Cross Sectional Study

EVALUATING THE PATTERNS OF IMPACTION IN LOWER THIRD MOLARS AND ASSOCIATED RADIOLUCENT LESIONS: OBSERVATIONAL CROSS-SECTIONAL STUDY

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ABSTRACT

An impacted third molar occurs when neighboring teeth overlying the bone or soft tissue hinder its normal eruption. Thus, it fails to fully emerge by the expected age of 20 years. The impacted third molar is not always associated with clinical symptoms, and an unknown percentage of unerupted third molars remain asymptomatic for years. This study aimed to evaluate radiolucent lesions associated with impacted third molars in terms of their pathological diagnosis and the sex and age distribution of the affected individuals. This was a retrospective cross-sectional study conducted at the King Khalid Dental University Hospital, Riyadh, Saudi Arabia, between January 2020 and August 2023. A total of 312 orthopantomography (OPGs) were recovered. Among study subjects, a total of 549 teeth were studied. A total of 103 teeth had a lesion, which was more frequently seen in male than female patients and in patients aged ≤30 years than in patients aged >30 years with significant differences. Additionally, most impacted teeth were classified as impaction depth A, indicating the same or higher level regarding the occlusal plane of the second molar. In conclusion, the pattern of lower third molar and dental characteristics (impaction depth classification, ramus relationship, angulation classification, and tooth type) was associated with age. There was no association between gender and dental characteristics, except for the presence of a lesion.

Key words: Lower third molars, Impaction, Pathological lesion, Radiolucency.

Introduction

The word impaction is originated from the Latin word "impact" means organ or structure, which because of an abnormal mechanical condition has been prevented from assuming its normal position [1].

The specific cause for the high impaction risk in third molars remains not well known, but the most widely accepted theory suggests that it is caused by its late eruption time between 17 and 21 years, where space is not always available. Impaction may also be caused by physical barriers such as dense bone or excessive soft tissue coverage and other pathologies such as cysts, tumors and systemic diseases. The high percentage of impaction increases the risk of associated pathologies, pain and necessity for therapeutic removal [2-5]. This explains the high frequency of the procedure in practice, with its diffi- culty varying based on multiple factors such as depth of impaction, angulations of the third molar and thickness of overlying bone. Due to this high rate of surgical removal, the necessity for tools to predict possible com- plications has been put forward and multiple studies attempted to determine the specific factors needed to be analyzed to obtain an accurate prediction of the difficulty of extraction, showing that certain criteria such as bone thickness, root complexity and proximity to anatomical structures are strong indicators of surgical difficulty [6].

Particularly, partially erupted impacted third molars are associated with odontogenic infections, such as caries, periodontal diseases, and pericoronitis [7]. The challenges in maintaining proper oral hygiene around partially erupted teeth contribute to a higher incidence of dental caries and endodontic diseases compared to fully unerupted teeth. On the other hand, noninflammatory conditions, such as dentigerous cysts, odontogenic keratocysts, and ameloblastomas, are mostly related to an entirely unerupted lower third molar. The impacted third molar is not always associated with clinical symptoms, and an unknown percentage of unerupted third molars might remain asymptomatic for years. It is advised to evaluate each case individually to decide whether it is better to keep or remove an impacted third molar [8]. Additionally, regular clinical and radiographic monitoring should be done to detect any developing problems that might require surgical intervention if a non-extraction approach is chosen. Third molar impaction can occur in different angulations, which are guided by local causative factors [9]. Several classification systems are proposed to categorize impacted third molars based on their position, level, and relationship with adjacent structures.

In the Pell & Gregory classification system, third molar impaction is classified according to its depth level in relation to the occlusal surface of the second molar vertically, and the relation of the impaction to the body of the Ramus hori- zontally. As for angulation, third molar impaction was classified by the Winter's classification system in 1926. According to Winter's classification, the angulation of the third molar can be vertical, mesioangular, horizontal, and distoangular. Studies have shown varying prevalence rates of impacted teeth, with some reporting higher frequencies in specific populations. This study aimed to determine the association between lower third molar impaction patterns regarding their position, angulation, and level with the prevalence of associated radiolucent lesions in a Saudi population in the central region of Saudi Arabia. Radiographic evaluations are crucial in assessing the potential pathologies associated with impacted third molars, and studies have highlighted their importance in treatment planning. Moreover, understanding the prevalence of pathologies related to impacted third molars can guide clinical decisions regarding their management and potential prophylactic removal [10].

Materials and Methods

The study was a retrospective cross-sectional study conducted at the King Saud University Medical City, Riyadh, Saudi Arabia. The institutional review board (IRB) of King Saud University approved this study, ethical approval number (E-23-8093) [11-18]. A total of 312 orthopantomography (OPGs) patients were recovered; the OPGs were taken at King Saud Medical City, Riyadh, Saudi Arabia, between January 2020 and August 2023 [6]. The inclusion criteria were listed as follows:

1. Healthy patients.
2. Impacted third molar with completed root development as shown on the OPGs.
3. Patients aged 24 to 51 years.

The number of the OPGs excluded was 228 for the following reasons:

1. History of jaw trauma.
2. Past surgery in the third molar sites.
3. Congenital syndromes or craniofacial anomalies.
4. Poor quality of x-rays or incomplete records [19].

Patients' data, including age, gender, and health status, were retrieved from electronic health records (Salud) at the King Khalid Dental University Hospital [20]. The impacted third molars were studied by OPGs using Planmeca Romexis® software version 6.0 [21]. Each radiograph was assessed by two blinded investigators [22].

Sample size calculation:

$$n = \frac{(1.96)^2 \times 0.196 \times (1 - 0.196)}{(0.05)^2} \quad (1)$$

$$n \approx 242.56$$

The angular position was evaluated using Winter's classification in terms of vertical, horizontal, mesioangular, distoangular, and other (buccolingual) impaction [9]. The level of eruption was evaluated using the Pell and Gregory classification in two ways:

1. The first method evaluated the depth of the impacted lower third molar relative to the occlusal plane of the lower second molar, providing three positions:
   - Position A: The highest part of the lower third molar located on the same level as or above the occlusal line.
   - Position B: The highest part of the lower third molar is located below the occlusal line but above the cervical line of the second molar.
   - Position C: The highest part of the lower third molar is located on a level with or below the cervical line of the second molar [23].
2. The second method assessed the impacted lower third molar and its relation to the mandibular ramus, generating three classes:
   - Class I: Sufficient space between the distal part of the second molar and the ramus, allowing the mesiodistal diameter of the lower third molar crown to erupt completely.
   - Class II: Less space between the distal part of the second molar and the ramus, not allowing the full mesiodistal diameter of the lower third molar crown to erupt completely.
   - Class III: Almost the entire lower third molar was within the ramus [19].

Data analysis

Data were analyzed using IBM SPSS Statistical software for Windows version 26.0 (IBM Corp., Armonk, N.Y., USA) [24]. Descriptive statistics (frequencies and percentages) were used to describe the categorical variables. Pearson's Chi-square test was used to observe the association between categorical study variables (age groups, gender, and tooth number) and categorical outcome variables (impaction depth classification, ramus relationship, angulation classification, and presence of a lesion). A p-value ≤ 0.05 indicated statistical significance [7].

Results and Discussion

Out of 312 study subjects, 41.3% were aged ≤30 years and 58.3% were female [1]. Of 549 teeth identified in these 312 subjects, 269 (49%) cases were related to tooth #38, 258 (47%) cases were related to tooth #48, and the remaining 11 teeth were not related to teeth #38 and #48 [6]. Out of all 549 teeth, 474 were bilateral and 75 were unilateral [10]. Regarding the impaction depth, position A was found in 75.6% of teeth, while positions B and C were found in the remaining 24.5% of teeth [20]. Regarding the ramus relationship, class I was observed in 75.8% of teeth, and classes II and III were found in the remaining 24.2% of teeth. Vertical angulation was observed in 66.5% of teeth, middle angulation was in 17.6% of teeth, and horizontal angulation was in 14% of teeth [22]. The presence of a lesion was observed in 103 (19.6%) subjects [9].

Table 1. Distribution of Participants' Demographic and Dental Characteristics Related to the Total Number of Teeth

Characteristic	Number (n)	Percentage (%)
Age Groups		
≤30 years	129	41.3
>30 years	183	58.7
Gender		
Male	123	41.7
Female	172	58.3
Teeth Type		
Unilateral	75	13.7
Bilateral	474	86.3
Impaction depth classification		
Position A	396	75.6
Position B	90	17.2
Position C	38	7.3
Ramus Relationship		
Class I	394	75.8
Class II	117	22.5
Class III	9	1.7
Angulation Classification		
Vertical	347	66.5
Mesioangular	92	17.6
Horizontal	73	14.0
Distoangular	7	1.3
Buccolingual	3	0.6
Tooth Number		
Tooth #38	269	51.0
Tooth #48	258	49.0
Diagnosis		
Presence of Lesion	103	19.6
Absence of Lesion	423	80.4

The association between age groups of study subjects and their dental characteristics (impaction depth classification, ramus relationship, angulation classification, tooth type, and presence of a lesion) shows statistically significant associations for impaction depth classification, ramus relationship, type of tooth, and presence of a lesion. For the impaction depth classification, a higher proportion of position A classification (81.4%) was prevalent in subjects aged >30 years compared with subjects aged ≤30 years, whereas position B classification was higher (24.5%) in subjects aged ≤30 years compared with subjects aged >30 years, with high statistical significance ($p < 0.0001$). For ramus relationships, a higher proportion of class I ramus relationships (79.8%) was observed in subjects aged >30 years compared with subjects aged ≤30 years, whereas class II ramus relationships were more frequent (27.6%) in subjects aged ≤30 years compared with subjects aged >30 years, which is statistically significant ($p = 0.046$) [6]. The proportion of unilateral teeth (16.9%) was higher in subjects aged >30 years, whereas the proportion of bilateral teeth (90.7%) was higher in subjects aged ≤30 years, showing statistical significance [10]. The presence of a lesion was more frequent (26.6%) in subjects aged ≤30 years compared with subjects aged >30 years (14.1%) with high statistical significance ($p < 0.0001$) [20]. Additionally, no statistically significant association was observed between the distribution of angulation classification and age groups of study subjects [21] **(Table 2)**.

No association was identified between the gender of study subjects and their dental characteristics, except for the presence of a lesion [24]. The presence of a lesion was significantly more frequent in males (26.8%) compared with females (14%), showing high statistical significance ($p < 0.0001$) [22] **(Table 3)** [11-18, 25]. Furthermore, the distribution of dental characteristics was not significantly different across the two tooth numbers (38 and 48) [9] **(Table 4)**.

Table 2. Association between age groups and dental characteristics related to the total number of teeth

Characteristic	≤30	>30	p-value
Impaction depth classification			
A	156 (68.1%)	161 (70.6%)	<0.0001
B	56 (24.5%)	63 (27.6%)	
C	17 (7.4%)	4 (1.8%)	
Ramus Relationship			
I	143 (62.4%)	240 (81.4%)	0.046
II	46 (20.1%)	34 (11.5%)	
III	36 (15.7%)	21 (7.1%)	
Angulation Classification			
V	3 (1.3%)	5 (1.7%)	0.490
M	1 (0.4%)		
H	22 (9.3%)		
D	214 (90.7%)		
Type			
Unilateral	61 (26.6%)	204 (69.6%)	0.010
Bilateral	168 (73.4%)	46 (15.7%)	
Diagnosis			
Presence of Lesion	53 (16.9%)	42 (14.1%)	<0.0001
Absence of Lesion	260 (83.1%)	255 (85.9%)	

Table 3. Association between gender and dental characteristics related to the total number of teeth

Characteristic	Number (n)		p-value
	#38	#48	
Impaction depth classification			
A	201 (75.0)	195 (76.2)	0.869

B	46 (17.2)	44 (17.2)	
C	21 (7.8)	17 (6.6)	
Ramus Relationship			
I	207 (77.8)	187 (73.6)	0.462
II	54 (20.3)	63 (24.8)	
III	5 (1.9)	4 (1.6)	
Angulation Classification			
V	181 (67.8)	166 (65.1)	0.513
M	48 (18.0)	44 (17.3)	
H	32 (12.0)	41 (0.8)	
D	5 (1.9)	2 (0.8)	
B	1 (0.4)	2 (0.8)	
Type			
Unilateral	39 (14.5)	36 (14.0)	0.858
Bilateral	230 (85.5)	222 (86.0)	
Diagnosis			
Presence of Lesion	53 (19.8)	50 (19.5)	0.944
Absence of Lesion	215 (80.2)	206 (80.5)	

Table 4. Association between tooth number and dental characteristics related to the total number of teeth

Characteristic	Male	Female	p-value
Impaction depth classification			
A	156 (73.6%)	157 (75.1%)	0.483
B	38 (17.9%)	46 (22.0%)	
C	18 (8.5%)	6 (2.9%)	
Ramus Relationship			
I	128 (61.0%)	212 (74.9%)	0.306
II	42 (20.0%)	68 (24.0%)	
III	35 (16.7%)	3 (1.1%)	
Angulation Classification			
V	3 (1.4%)	4 (1.4%)	0.254
M	2 (1.0%)	1 (0.4%)	
H	29 (13.3%)	44 (14.6%)	
D	189 (86.7%)	257 (85.4%)	
Type			
Unilateral	57 (26.8%)	40 (14.0%)	0.671
Bilateral	156 (73.2%)	245 (86.0%)	
Diagnosis			
Presence of Lesion	220 (77.5%)	212 (74.9%)	<0.0001
Absence of Lesion	47 (16.5%)	68 (24.0%)	

Mandibular third molars are the most frequently impacted teeth, with their surgical extraction becoming one of the most common dentoalveolar surgeries [6]. Therefore, analyzing data pertaining to the incidence and progression of pathological conditions in and around impacted teeth is essential during clinical judgment and can guide us further to extract the tooth or keep it [26]. Our study further clarifies the relationship between third molar calcification and skeletal maturity [25, 27-33]. This correlation suggests that the development of third molars can serve as a reliable indicator of an individual's skeletal age, which is particularly valuable for orthodontists when planning treatment for impacted third molars [34]. The growth patterns of the mandible and the direction of condylar growth play a crucial role in determining the space available for third molars and their potential for impaction [35]. These findings are consistent with the research conducted by Pursafar *et al*. [20], which identified mandibular length and alveolar prognathism as important factors in orthodontic assessment and treatment planning to mitigate complications associated with impacted third molars. Our study also confirms the high prevalence of impacted teeth. The presence of pathologies, such as caries and root resorption, highlights the importance of careful evaluation and potential treatment of impacted teeth [36]. Moreover, the influence of adjacent teeth on the angulation of impacted third molars is a significant factor to consider. Horizontal impaction is more common when adjacent teeth are missing, possibly influencing decisions regarding the extraction of impacted teeth [37]. The symmetry in symptoms and pathologies of bilateral mandibular third molars provide valuable insights for clinical management and surgical decisions. Our findings also indicate that mesioangular-impacted teeth are more prone to pathological conditions. This highlights the increased risk of caries on adjacent molars and emphasizes the importance of identifying impacted teeth and associated pathologies for appropriate management and treatment decisions. Pathological conditions might be influenced by the impaction position [19], underscoring the need for regular follow-ups and early surgical intervention when pathologies are detected. Furthermore, the prevalence of cysts or tumors associated with impacted third molars increases with age. This age-related risk factor reinforces the importance of carefully considering the prophylactic extraction of impacted third molars. Our study, which analyzed data from 312 subjects and 549 teeth, showed 103 (19.6%) teeth with a lesion, a higher prevalence of third molar impaction in males compared to females (26.8% vs. 14%), and patients aged ≤30 years compared to patients aged >30 years (26.6% vs. 14.1%) with statistically significant differences (both $p < 0.0001$). Furthermore, most impacted teeth (75.6%) were classified as impaction depth A, indicating that most of the impacted teeth were at the level with or above the occlusal plane of the second molar. This predominance of less severe impactions was particularly notable in subjects older than 30 years, suggesting a potential decrease in impaction severity with age. We also found a significant association between age and impaction depth, with a higher prevalence of less severe impactions in the older age group [38-42]. This could indicate either a natural eruption process that reduces impaction severity over time or a selective removal of more severely impacted teeth at a younger age. Additionally, our study revealed that the majority of impacted third molars had a ramus relationship I (75.8%), particularly in older subjects.

Conclusion

In conclusion, the pattern of lower third molar impaction and dental characteristics (impaction depth, ramus relationship, angulation, and tooth type) was associated with age. There was no association between gender and dental characteristics except for the presence of a lesion. In this study, the pattern of lower third molar impaction was associated with radiolucent lesions in males and patients aged >30 years. Our data contributes to the understanding of impaction dynamics and might influence treatment strategies for impacted third molars. An acknowledgment this study was limited in King Saud University, Riyadh, Saudi Arabia. However, further studies with a large sample size are necessary to provide better patient management and decision-making.

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