Pattern of mandibular third molar impaction: a cross-sectional CBCT study

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ABSTRACT

Objective: This study aimed to describe the mandibular third molar’s impaction classifications in three dimensions by using cone beam computed tomography (CBCT). These classifications might help oral and maxillofacial surgeons in making a clinical choice about when to extract a tooth or prepare another treatment strategy.

Methods: A total of 259 CBCT scans were found eligible for inclusion in the study. Impacted mandibular third molars were radiographically assessed for Pell and Gregory’s classification (impaction), Winter’s classification (angulation of the impaction), and the relation of the impacted mandibular molar to the buccal and lingual bone (horizontal relation).

Results: Mesioangular angulation constituted 55.6% of all angulations, with horizontal angulation constituting 21.62% and vertical angulation 16.22%. The most frequent horizontal relation was lingual impaction. The most prevalent level of impaction was level A, and the most prevalent ramus relationships were class II at 52.51%. Both men and women were classified similarly, and there was no discernible difference between the right and left sides of the mouth ($p > 0.05$).

Conclusion: Additional research with a bigger sample size is required to assess the Saudi Arabian third mandibular molar impaction pattern.

Keywords: Impacted mandibular third molar, CBCT, classification, pattern, Saudi Arabia.

Introduction

The term “impacted tooth” is one of the most prevalent dental anomalies in humans. It generally refers to a tooth that has difficulty emerging due to physical obstructions in its eruption path or an irregular inclination of its axis. The third molars are the teeth in the human dentition that are most likely to become impacted, particularly the mandibular third molars, which are more likely to become impacted than maxillary third molars because the mandible is smaller and restricted by the ascending ramus and have fewer space for the lower third molars to erupt [1]. Although impacted third molars might be present for years without showing any untoward effects, they might also be associated with a number of signs and conditions, including pericoronitis, discomfit, swelling, distal caries, bone loss, root resorption of neighboring teeth, odontogenic cysts, and tumors.

Undoubtedly, one of the most common treatment decisions in the dentistry profession is whether or not to extract a mandibular third molar [2]. Following the removal of the impacted tooth, a few side effects might occur, including postoperative discomfort, edema, trismus, and paresthesia.

The types of flaps needed for surgical extraction and the difficulty of extraction, along with the frequency of postoperative problems, are both strongly influenced by the locations of the mandibular third molar teeth [3]. To obtain adequate informed consent for the intervention and to optimize the daily routine for both operators and patients, it is important to offer the patient an accurate and reliable prediction regarding the surgical complexity and risks of complications [4].

In a systematic review, Akadiri and Obiechina [5] found that in terms of the risks of impacted mandibular molar extraction, all of the included studies had examined...
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radiographic parameters such as the depth of impaction, angulation, and root/tooth. Some studies have also analyzed the morphological characteristics of the mandibular third molar root [6,7], whereas others have examined the relation of the root to the inferior alveolar canal [8,9], or its position and classifications [3,10].

Many researchers have also categorized the locations of the third molars on the mandible. The Winter (1926) and Pell and Gregory (1933) classifications are among them and are the most often used classification techniques [3]. According to the Winter’s classification, there are four main categories based on the angle between the second molar’s long axis and the third molar’s long axis (vertical, mesioangular, distoangular, horizontal, and other). Third-molar impaction types are divided into class A, class B, and class C according to Pell and Gregory’s vertical classification [11].

Improved interdisciplinary communication and treatment planning might result from the use of a classification system for impacted third molars in terms of their position and degree of angulation. In clinical practice, Pell and Gregory’s classification is frequently used to categorize the position of the third molar based on its spatial interactions with the ascending ramus of the mandible and the occlusal plane [12,13].

Oral and maxillofacial surgeons should examine third molars on the mandible radiographically to learn more about their anatomical linkages and spatial relationships [14]. The standard examination for the preoperative evaluation of the lower third molars is panoramic radiography. It might be safer to choose a test that shows the structures in three dimensions (3-D), such as cone beam computed tomography (CBCT), especially in cases where the roots of the molar are in close contact with the mandibular canal because panoramic radiography can reveal the object of study in only two dimensions.

As a backup, 3-D imaging could be helpful because it can reveal more details about the connection between the inferior alveolar canal and the lower third molar [15]. Gregory’s classification has been used in clinical practice to measure third molar impaction with panoramic radiographs. However, it has been reported to be prone to interpretation error, have insufficient levels of reliability, and have low predictive values in relation to extraction difficulty [16].

Among the limitations of panoramic radiography, its inherent flaws of picture overlapping and lack of 3-D spatial information seriously impair its accuracy and make treatment planning and risk assessment more difficult. In contrast, the low radiation doses and nonoverlapping between various anatomical structures provided by CBCT’s many planes allow for accurate identification of dental structures and their position [14,17]. An accurate grasp of anatomical links might help patients avoid injuries and protect their second mandibular molars [18].

Several panoramic radiograph studies in the literature have described patterns of Pell and Gregory’s and Winter’s classifications of impacted mandibular third molars in the Saudi population [19,20]. However, this study aimed to describe these classifications by using CBCT and to contrast their frequencies to those reported in comparable studies. Such a study might assist oral and maxillofacial surgeons in arriving at a clinical decision regarding the time frame of an extraction or a different treatment plan based on the condition of impaction.

Subjects and Methods

An initial 561 CBCT scans of patients were gathered from various departments, including oral surgery, prosthetics, and orthodontics. The patients who had been referred for dental treatment between April 2019 and 2021 and had undergone CBCT scans with fields of vision ranging from medium to large were included in the study. This study used only those CBCT images that included the complete mandibular dentition or more.

CBCT images that were excluded from this study included patients under the age of 21 years with impacted mandibular third molars that were expected to erupt with less than two-thirds of the roots, and patients whose radiographs contained artifacts caused by high-density materials or other factors that obscured the areas of interest. Thus, only 259 CBCT scans of the initial 561 qualified for inclusion in the study.

A CS 9300 PREMIUM 3-D CBCT device (CareStream, Rochester, NY) was used to acquire CBCT scans that were recovered from the database of Carestream R4 Clinical and Practice Management Software (CareStream Health, Rochester, NY).

The impacted lower molar characteristics were measured, assessed, and gathered by one observer with >7 years of experience. Intraobserver and interobserver relationships were examined with a calibrated colleague, using a smaller sample of the data. InVivoDental software, version 6.0.1, from Anatomage, Inc., was used to manipulate the CBCT volumes.

An impacted third molar does not have a functional occlusion while root formation is ongoing [21]. According to Pell and Gregory’s classification, class A denotes that the impacted tooth’s occlusal plane is roughly at the same level as the second molar’s occlusal plane, or “higher if angulated.” Class B denotes the occlusal plane of the impacted tooth is between the occlusal plane and the cervical line of the second molar. Class C denotes to the impacted tooth is located below the second molar’s cervical line [21]. Furthermore, class I refers to the ramus and the distal portion of the second molar are separated by enough space to accommodate the mesiodistal diameter of the third molar. Class II refers to the ramus of the mandible covering half of the tooth’s crown radiographically because there is less space between the second molar and the ramus than the third molar’s mesiodistal diameter. Class III refers to the third molar is entirely or mostly located in the ramus of the jaw.
According to Winter’s categorization, the angle between the second and third molars’ longitudinal axis is divided into the following categories, including vertical impaction ranges from 10 to -10; mesioangular impaction ranges from 11 to 79; horizontal impaction ranges from 80 to 100, distoangular impaction: -11 to -79; and other impaction ranges from 111 to -80 and buccolingual impaction [22].

Axial slices were used to view the buccolingual position of the mandibular third molar in the alveolar crest and to pinpoint the location of the impacted third molar. Depending on how close the tooth is to the buccal or lingual bone, it is identified as being in the buccal, middle, or lingual portion [23]. The mandibular third molar is located in the middle of the alveolar bone if the distances to both of its sides (buccal and lingual) are identical.

Frequencies and chi-square tests were performed with Stata software (IC 13.1, Release 16, StataCorp LP). Cohen’s test was used to examine intraobserver and interobserver agreement in grading the radiographic findings (poor agreement: less than 0.40; intermediate agreement: 0.40 to 0.59; good agreement: 0.60 to 0.74; excellent agreement: 0.75 to 1.00).

Results

A total of 259 impacted lower third molars from 160 patients met the inclusion criteria. Among the patients, 98 (61.25%) were men and 62 (38.75%) were women, their age varying from 21 to 70 years, with a mean of 32.98 years. A t-test with a p-value of 0.0002 showed that the mean age of men was considerably greater than that of women at 35.05 years [95% confidence interval (CI): 33.09-37.01 years] versus 29.70 years (95% CI: 28.12-31.29 years), respectively. Sixty-one patients (41 men and 20 women) had unilaterally impacted third molars (38.12%), whereas 99 patients (57 men and 42 women) had bilaterally impacted third molars (61.88%). The number of bilaterally impacted mandibular molars did not differ significantly between men and women (p = 0.224).

In this study, the prevalence of mesioangular angulation (55.60%) was higher than other angulations (Table 1, Figure 1).

Among the three impaction levels, level A (49.80%) was more prevalent than other levels (Figure 2).

The relation of the mandibular third molar to the ramus showed that class II was the most common relation (52.51%) (Figure 3).

In addition, the horizontal position of the mandibular third molar was more often toward the lingual cortical bone of the mandible (59.08%), followed by the median between the cortical bone of the mandible (Figure 4).

Discussion

Of the 160 impacted third molars, 99 (61.88%) were bilateral, and 61 (38.12%) were unilateral. This finding

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**Table 1. The distribution of impacted mandibular third molars according to study variables.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency of impacted tooth, male (%)</th>
<th>Frequency of impacted tooth, female (%)</th>
<th>Frequency of impacted tooth, total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 155</td>
<td>N = 104</td>
<td>N = 259</td>
</tr>
<tr>
<td>Angulation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mesioangular</td>
<td>85 (54.84)</td>
<td>59 (56.73)</td>
<td>144 (55.60)</td>
</tr>
<tr>
<td>Vertical</td>
<td>21 (13.55)</td>
<td>21 (20.19)</td>
<td>42 (16.22)</td>
</tr>
<tr>
<td>Horizontal</td>
<td>41 (26.45)</td>
<td>15 (14.42)</td>
<td>56 (21.62)</td>
</tr>
<tr>
<td>Distoangular</td>
<td>5 (3.22)</td>
<td>9 (8.66)</td>
<td>14 (5.41)</td>
</tr>
<tr>
<td>Other</td>
<td>3 (1.94)</td>
<td>0 (0)</td>
<td>3 (1.15)</td>
</tr>
<tr>
<td>Impaction depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level A not buried</td>
<td>82 (52.90)</td>
<td>47 (45.19)</td>
<td>129 (49.80)</td>
</tr>
<tr>
<td>Level B under the CEJ*</td>
<td>59 (38.07)</td>
<td>37 (35.58)</td>
<td>96 (37.07)</td>
</tr>
<tr>
<td>Level C completely buried</td>
<td>14 (9.03)</td>
<td>20 (19.23)</td>
<td>34 (13.13)</td>
</tr>
<tr>
<td>Relation to the ramus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I: anterior to ramus</td>
<td>49 (31.61)</td>
<td>42 (40.38)</td>
<td>91 (35.13)</td>
</tr>
<tr>
<td>Class II: half of the crown covered</td>
<td>87 (56.13)</td>
<td>49 (47.12)</td>
<td>136 (52.51)</td>
</tr>
<tr>
<td>Class III: the crown covered by the ramus</td>
<td>19 (12.26)</td>
<td>13 (12.5)</td>
<td>32 (12.36)</td>
</tr>
<tr>
<td>Horizontal location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buccal</td>
<td>2 (1.29)</td>
<td>0 (0)</td>
<td>2 (0.77)</td>
</tr>
<tr>
<td>Median</td>
<td>71 (45.81)</td>
<td>33 (31.73)</td>
<td>104 (40.15)</td>
</tr>
<tr>
<td>Lingual</td>
<td>82 (52.90)</td>
<td>71 (68.27)</td>
<td>153 (59.08)</td>
</tr>
</tbody>
</table>

*CEJ: cement-enamel junction.
was in agreement with the results of other studies. Quek et al. [21] found that bilateral cases were more common than unilateral. Dachi and Howell [24], however, concluded that both bilateral and unilateral cases occur with equal frequency.

In the present study, the most common angulation type of impacted mandibular third molar was mesioangular (55.60%), followed by horizontal (21.62%) and vertical angulations (16.22%). In agreement with these findings, other studies found that mesioangular impaction was the most prevalent type of impaction in the mandibular third molars of Iranian, Singaporean, and Arabian populations, respectively [21,22,25,26].

The current study sample showed that the most frequent impaction was class A, accounting for 90 cases (34.75%). This finding contradicts the results of

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Figure 1. CBCT slice from reformatted panorama showing third mandibular molar impaction angulations (Winter’s classification).

Figure 2. CBCT reformatted panorama X-ray view showing third mandibular molar impaction depth (Pell and Gregory classification).

Figure 3. CBCT volume rendering showing ramus relation to impacted third mandibular molar. Notice that the class I molar has enough space; in class II, half of the crown is covered by the ramus; and in class III, the third molar is completely covered by the ramus.
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previous studies, which identified class B as the most common impaction level [21,22,26–28]. However, it was consistent with the findings of other studies, which reported that class A (not buried) was the predominant impaction level. The disparity in results among various studies can be attributed to differences in the methods of classification [25,29,30]. In the current study, the impaction level was assessed on the basis of the relationship between the occlusal surfaces of the third molar and the adjacent second molar. Conversely, in other studies, the impaction level was determined by the position of the cement-enamel junction relative to the alveolar bone level. In the studies in which class A was reported as the most prevalent type, the same classification method was used [22].

Class II was the most frequently observed type in the majority of impacted mandibular third molars examined in the present study, where the anterior border of the mandibular ramus covered half of the crown, resulting in its classification. This finding was consistent with the results of other studies [25,27–30]. The majority (59.08%) of impacted third molars in the current study were located on the lingual side of the mouth. This observation was consistent with the findings of other studies, which discovered that mandibular third molars in the lingual position were the most common impaction, followed by central and buccal locations [10,23]. It was concluded that this disparity was caused by the buccal side of the alveolar bone being thicker than the lingual side because of the existence of an external oblique ridge on the buccal plate [10].

In contrast, the results of the study conducted by Dachi and Howell [24] reported increased mesioangular impaction in women. The current study showed no discernible difference between men and women in terms of Winter’s categorization, Pell and Gregory’s classification, or horizontal location.

To ensure that individuals with incomplete root formation of the mandibular third molar were excluded from this study, patients younger than 21 years old were not included in the current study [21]. Because of a higher prevalence of difficulties associated with impacted mandibular third molars in contrast to maxillary wisdom teeth, patients with maxillary third molar teeth were also eliminated from the study. Furthermore, racial differences can affect the maturation and eruption timing, as well as the size of the jaw; this could be explained by the different rates of incidence reported for different countries [21,25,26,28].

This study aimed to identify the representative pattern of mandibular third molar impactions in Saudi Arabia by using CBCT. However, the study was limited to patients referred to Taibah University clinics for CBCT examination, and did not include patients who did not have a 3-D examination. Furthermore, maxillary third molars were not included in the study even though the same classifications can be applied. Despite these limitations, this study describes the 3-D pattern of one of the most difficult impactions and provides valuable information and images for future research.

Conclusion

The most common angulation was mesioangular angulation, followed by horizontal and vertical; in buccolingual impaction, lingual impaction is most common. The most common level of impaction was level A and class II. There was no significant difference in Winter’s classification, impaction depth, or horizontal location between men and women. Further studies with a larger sample size are needed to evaluate the impaction pattern of the third molar in Saudi Arabia.

Acknowledgment

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List of Abbreviations

3-D Three dimensional
CBCT Cone beam computed tomography
Mandibular third molar impaction pattern

Conflict of interest
The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent to participate
Written informed consent was obtained from all the participants.

Ethical approval
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