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# Distribution and Angulation Pattern of Impacted Mandibular Third Molars

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## Abstract

**Objective**: The objective of this study was to determine the distribution of impacted mandibular third molars on digital panoramic radiographs, based on sex of the patient, side, level of impaction, relationship with the mandibular ramus, and angulation pattern of impaction. **Material and Methods**: This study analysed 98 people aged 18 and above with 153 impacted mandibular third molars who were treated at the Department of Oral and Maxillofacial Radiology at Ashur University's College of Dentistry. Patients were categorised by sex, right or left side, depth of impaction, relationship with the mandibular ramus, and angulation patterns. **Results**: The only significant difference found was related to the left side impaction depth with females having more level C impactions than males. **Conclusion**: The distribution of impacted mandibular third molars were mostly mesioangular, followed by horizontal angulation, impaction level C, and class II.

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## Introduction

Dental impaction refers to a tooth that has not fully or partially erupted within the jawbone or under gum tissue. Dental impaction can occur in all teeth, but the most common teeth of impactions are the third molars [1]. The third molar impactions account for 98% of all types of impacted teeth [2]. The impaction rate varies between different geographics from 18.97% to 30.8% within the Gulf region but 68.6% in East Asia [3,4].

Molar impactions have many causes, such as insufficient skeletal growth, mucosal thickness over the growing tooth, macrodontia, lack of space or systemic conditions such as Down's syndrome. There are studies that show variation based on diet as there was differences between the mandibular jaw size between mediaeval to post-mediaeval peoples [5]. This occurred due to biomechanical forces, which stimulated craniofacial growth and development. In addition, there is a variation in eruption and position of the third molar, which can be influenced by ethnicity, masticatory effectiveness, and inherited factors [6].

Impaction complications include crowding, caries, pericoronitis, resorption of adjacent tooth roots, face pain, temporomandibular joint dysfunction, and the most prevalent condition, dentigerous cyst or tumour [7]. Life-threatening is the transformation of the cystic wall into squamous cell carcinoma [1]. The early diagnosis of impacted teeth can avoid future malocclusions and lesions [8]. Identifying and managing these dental anomalies at an early stage can avert complications. Regular dental check-ups, including radiographic evaluations, play a pivotal role in the timely detection and treatment of impacted teeth.

Panoramic radiography classification is an essential component of treatment planning for the operation of removal of the mandibular third molar, which is still a comprehensive clinical and radiographic evaluation. The patient should have a complete case history that includes detailed systemic and local evaluation. Age (increasing difficulty for extraction with age) and sex (incidence of increase of sclerotic bone in males with age/consider the incidence of post-menopausal osteoporosis in females) should also be noted [9]. Panoramic radiograph is based on some sort of classification and in this study we established the classification on Pell, Gregory, and Winter, are crucial for determining third molar position, depth, and bone covering, as well as assessing surgical treatments' challenges [6,10,11].

In this study, we focused only on the lower third mandibular molar and utilized different classification to organize different types of impactions of the molars. These impactions were then compared between different sexes.

## Material and Methods

A cross-sectional observational study was undertaken at Ashur University's Dental

Radiology Clinics - Department of Oral and Maxillofacial Radiology in Baghdad, Iraq. We reviewed all panoramic radiographs at Ashur University's Dental Radiology Clinics from November 2023 to November 2024. A total of 153 impacted mandibular third molars were evaluated in 98 individuals who were 18 years or above. These data were further separated into two groups based on sex.

The examination of the lower third mandibular molar was performed using digital orthopantomography (panoramic radiography). These images were assessed using Pell, Gregory, and Winter for evaluating the depth, relationship to ramus and angulation of the teeth. During the study, all patients were handled by the same operator, and panoramic radiographs were obtained using the same machine. Digital panoramic exposures were achieved using conventional techniques. Two examiners examined all panoramic radiographs and conducted analyses.

*Study design.* In this study we analysed all panoramic radiographs at Ashur University's Dental Radiology Clinics from November 2023 to November 2024 using data collected during a one-year period. Radiographs from normal dental examinations were randomly obtained from the Department of Oral and Maxillofacial Radiology archives. The study excluded patients with incomplete root formation or deformed mandibular third molar roots, as well as those without mandibular second molars. This study only included high-quality radiographs with clear reproduction of teeth and no superimposition (example in Figure 1). Patients were divided into groups based on their sex, right or left side, depth of impaction, relationship with the mandibular ramus, and angulation patterns.

Digital panoramic radiographs were taken using the Myray Hyperion X9 Pro machine at 70 Kvp, 7mA, and 12.7 seconds exposure duration at our Department of Oral and Maxillofacial Radiology. Two examiners viewed radiographs with the iRYS software version 14.0.1. The collected data were analysed using statical SPSS software version 29.0.1.1.

*Study parameters.* The following criteria were assessed in this study (Figures 2 and 3):

1. The angulation of the impacted third molar teeth was categorized using Winter's classification [6,12].
2. The Pell and Gregory classification was used to define the depth of the impacted third molar teeth [11,13].
3. The Pell and Gregory categorization was used to define the relationship between an impacted third molar and ramus [11,13].

Winter's Classification classified third molar impactions as mesioangular, distoangular, horizontal, vertical, buccal, and others [6]. We used another classification for the depth and relation to ramus neck of the jaw. Pell and Gregory's A, B, and C ratings are based on their depth and relation with the mandible's ramus [11]. The following definitions were used in this study for impaction and angulation of impaction. A tooth was termed impacted if its occlusal plane was below that of the adjacent tooth and bone level. A partially or semi-impacted tooth is one that has partially erupted but still in the line of occlusion. To assess the inclination of an impacted mandibular third molar, the angulation between the longer axis and the neighbouring second molar teeth was measured using Winter's classification.

*Impaction:* The third molar must not have a functional occlusion when the root formation is finished to be classified as impacted.

*Depth of impaction:* The Pell and Gregory classification categorizes the cementoenamel junction (CEJ) of the third molar with respect to bone level: Level A - Not buried in bone; Level B - Partially buried in bone if any part of the CEJ was lower than bone level; and level C - Completely buried in.

*Relationship with the mandibular ramus:* The Pell and Gregory classification categorizes the distal surface of the third molar crown in relation to the anterior border of the ascending ramus into the following positions: Class I is anterior to the anterior border, Class II is half of the crown covered by the anterior border, and Class III is the entire crown covered by the anterior border.

*Angulation of impaction:* Winter's classification categorizes the angle between the longitudinal axis of the second and third molars, measured with an orthodontic protractor. Vertical impaction ranges from 10 to -10, whereas mesioangular impaction ranges from 11 to -79, horizontal impaction ranges from 80 to 100, distoangular impaction ranges from -11 to -79, others range from 111 to -80, and buccolingual impaction occurs when the crown and roots are superimposed.

## Results

*Unilateral vs. bilateral*

Table1 presents the distribution of unilateral and bilateral mandibular third molar impactions based on sex. Among the 98 cases, 65 were males and 33 were females. Unilateral and bilateral impactions were more frequent in males than females, but that difference was not statistically significant (p = 0.84).

The depth of impaction was classified using the Pell & Gregory scale. The results in Table 2 indicate that Level C impactions (deepest) were the most common in both sexes with approximately half of the cases. For the left side depth, Level B impactions were most common in males (38.5%), while Level C impactions were predominant in females (60.6%), indicating that females tend to experience deeper impactions compared to males (p=0.048).

The classification of impacted molars based on their relationship with the mandibular ramus was evaluated as seen in Table 3. Most impactions fell under Class II (69.2% in males, 66.7% in females), indicating that the impacted molars were partially covered by the anterior border of the ramus.

Winter's classification was applied to evaluate the angulation of impacted third molars. The most common angulation type observed was mesioangular impaction, occurring in 55.3% of males and 44.7% of females as seen in Table 4. Horizontal impactions were notably more frequent in males (82.1%) compared to females (17.9%), although not statistically significant (p=0.168). When analysing angulation patterns on the left side, mesioangular impactions were again the most frequent (32.3% in males, 39.4% in females). Interestingly, horizontal impactions were more frequent in males (75%) than females (25%), whereas distoangular impactions were only seen in females (9.1%) (p=0.14).

## Discussion

There was no significant difference between males and females when it came to unilateral and bilateral impaction. The results for right sided depth, ramus relationship and angulation classification showed that there was no significant variation between males and females. The left side results were also not significant different when it came to the categorization of ramus and angulation of the third molar, but there was a significant variation when it came to the left sided depth classification. The lack of significance is likely due to small sample size. Other factors that may impact the actual development of teeth in humans include genetic variation, aging, developmental disorders, and dietary factors. It is to be noted that there is a sexual dimorphism in tooth size, which has genetic inheritance, testosterone, and evolutionary selection, and hormonal secretion influences. Growth hormone, testosterone, promotes growth of teeth size whereas estrogen would limit the jaw size growth and teeth size [14-16].

Many genes play a role in crown size [14]. As an example, *FGF10* and *FGF13* were associated to molar size discrepancies [16]. There is a decrease in jaw size with age between 18 and 40 years, which may relate to a decrease in testosterone and the impact of growth hormone, which makes male jaw to be bigger in size comparison to the female jaw size [17]. There is

also the implication of dietary habit in final jaw sizes [18,19].

Lack of differences in the impaction of third molars between males and females agrees with previous data [20,21] . Bilateral impactions are more common than unilateral ones and these differences are independent from sex [22,23].

## Conclusions

Impaction of the mandibular third molars is common among Iraqis. It has been noticed that males had more impacted molars compared to females, but the difference was not significant. The most common pattern for impacted mandibular third molars was mesioangular, followed by horizontal angulation, impaction level C, and class II. Males experienced more unilateral impactions and slightly more bilateral impactions than females. Comparing our data to various populations revealed similarities in some characteristics, such as angulation and connection to ramus, but overall results vary.

This study has been characterized by a high frequency of lower third molar impaction, particularly in males. This high frequency signifies that an increasing number of individuals are retaining the impacted third molars.

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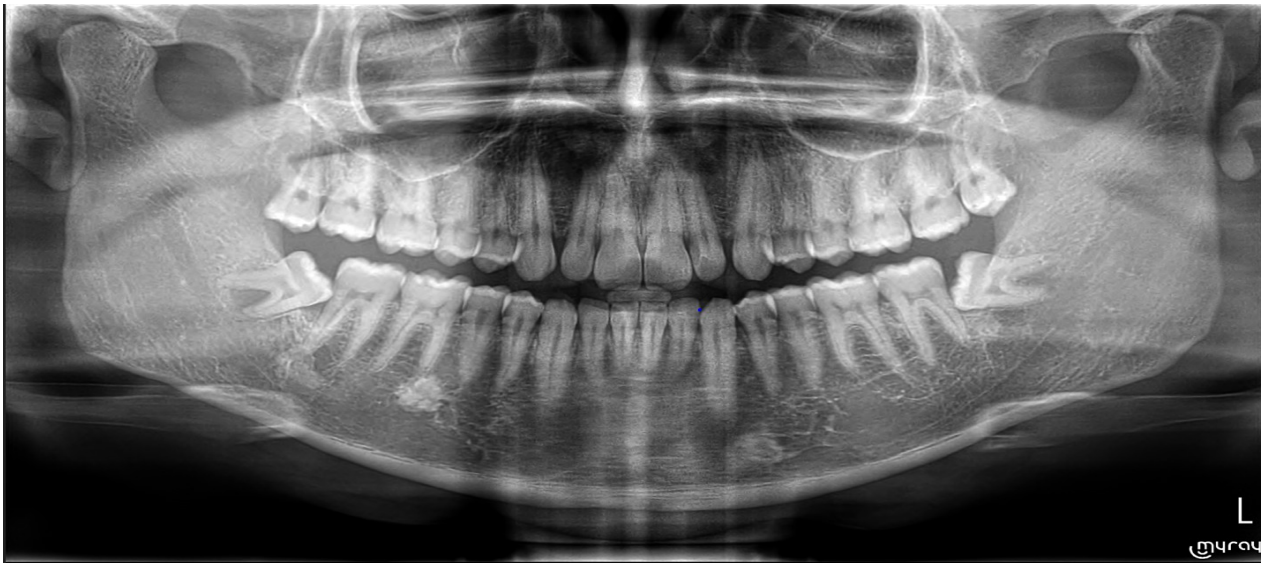


Figure 1. An orthopantomogram showing an impacted mandibular third molar.

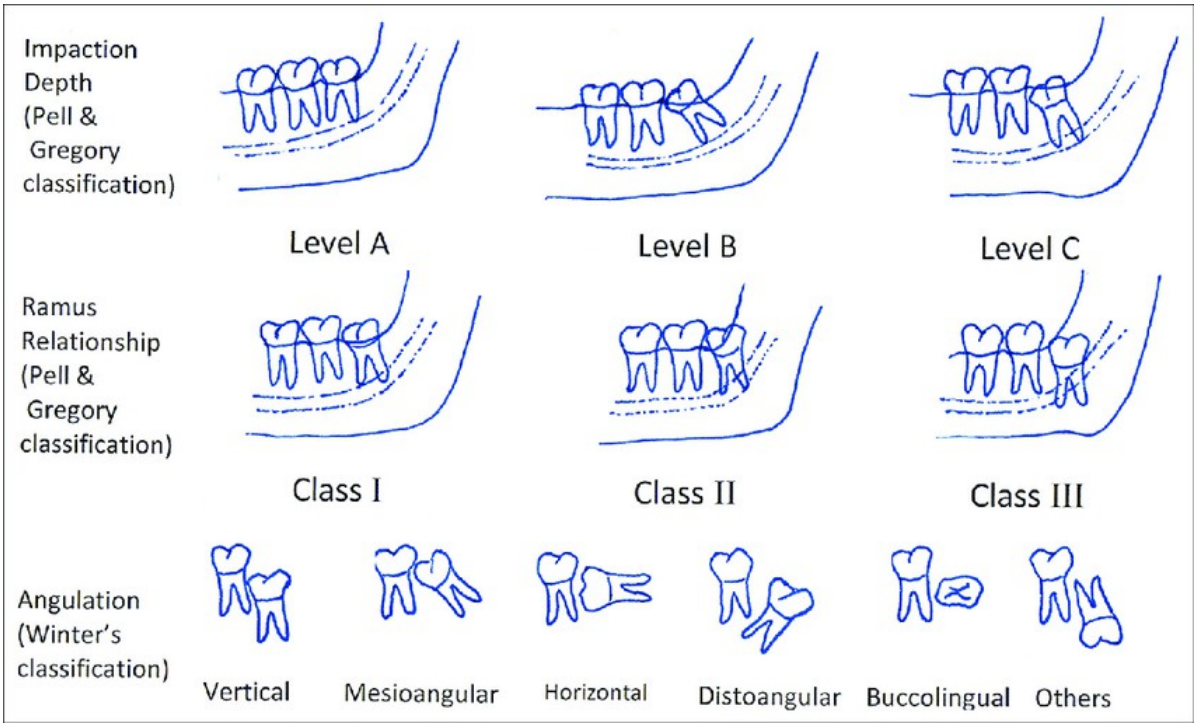


Figure 2. The impaction depth, ramus relationship, and angulation classification of mandibular third molars take from pattern of mandibular third molar impaction: A cross-sectional study in northeast of Iran" paper written by Eshghpour and colleagues.

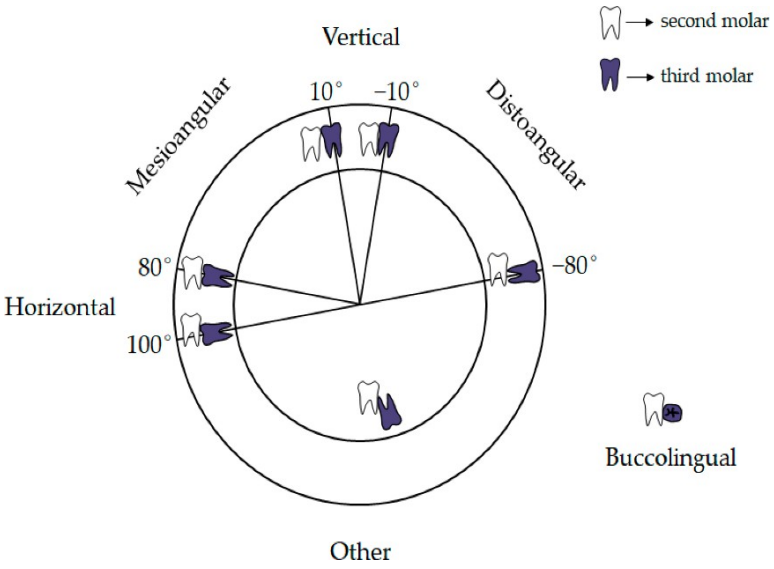


Figure 3. Winter's classification taken from article "A Lightweight Knowledge-Distillation-Based Model for the Detection and Classification of Impacted Mandibular Third Molars" by Lei and colleagues.

Table 1. Comparison between the unilateral/bilateral impaction by sex.

| | | Side | | Total |
|---|---|---|---|---|
| | | Unilateral | Bilateral | |
| Sex | Male | 29 (67.4%) | 36 (65.5%) | 65 |
| | Female | 14 (32.6%) | 19 (32.6%) | 33 |
| Total | | 43 (100%) | 55 (100%) | 98 |
| $X^2 = 0.043$, $p = 0.836$ | | | | |

Table 2. Comparison of the impaction depth according to the Pell & Gregory category by sex.

| | | Sex | |
|---|---|---|---|
| | | Male | Female |
| | | Count | Count |
| Right side Impaction Depth | N/A | 11 (16.9%) | 7 (21.2%) |
| | A | 0 (0%) | 0 (0%) |
| | B | 19 (29.2%) | 8 (24.2%) |
| | C | 35 (53.8%) | 18 (54.5%) |
| $X^2$ = 0.419 ($p$ = 0.811) | | | |
| Left Side Impaction Depth | N/A | 18 (27.7%) | 7 (21.2%) |
| | A | 1 (1.5%) | 0 (0.0%) |
| | B | 25 (38.5%) | 6 (18.2%) |
| | C | 21 (32.3%) | 20 (60.6%) |
| $X^2$ = 7.903 ($p$ =0.048) | | | |

Table 3. Comparison of the impaction ramus relationship according to the Pell & Gregory category by sex. N/A means the absence of the impaction related to the ramus.

| | | Sex | |
|---|---|---|---|
| | | Male | Female |
| | | Count | Count |
| Right side Ramus Relationship | N/A | 11 (16.9%) | 7 (21.2%) |
| | I | 9 (13.8%) | 3 (9.1%) |
| | II | 45 (69.2%) | 22 (66.7%) |
| | III | 0 (0%) | 1(3%) |
| $X^2$ = 2.614 ($p$ =0.455) | | | |
| Left Side Ramus Relationship | N/A | 18 (27.7%) | 7 (21.2%) |
| | I | 11 (16.9%) | 5 (15.2%) |
| | II | 35 (53.8%) | 21 (63.6%) |
| | III | 1 (1.5%) | 0 (0%) |
| $X^2$ = 1.277 (p = 0.735) | | | |

Table 4. Comparison of the impaction angulation according to the Winter's classification by sex.

| | | Sex | |
|---|---|---|---|
| | | Male | Female |
| | | Count | Count |
| Right side Angulation | N/A | 11 (16.9%) | 7 (21.2%) |
| | Vertical | 8 (12.3%) | 4 (12.1%) |
| | Horizontal | 23 (35.4%) | 5 (15.2%) |
| | Distoangular | 0 (0%) | 0 (0%) |
| | Mesioangular | 21 (32.3%) | 17 (51.5%) |
| | Buccolingual | 2 (3.1%) | 0 (0%) |
| | Other | 0 (0%) | 0 (0%) |
| | Total | 65 | 33 |
| $X^2 = 6.454$ ($p = 0.168$) | | | |
| Left Side Angulation | N/A | 18 (27.7%) | 7 (21.2%) |
| | Vertical | 4 (6.2%) | 3 (9.1%) |
| | Horizontal | 21 (32.3%) | 7 (21.2%) |
| | Distoangular | 0 (0%) | 3 (9.1%) |
| | Mesioangular | 21 (32.3%) | 13 (39.4%) |
| | Buccolingual | 1(1.5%) | 0 (0%) |
| | Other | 0 (0%) | 0 (0%) |
| $X^2 = 8.301$ ($p = 0.14$) | | | |