of impaction in mandible was position A and Position C was the most common in maxilla. 29.53% of mandibular third molars associated with inferior alveolar nerve.

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Introduction

Impaction can be defined as considerably delayed eruption of a tooth with a clinical and radiographical evidence and further eruption may not occur [1]. Generally, impaction of teeth arises because of either systemic or local factors [2]. In a systematic review, Dalessandri et al listed the suggested causes of impaction that include disturbance of dental lamina, trauma, endocrine disorders, hereditary factors and or any pathological conditions causing local disturbance of the eruption[3]. However, Impaction may occur in any tooth and among all impacted teeth, third molar is the most common type[4]. Being the tooth to erupt may explain the increased chance for impaction[5].Mandibular third molar seems to be the most popular among impactions[6]. Impacted Third Molar (ITM) may lead to several clinical conditions that indicate the removal of the tooth[7].

The risk of non-intervention with impacted third molar may lead to pericoronitis, resorption

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of the adjacent root, caries of adjacent tooth or development of a pathological condition[8]. However, along with the benefit of ITM removal, few complications may also arise[9]. One of the complications which occur during removal of mandibular third molar is injury to inferior alveolar nerve though loss of sensation due to nerve damage is transient[10], in some situations permanent loss of sensation might take place[11]. Therefore, preoperative radiographic assessment is mandatory. To assess ITM, radiographs are still the gold standard for investigation. Usually, panoramic radiograph is the investigatory method for assessment of impacted teeth[12]. However, orthopantomography (OPG) showing only 2-dimensional information that does not provide accurate assessment of the relation between IAN and impacted mandibular third molar. As a result, 3 dimensional radiographs like CBCT are recommended[13].Cone beam computed tomography (CBCT) scan is currently one of the diagnostic tools for use on the maxillofacial region with low radiation doses and high resolution which can depict objects in three dimensions[14].

Worldwide the prevalence of ITM has been studied broadly [15–17]. In Saudi Arabia different studies conducted and assessed the prevalence and status of ITM in different regions of the kingdom[2,15,18,19]. Braimah et al reported a prevalence rate of 16.5% in southern region[20]. In the central region of the kingdom Alfadil et al reported 58.3% prevalence rate[19]. In addition, Hassan reported a prevalence rate of 40.6% in western region[2]. However, in the eastern region Alamri et al found 13.2% is the prevalence rate of third molar impaction[21]. Moreover, Al-Ramil et al measured the occurrence of impactions among Al-Hasa region and found a 27.1% prevalence rate which includes 62.80% of mandibular third molar impaction[4].

This study aimed to determine the prevalence of maxillary and mandibular third molars in patients attending dental clinic complex at college of dentistry, king faisal university, Al Ahsa in Saudi Arabia by evaluating the status, Angulation, level of eruption, available space for eruption and assessment of association of impacted mandibular third molar to IAN.

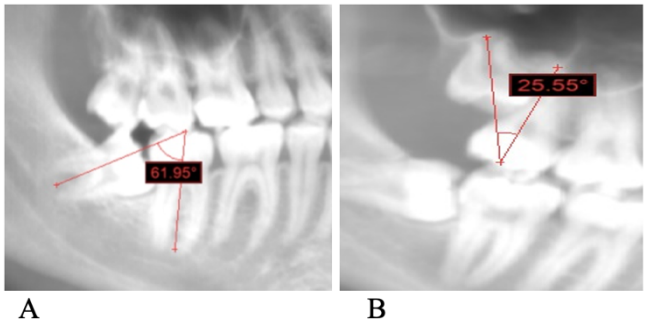
Materials and methods

This retrospective study consisted of 500 CBCT radiographs of randomly selected patients form those who visited the dental clinics complex at King Faisal University, Al-Ahsa, Saudi Arabia. The inclusion criteria were adults aged 20 to 60 years among 285 were males and 215 females. Patients below the age of 20 years excluded, as the eventual outcome of third molar eruption is uncertain. CBCT images captured with I-CAT Vision QTM Version 1.9.3.14. (Imaging Sciences International, Hat-field, PA, USA.). The field of view 130 * 160 mm with a voxel size was 0.25mm, 120 kV, and 5 mA with exposure time 2-7s. 3D reconstruction and measurement of CBCT images constructed using Blue-sky Plan (Version 4.7.55, GmbH, and Lagena-gen, Germany). This is a retrospective, cross-sectional study in which all the CBCT images screened by a single examiner for the status of third molar teeth. The screened CBCT images then filtered according to the inclusion and exclusion criteria.

CBCT were taken for all subjects to assess the status of third molars. During the study of third molar impaction the angulation, level of eruption, horizontal relation with the ramus and association with inferior alveolar nerve for mandibular arch were assessed while the angulation and level of eruption in maxilla were assessed.

Angulation (according to Winter):

The vertical relationship between the third molars' long axis and the adjacent second molar's long axis, as determined by CBCT tracing, was used to establish the third molars' position.



A B

Figure 1. Showing the angulation.
(A)Mandibular third molar (B)Maxillary third molar.

The midpoint of the occlusal surface and t he furcation point in the second and third molars were marked with a l ine. The long axis of the teeth is represented by these lines. The degree of the third molars' inc lination with respect to the second molars was

determined by the angle created by the intersecti ng long axes (Figure 1).

Level of Eruption (Position): Referring to the position of eruption in CBCT according to the Pell and Gregory's classification system, two parallel horizontal lines were drawn, with the first line being places at the cementoenamel junction of the first and second molars, and the second line being positioned at the occlusal plane of the first and second molars. One of the three groups was determined based on the third molars' depth in respect to the neighboring second molar. The highest part of the third molar was in position A on the same level as or above the occlusal plane of the adjacent second molar: in position B, it was below the occlusal plane but above the second molars' cervical line; and in position C, it was below the second molars' cervical line (Figure 2).

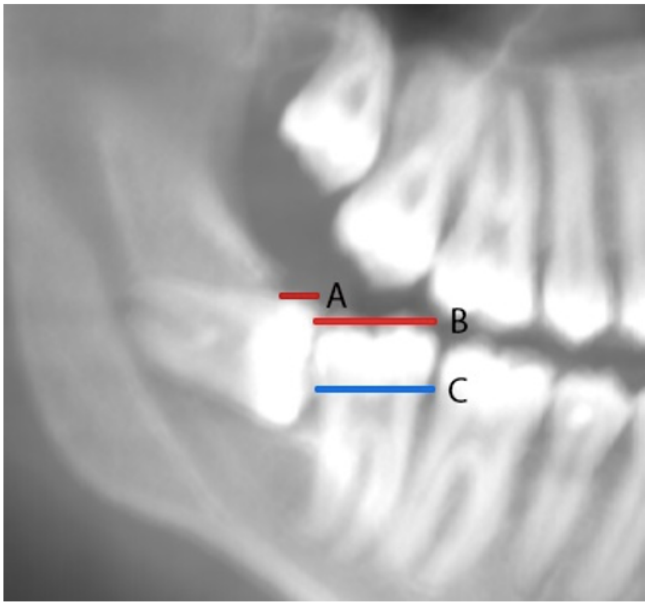


Figure 2. Indicating level of eruption(position)
A.Highest point of impacted third molar
B.Horizontal line indicating occlusal surface
C.Horizontal line indicating Cervical line of adjacent second molar.

Horizontal space available: Available horizontal space was calculated as the difference between the mesiodistal width of the third molar and the distance between the distal surface of the second molar crown and the anterior border of the ramus on the occlusal plane (Pell and Gregory classification). The distance between the distal surface of the second molar and the anterior border of the mandibular ramus was measured using a vertical line anterior to the anterior border of the ramus in accordance with Pell and Gregory's classification of ramus connection Class I: There is enough room for the eruption of the third molar between the distal side of the second tooth and the anterior border of the ascending ramus. Class II: There is less space between the distal side of the second molar and the anterior border of the ascending ramus. Class III: absolute lack of space and the third molar is totally embedded in the ascending ramus. (Figure 3).

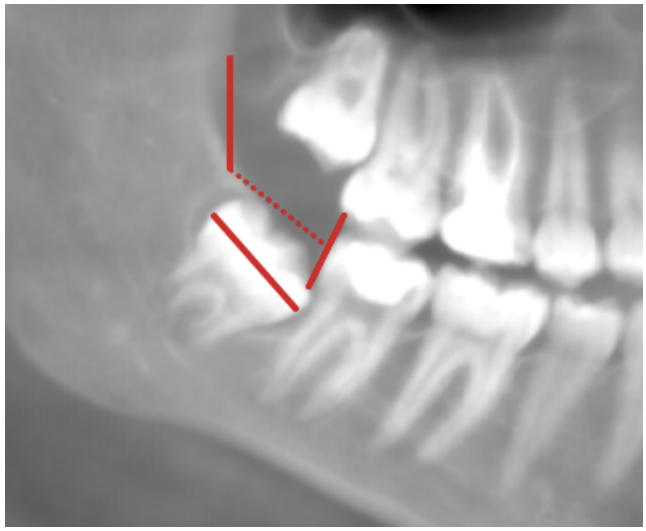


Figure 3. Indicating Horizontal space available between ascending ramus and distal surface of mandibular third molar

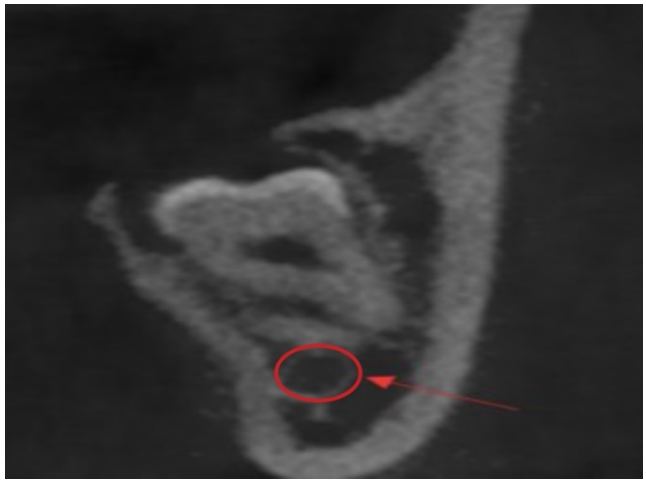


Figure 4. Showing the relation of inferior alveolar nerve canal with the roots of mandibular third molar.

Relation with Inferior alveolar canal: On the coronal view of the multiplanar reformation (MPR) assessment of impacted

mandibular third molar was carried out by evaluating the roots if they are associated with the canal or not associated (Figure 4).

Statical analysis: Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, N.Y., USA). Descriptive analysis was performed using simple frequencies and percentage. Data was presented as count and percentage.

Results

The total sample size of 500 CBCT images were evaluated in which 285 were male and 215 were female patients. Of the 500 CBCTs evaluated, 431 (21.6%) third molars were impacted, 794 (39.7%) erupted and 775 (38.8%) third molars were missing (Table 1).

	Maxilla		Total n (%)	Mandible		Total n (%) 254
	Right n (%)	Left n (%)		Right n(%)	Left n (%)	
Vertical	70 (77.8)	73 (83.9)	143 (80.8)	27 (21.8)	30 (23)	57 (22.4)
Mesioangular	10 (11.2)	7 (8.05)	17 (9.6)	71 (57.3)	70 (53.9)	141 (55.5)
Horizontal	1 (1)	1 (1.15)	2 (1.13)	20 (16.1)	30 (23)	50 (19.7)
Distoangular	7 (7.8)	3 (3.45)	10 (5.7)	4 (3.2)	0 (0)	4 (1.6)
Others	2 (2.2)	3 (3.45)	5 (2.8)	2 (1.6)	0 (0)	2 (0.8)

Table 3. Showing Mandibular third molar Level (Position) of eruption according to Pell and Gregory's system.

Level	Maxilla		Total n (%)	Mandible		Total n (%)
	Right n (%)	Left n (%)		Right n (%)	Left n (%)	
Position A	3 (3.3)	3 (3.45)	6 (3.4)	58 (46.8)	60 (46.1)	118 (46.5)
Position B	8 (8.9)	12 (13.8)	20 (11.3)	27 (21.8)	33 (25.4)	60 (23.6)
Position C	79 (87.8)	72 (82.8)	151 (85.3)	39 (31.5)	37 (28.5)	76 (29.9)

Table 1. Showing Eruption Status of Maxillary and Mandibular Third molars in numbers and Percentage.

In this study incidence of mandibular third molar impaction is 58.9% and no significant difference between right and left side with right side being 20.4% and left side 21.4%. Whereas 41.07% of maxillary third molars noticed impacted with no significant difference between right and left side, (right 14.8% and left 14.3%). The most common angulation of impaction in the mandible was mesioangular position (55.5%) followed by vertical impaction (22.4%) and the most common angulation of impaction in the maxilla was the vertical (80.8%), followed by mesioangular impaction (9.60%). Horizontal position being 2 (1.1%) in maxilla and 50 (19.7%) in mandible with distoangular 10 (5.7%) in maxilla and 4 (1.6%) in mandible, while others being 5 (2.8%) in maxilla and 2 (0.79%) in mandible (Table 2).

The level of eruption of mandibular third molar was found to be 118 (46.5%) at position A, 60 (23.6%) at position B and 76(29.9%) at position C. Association of mandibular third molars with inferior alveolar nerve was found in 29.5% of teeth. The level of eruption of maxillary third molars found to be 6(3.4%) teeth with position A, 20(11.3%) teeth were in position B followed by 151(85.3%) teeth in position C (Table 3).

Status of third molars	Frequency	Percentage
Erupted	794	39.7
Impacted	431	21.6
Missing	775	38.8

Table 2. Showing Angulation of maxillary and mandibular teeth according to Winter's classification system with total number and percentage.

During assessment of Ramus relation according to Pell and Gregory classification we found class 1 with 218 (85.83%) where in the right mandible 111 and left mandible 107 followed by class 2 at 22 (8.66%) in which right mandible 10 with left mandible 12, and class 3 at 14 (5.51%) in right mandible 3 and left mandible 11(Table 4).

Type	Right mandible	Left mandible	Total n (%)
Class 1	111 (89.5)	107 (82.3)	218 (85.8)
Class 2	10 (8)	12 (9.2)	22 (8.7)
Class 3	3 (2.4)	11 (8.5)	14 (5.5)

Table 4. Showing the total number and percentage according to Ramus relation (Pell and Gregory) of mandibular third molar.

Whereas 75 (29.53%) of the mandibular third molars found to be associated with inferior alveolar canal in which left mandible to be higher than right mandible, 42 and 33 third molar teeth respectively.

Discussion

The study documented the status of third molar among Al Ahsa population of Saudi Arabia using 3D CBCT images. Evaluating incidence, position, and depth of impacted teeth in a population enable us to compare the pattern of impacted teeth in other geographical regions and population of the world. Specifically, in Saudi Arabia ITM has been studied extensively. In the present study ITM characterized by a prevalence of 21.6%. The other studies conducted gave a wide range of 15.9% to 77.1% prevalence rate in different regions of Saudi Arabia [19,20,22–26]. More specifically to Al-Hasa region, Al-Rumail et. al. reported a prevalence rate of 27.1% of ITM's with the mandibular third molar being the most common [27]. The present study of ITM found a prevalence rate of 21.6% with a predilection for impactions in the mandible as compared to the maxilla, the highest being the mandibular left side. Our results are comparable to those reported by Al-Rumial et. al [27].As the pattern of impaction angulation, the study shows that most common type of impaction in the mandible is mesioangular followed by vertical, horizontal, distoangular and least being other types. Hassan [2], Alfadil et al [19] and Idris et al [2,19,28] reported similar findings studying different populations in Saudi Arabia. Additionally, vertical impactions were commonly seen in the maxilla which is consistent with other studies in the Saudi Arabia [2,19,28].

Utilizing Pell &Gregory's classification, most of the third molars were noticed in position A, followed by position C and position B. The level of impaction most seen in mandibular third molar was position A and this was in concurrence with Al-Dajani et al [25], Zaman et al [18] and Braimah et al [29]. However, Alfadil et al reported position C as the most common in mandible [19]. As for the maxillary third molar impactions, position C was the most common level of impaction similar to Alfadil et al [19]. Conversely, Al-Dajani et al established that position A is the most common of level of eruption for maxillary impactions [25]. While Hassan found position B as the commonly seen in both arches [2]. When examining the horizontal relation of impacted mandibular third molars with the ramus class I relationship was the most common. Our findings agree with Alfadil et al [19] and Braimah et al [29]. On the contrary, El-Khateeb et al found the majority to have a class II relationship to the ramus[30].

To avoid complications associated with ITM and associated surgical procedures, presurgical investigations are essential. Panoramic radiographs are usually utilized to evaluate the actual angulation, position, and orientation of the tooth[31]. Seven diagnostic criteria are used to diagnose the relationship of ITM's to the inferior alveolar nerve canal, these criteria are darkening of roots, deflection of roots, narrowing of roots, bifid root apex, diversion of the canal, narrowing of canal, and interruption in the white line of the canal. The presence of any of these signs may indicate the increased risk of nerve damage during surgical removal of ITM. Being a 2-dimensional image, panoramic radiographs may cause overlapping of crucial structures and obscure the important information vital to risk assessment. Many studies have concluded the advantageous nature of the 3-dimensional CBCT over a 2-dimensional image of the OPG[32,33]. Nirmalendu Saha et. Al concluded that OPG's are a poor predictor of ITM involvement with the mandibular canal[32]. However, with the advent of technology the use of Orthopantomography (OPG) images might be inadequate, therefore CBCT images are useful to evaluate the ITM and its association with inferior alveolar nerve [34]. Shujaat et al found that usually the inferior alveolar canal located in the lingual plate and inferior to ITM[35]. In the current study, 29.53 % of mandibular third molar found to be associated with inferior alveolar nerve. Results are more accurate as this study designed to assess the criteria with CBCT. Hence critical and accurate analysis of the pattern and status of impaction along with assessment of nerve involvement is of utmost importance in management of a case of impacted third molar as there is no universal consensus.

Conclusions

Our CBCT study reveals the third molars status among a section of Al-Hasa population, eastern province, Saudi Arabia. Impaction was found in 21.6% of the study population in which the incidence of mandibular third molar impaction was higher than the third molar impaction in maxilla. The most common angulation was the mesioangular in the mandible, and vertical in the maxilla. The proportion of impacted mandibular third molars associated with IAN was 29.5% of

the total sample size. Prior to surgery, these variables should be accurately assessed to gauge the overall surgical risk and potential harm to the IAN. When treating a third molar impaction instance, it is crucial to critically analyze the pattern of the impaction. Results are more precise because this study was made to use CBCT to evaluate the criterion. This study may aid clinicians in understanding similarities and differences in impaction patterns to perform meticulous surgical procedures. There is still a huge opportunity to conduct standardized global multicentric studies with uniform guidelines and a larger number of subjects.

Evaluating the incidence, depth, position, and association with inferior alveolar nerve of impacted teeth in a subregional population allows us to compare impacted tooth patterns in other areas.

Ethical Approval

Ethical approval obtained from the Research Ethics Committee, King Faisal University (KFU-ETHICS37).

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Declaration of Interest

The authors report no conflict of interest.

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