AL-AZHAR
Assiut Dental Journal

The Official Publication of The Faculty of Dental Medicine, Al-Azhar Assiut University, Egypt

AADJ, Vol. 5, No. 1, April (2022) — PP. 69:76
ISSN 2682-2822

Radiographic Correlation In Bilateral Impacted Lower Third Molars: A Retrospective CBCT Based Study

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Codex : 08/2022/04

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KEYWORDS

CBCT, impacted lower third molars, DICOM files, crown caries, inferior alveolar canal

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ABSTRACT

Aim: This study aimed to assess the CBCT based radiographic correlation in bilateral impacted lower third molars so that, if correlated, data available for one side can aid in surgical planning for the other side or justifies the need for additional imaging. **Subjects & methods:** DICOM files of 50 cases with bilateral impacted third molar were retrieved and both sides were compared according to four parameters. **Results:** Results revealed statistically significant positive correlation between right and left sides regarding impaction angulation, number of roots, and crown caries. Weak correlation was found regarding inferior alveolar canal approximation. **Conclusion:** Multicentric larger sample size study with detailed investigations is recommended.

INTRODUCTION

Third molar or wisdom teeth impaction is probably an old problem that started as early as history of mankind and continue to modern dentistry [1, 2]. The term impacted tooth defines a tooth's failure to erupt within the expected amount of time into the dental arch unless intervened with treatment [3].

Although complications may occur only occasionally, it may affect the patient quality of life so that preoperative thorough assessment is of great importance [4]. Treatment planning depends not only on the clinical assessment but also on the proper radiographic evaluation before any surgical intervention [5]. Two dimensional radiography offers low dose imaging but it is not reliable in determining the relationship between the impacted third molar and the inferior alveolar canal in advance[2] which is important to avoid nerve injury and related complications[6]. CBCT offers a solution in that cases if used as indicated [1]. The problem with CBCT is the higher exposure dose which makes routine use of it considered unjustified beside that the cost and availability drive clinicians in some socioeconomic area to search for alternatives [7].

The aim of this study was to test the correlation in radiographic findings of bilateral impacted lower third molar so that if correlated, clinicians can benefit from assessment done on one side CBCT data record if available without need for additional 3D imaging or it justifies the need for additional imaging.

METHODOLOGY

This study was done on archived data of 50 cases. All images were acquired with Planmeca® system (Promax 3D Classic, Helsinki, Finland) with operating parameters: 90 kV, 6 mA, and a voxel size of 0.2 mm.

The retrieved data were matching the following inclusion criteria:

- Bilateral impacted lower third molar
- Lower second molar is present
- No associated periapical or pericoronal lesions

Planmeca Romexis® 5.3 software was used. For preliminary evaluation, 3D volume rendering was set at X-ray shaded style with modified transparency level to 10 then each side was segmented from the other side by the simple clean rendering tool. After application of this protocol, impaction position and number of roots were easily preliminary detected (Figure 1). Verification was done by slices of implant module where axial slice was adjusted to be at the level of alveolar bone crest of lower arch and a panoramic curve was drawn to reconstruct a panorama like view. The panoramic curve thickness was set to be 25 mm. Multiple cross-sectional slices were adjusted on the reformatted panorama so that each impaction site was completely covered where at least the first and last slices were located beyond the impacted tooth and two slices coincide with the most mesial and distal part of the impaction. The slicing protocol was as following:

- 7 Slices in the row
- From one to three rows
- 0.5 mm slice thickness
- Slice buccolingual width of 35 mm
- Interslice distance of 2 mm

Each case was evaluated according to four different simple parameters:

- Impaction position: Mesioangular – Distoangular - Horizontal – Vertical – Other positions (Table 1).
- Relation to inferior alveolar canal: Critical – Noncritical (Table 1).
- Number of roots: One or Fused – Two – Three – More than three.
- Crown caries: Yes – No.

Table (1) *Definition for terminologies used in the four parameters*

Mesioangular	Long axis inclined in mesial direction to second molar
Distoangular	Long axis inclined in distal direction to second molar
Horizontal	Long axis perpendicular to second molar
Vertical	Long axis parallel to second molar
Other positions	Not in the other four categories
Critical relation to IAC*	Canal located less than 1.5 mm from third molar

**Inferior alveolar canal*

Teeth were examined from cross sectional cuts, full thickness reformatted panorama, axial cut navigation, 1 mm panorama like slice navigation to assess the four parameters and data were recorded for comparison (Figure 1).

The protocol was proposed by two oral and maxillofacial radiology specialists and was taught to three with other specialty (two oral and maxillofacial surgeon and one orthodontist). The five observers examined the cases and inter-observer agreement was calculated.

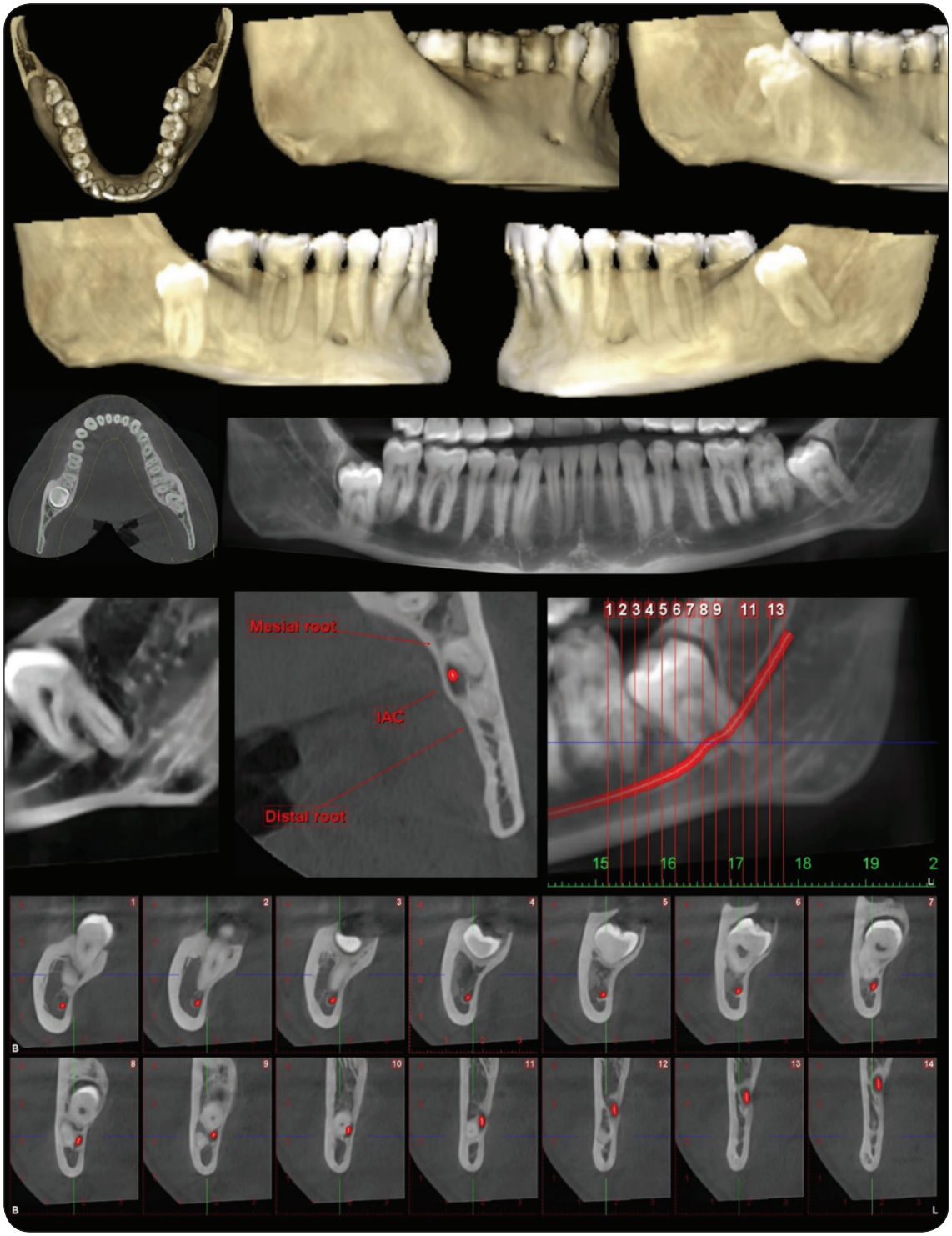

Fig. (1) CBCT representing a case for bilateral impaction. Note: The superimposition of both third molars on volume rendering with increased transparency and how this superimposition was eliminated after segmenting the other side. Also, The clear appearance of root number in sliced panorama like view.

Data were collected and presented as frequency, percentage, and correlation ratio (R). Also, data were explored for normality by checking the data distribution using Shapiro-Wilk tests.

Inter-observer reliability (agreement) was measured using Cronbach's alpha reliability coefficient. Cronbach's alpha reliability coefficient normally ranges between 0 and 1. The closer Cronbach's alpha coefficient is to 1.0, the higher the reliability.

For non-parametric data, Pearson correlation coefficient was used to evaluate the correlation between right and left side regarding the different variables. The significance level was set at $P \leq 0.01$. According to Dancey and Reidy's categorization of correlation (8) , the strength of correlation and a value of correlation coefficient is interpreted as follows: (a) Perfect: 1, (b) Very strong: 0.99 to 0.70, (c) Strong: 0.40 to 0.69, (d) Moderate: 0.30 to 0.39, (e) Weak: 0.20 to 0.29, and (f) No relationship: 0.01 to 0.19. Statistical analysis was performed with IBM SPSS Statistics Version 22 for Windows.

RESULTS

Results of Shapiro-Wilk tests showed that data was non-parametric, so Pearson correlation coefficient was used to evaluate the correlation between right and left side. Exploring the gender distribution among patients revealed that female constituted 60% while male constituted 40%. Regarding inter-observer agreement, there was very good inter-observer agreement regarding all measurements observed.

Percentage of impaction angulation, relation to inferior alveolar canal, number of roots, and crown caries are shown in (Figure 2).

Pearson correlation coefficient test revealed statistically significant positive correlation between right and left sides regarding impaction angulation, number of roots, and crown caries as shown in (Table 3).

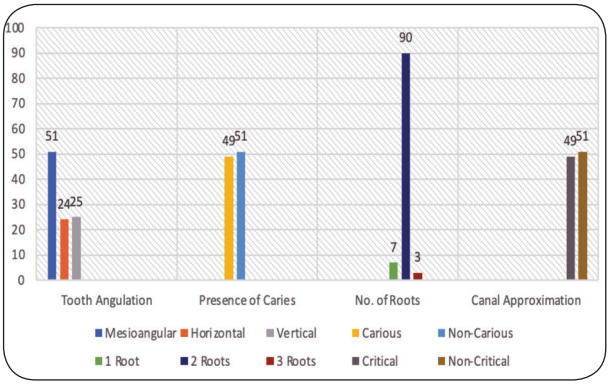

Fig. (2) Percentage of impaction angulation, crown caries, number of roots, and relation to inferior alveolar canal.

Table (3) *Pearson correlation coefficient test for correlation between right and left sides.*

	Spearman's ratio	Sig. (2-tailed)
Position R - Position	0.538	0.000*
Caries R - Caries L	0.806	0.000*
Root No. R – Root No. L	0.391	0.005*
Nerve approximation R-Nerve approximation L	0.206	0152

***. Correlation is significant at the 0.01 level (2-tailed).*

DISCUSSION

Lower third molar associated dental complaint is a common old problem so that surgical teeth removal may be considered a common surgical intervention in dentistry [1]. Although the surgical procedure is associated with little or no risk in the majority of cases, multiple cases are in need for careful radiographic analysis to avoid complications[9,10]. CBCT as an imaging modality offers high-quality three-dimensional data, that why it can be used for evaluation of impacted third molar treatment planning and patient education [11]. This was the imaging modality of choice for this research.

Despite of 2D imaging related limitations, it is the most used radiographic techniques before extraction and some related radiographic signs may predict increased surgical risk of the case which justifies going for 3D evaluation [12-14]. Nevertheless, 3D imaging modality should not be used routinely for every case.

Preoperative CBCT based planning may change the operative decision or the protocol of surgery in many cases but the routine use of CBCT in evaluation of third molars is not justified [15]. If the patient was previously imaged by CBCT with a limited field of view focusing only on the side of previous time chief complaint or imaged for dental implant or for any other reason in one side then afterward he or she has a problem with the other side, can the surgeon get benefit from imaging of other side to avoid another CBCT imaging for the new proposed side? Or it justifies the need for additional imaging. This was the research question motivating for this research. If this is applicable, the routinely used 2D imaging as intraoral radiography or panoramic imaging may be enough for their benefits regarding effect on patient's and societal costs [16].

Because the radiograph should provide data about the tooth and related anatomical structures, the most important parameters for impacted lower third molars are position of tooth, tooth status, number of roots, and relation to inferior alveolar canal [16]. The four parameters were used in this study. No detailed analysis was done as there is no need for that unless primary correlation is found.

Choosing the minimal safety distance required to say that the relation with inferior alveolar canal is not surgically critical was not easy because of the surprisingly few studies quantifying and relating distance with risk of canal damage and related neurologic manifestations [17]. Studies are not only few but also variable. Jhamb et al. [18] correlate nerve paresthesia only for cases with direct contact (0 distance) from canal that shows cortical break while Sammartino et al. [19] recommending a minimal safety distance of 1.5 mm during surgery for implants to avoid indirect multifactorial effects which may also have a role in surgical extraction. These factors include the effect of inflammatory processes beside the extended effect of physical trauma [19, 20]. A 1.5 mm distance was chosen for this study for considering patient safety and the effect of damage on quality of life.

Correlation test revealed statistically significant positive correlation between right and left sides regarding impaction angulation, number of roots, and crown caries. This correlation was strong regarding impaction angulation, very strong regarding crown caries, and moderate regarding number of roots. For number of roots, the correlation was expected as the majority of lower third molars are with two roots but being in moderate level was the unexpected result. This can be explained by that in multiple cases with one or three roots there is no correlation between both sides which affects the overall statistical analysis.

The highest correlation was related to caries in crown of impacted tooth that was very strong. Finding significant bilateral correlation of caries occurrence is not new. For example, the study of Wyne et al [21] found that the highest correlation of caries incidence was in mandibular molars. The high percentage of caries found in this study may be justified by that patient is usually seeking dental intervention when feeling pain, and deep caries is one of the common causes of pain. Another important question is that if caries can be detected clinically why it is included in this radiographic study. Extent of hidden caries and amount of coronal destruction can be detected radiographically, and this may affect the surgical maneuver.

On the other side there is weak regarding relation with inferior alveolar canal. Unfortunately, this is the most important factor as its damaging directly affects patient's quality of life due to numbness and altered sensations in related areas. CBCT should be used according to indications because of the added

valuable information that is not clear by other methodologies. It is worthy to say that damaging to inferior alveolar canal may be dependent to large extent on case severity, surgical protocol, and surgeon skills but the use of CBCT has its rule on improving the level of treatment planning over the years seeking a more favorable patient centered outcome [22,23].

A high female dominance was found in this study while the most common pattern was the mesioangular impaction, findings that are in match with other studies[24,25]. The higher female prevalence can be clarified by the earlier than male growth stop so that no more space for the eruption of third molar[26]. However, other studies reported that there is no sexual predilection in wisdom tooth impaction [27] or even male domination [28], this may be due to the different geographic area, diet, physique and genetic factors [29].

One of the limitations of this study was the lack of studying age prevalence, this is because the found retrospective data show no age of the patients. The female to male prevalence was done based on patient name and fortunately no uncertain names were found.

Another limitation was the number of included cases which may be few for this kind of study, this can be explained by that only cases with suspected critical relation to vital anatomic structures are sent for 3D CBCT imaging. Also, finding data for cases with present bilateral lower impacted third molars that are included in field of view was not an easy task. The geographic location and associated socioeconomic level may be another reason. This also explains the high percentage of teeth in critical relation to inferior alveolar canal found in this study as this is the main indication for CBCT imaging according to guidelines [30]. If the primary 2D imaging shows no radiographic signs of critical relationship to inferior alveolar canal, the patient is usually not sent for further 3D radiographic assessment [31].

In conclusion, although this study found strong correlation between right and left side impacted third molars, it found weak correlation concerning relation to inferior alveolar canal which is the most important factor. A multicentric larger sample size is recommended with deep detailed investigations for both correlated and non-correlated factors.

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AADJ, Vol. 5, No. 1, April (2022) — PP. 76

ترابط معلومات صورة الأشعة ما بين ضروس العقل السفلية المطمورة: دراسة مرجعية مبنية على الأشعة المقطعية مخروطية الشعاع

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الملخص :

الهدف: تهدف هذه الدراسة الى تقييم اذا ما كان هناك ترابط للمعلومات المستخرجة من الأشعة ثلاثية الأبعاد ما بين ضروس العقل المطمورة على جانبي الفك الواحد وتأثير هذه العلاقة ان وجدت على خطة العلاج الجراحية أو تبرير الاحتياج لفحص إضافى بالأشعة ثلاثية الأبعاد.

المواد والأساليب : وهذه الدراسة اعتمدت على استدعاء ملفات أشعة ثلاثية الأبعاد لعدد خمسين حالة وجد فيها ضروس عقل مطمورة على جانبي الفك السفلي وتم مقارنتهم معا طبقا لأربعة معايير

النتائج: وجدت الدراسة علاقة قوية مثبتة احصائيا في ما يتعلق بوضع الضرس وعدد الجذور ونخر الأسنان بينما كانت العلاقة ضعيفة في ما يخص اقتراب الجذور من القناة السنخية السفلية.

الخلاصة: يوصى بعمل دراسة مفصلة متعددة المراكز على عينة أكبر.

الكلمات المفتاحية: اشعه مقطعيه مخروطيه، ضرس الثالث السفلى المدفون ,افلام ديكوم ، تسوس تاج السن، قناه العصب السنى السفلى.