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Pathologies Associated with Impacted Mandibular Third Molars: A Radiographic Study in Southeast of Iran

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Abstract

Objective(s): Impacted third molars may lead to various pathological complications and their prophylactic extraction is controversial. The purpose of this study was to radiographically determine the relationship between common pathologies and angulation and impaction depth of impacted mandibular third molars. **Methods:** In this study, 1158 panoramic radiographs with 1787 impacted lower third molars (ILTMs) were analyzed. The following pathologies were evaluated: caries in mandibular second molars, caries in ILTMs, radiolucency on distal surface of ILTMs, and bone resorption on distal surface of mandibular second molars. Data were analyzed using the chi-square test at $p<0.05$. **Results:** 58.5% of ILTMs were associated with at least one pathology. Caries of ILTMs were the most common finding (31.1%), followed by caries (21.2%) and bone loss (17.7%) of second molars, and distal radiolucency of ILTMs (4.3%). Caries in second and third molars and bone loss of second molars were significantly more common in mesioangular ILTMs ($p<0.05$). Radiolucency on distal surface of ILTMs was significantly more common in vertical ILTMs. Considering the ILTMs' impaction depth, class A molars had more pathologies than class B or class C ($p<0.05$). **Conclusion:** Most pathologic conditions were seen in mesioangular ILTMs, especially in Class A cases. Therefore, the angulation and depth of impaction of ILTMs should be taken into account when determining whether prophylactic extraction is necessary.

Keywords: Impacted Tooth; Third Molar; Panoramic Radiography

Introduction

Tooth impaction occurs when a tooth cannot grow into its expected functional position within a reasonable timeframe without intervention. This can happen when other teeth, bone, or soft tissue obstruct its eruption into a normal occlusion, and when it remains unerupted by the age of approximately 20 years [1]. The lower jaw's third molar is frequently impacted, with prevalence rates ranging from 16% to 80% in various studies. While some impacted teeth may remain symptom-free for extended periods, others can cause discomfort, such as pain, infection, or unrestorable carious lesions. Additionally, impacted teeth can lead to dental follicle-associated pathologies, including odontogenic cysts and tumors, jaw fractures, or resorption of adjacent teeth or bone [2-5]. These conditions are the recognized indications for extraction of impacted lower third molars (ILTMs), that is highly recommended in such cases [6, 7].

The decision to extract ILTMs is a common challenge that dentists often face. There have been ongoing discussions for years regarding the prescription for ILTMs removal [8, 9]. Some controversial evidence has been presented on preventive extraction of ILTMs without symptoms, making it challenging for dentists regarding the decision to extract or retain these teeth.[10] Complications following ILTMs removal have led to a reluctance to extract asymptomatic impacted third molars prophylactically [11,12]. Therefore, it is crucial for dentists to carefully consider the benefits of ILTMs removal in comparison to its possible complications and risks. Appropriate surgical methods can reduce the risks and complications related to the procedure [11-13].

The decision regarding ILTMs treatment is crucial due to potential post-surgery complications and risks. Moreover, if a correlation between pathological conditions and the angulation and depth of ILTM impaction is established, it can be helpful for dentists and surgeons when deciding on their extraction [9, 13, 14]. Since most studies on ILTM in Iran only examine the prevalence and impaction angulation and depth, and due to the limited studies on ILTMs-related pathologies,[8, 12, 15], this study was conducted to assess the frequency of common problems associated with ILTMs. These include distal caries of mandibular second molars, caries of ILTMs, distal bone loss of adjacent second molars, radiolucency on distal aspect of ILTMs, and their relationship with ILTMs angulation and

impaction depth radiographically.

Methods

This study was conducted over a six-month period (from April 2020 to September 2020) on patients referred to a radiology center in Kerman. All radiographs were taken using a Pax-i panoramic radiography machine manufactured by Vatech under standard conditions, including a 13-second exposure time at 10 mA and a Kvp set between 73 and 77 based on the patient's weight. The inclusion criteria required participants to be at least 20 years old and have the first and second molars adjacent to the ILTMs [16]. The sample size was determined using p=0.2, q=0.8, z=1.96 and d=0.03, resulting in the examination of 1787 impacted teeth.[16]

The impaction level of ILTM was classified according to Pell and Gregory's system as follows: Class I: No part of the crown is within the ramus; Class II: less than one-half of the crown is within the ramus; Class III: more than half of the crown is within the ramus; Class A: The highest point of ILTM is at or above the level of the occlusal plane; Class B: The highest point of ILTM is below the occlusal plane but above the cervical line of the adjacent second molar; Class C: the highest point of the ILTM is below the cervical line of the adjacent second molar[17].

The angulation of ILTMs were assessed based on the Winter method, which measures the angle formed between the longitudinal axis of the ILTM and that of the adjacent second molar. The data were categorized into the following groups: vertical: -10 to 10 degrees; mesioangular: 11 to 79 degrees; horizontal: 80 to 110 degrees; and distoangular: -11 to -79 degrees. Any cases that fell outside these measurements, such as angles between -80 to 111 degrees or buccolingual, were placed in a separate group [18].

Pathologic conditions associated with ILTMs included the followings: 1- Caries on the distal aspect of the second molars next to the ILTMs; 2- Bone resorption in the distal aspect of the second molars adjacent to the ILTMs; 3- caries in ILTMs; 4- Radiolucency in the distal surface of ILTMs.

Caries on the distal surface of second molars and caries of ILTMs were classified into two groups: 1- Absence of caries; 2- The presence of obvious caries in panoramic radiograph. Radiolucency at the distal surface of ILTMs was classified into two groups: 1-less than 2.5 mm; 2- equal to or more than 2.5 mm. Bone resorption on the distal surface of the second molars was measured from the CEJ to the marginal bone level and categorized into two groups: 1- less than 3 mm; 2- equal to or more than 3 mm. All the measurements were done accurately in millimeters using Scanora software version 5.1.1 [16]. Data including age, gender, impaction side, and observed pathologies were entered into an information form. Data was analyzed using SPSS 26 with the chi-square test, considering a significance level of 0.05. Patients' information was kept confidential, written informed consent was taken, and the Ethics Committee of Kerman University of Medical Sciences approved the study under the code IR.Kmu.Rec.1396.1711.

Results

In total, 4850 panoramic images were examined, of which 1158 radiographs with 1787 ILTMs were qualified to enter the study. 503 (43.4%) radiographs were related to women and 655 (56.6%) were related to men. The highest prevalence of ILTM (60.77%) was seen in the age group between 20 and 30 years (1086 cases). 948 (53%) cases were on the left mandibular arch and 839 (47%) were observed on the right mandibular arch.

The most common angle of impaction was mesioangular ILTMs (62.7%), followed by vertical (19.7%), horizontal (10.4%), and distoangular (6.7%). Only 8 cases (0.5%) were located buccolingually or with an angle of -80 to 111 degrees. Mesioangular impaction was significantly more prevalent than other angles (P<0.05).

The most frequent impaction level was level A (61.4%), followed by level B (22.7%), and C (15.9%). Level A was significantly more common than levels B and C (P<0.05). Class I impacted molars were more common (46.6%), followed by class II and class III cases with a frequency of 27% and 26.4%, respectively. Class I molars were significantly more common than classes II and III (P<0.05).

Regarding the frequency of different angles and depths of impaction, mesioangular level A molars with 770 cases (43%) were significantly more common than the others. Additionally, level A class I molars were significantly more common, with a prevalence of 714 cases (39.9%).

The most common pathologic change related to ILTMs was third molar caries, occurring in 31.1% of cases. After that, the second molar caries with a prevalence of 21.2% (379 cases), bone loss more than 3 mm at the distal surface of the second molar with a prevalence of 17.7% (317 cases), and radiolucency more than 2.5 mm in the distal of the ILTMs had a prevalence of 2.4% (75 cases) (Figures 1, 2).

There was no statistically significant association between the sex and second and third molar caries; however, the bone loss in the distal aspect of second molars and radiolucency in the distal aspect of ILTMs was significantly more common in men (p<0.05) (Table 1).

Caries on the distal surface of second molars, caries affecting the ILTMs, and bone loss in the distal surface of second molars were significantly more common in mesioangular molars. However, radiolucency in distal aspect of ILTMs was more common in vertical cases (Table 2).

Table 1- Frequency of pathologic conditions related to ILTMs in two genders			
Sex		Pathologic conditions	P – value
Male (%)	Female (%)		
257 (14.4)	298 (16.7)	Caries of the ILTMs	0.399
173 (9.7)	206 (11.5)	Caries of the second molar	0.347
182 (10.2)	135 (7.6)	Bone resorption >3mm of the second molar	0.001*
53 (3)	22 (1.2)	Radiolucency > 2mm of the ILTMs	0.001*

Figure 1: right side: vertical class A ILTM with no associated pathology. Left side: horizontal class A ILTM with caries of ILTM and bone resorption in the distal aspect of the second molar.

Figure 2: right side: distoangular class B ILTM with caries of second molar and ILTM. Left side: distoangular class B ILTM with caries of second molar and ILTM and radiolucency at the distal aspect of the ILTM.

Table 2 - Frequency of pathologic conditions related to ILTMs based on the angle of impaction				
Angle of impaction	Pathologic conditions			
	Radiolucency > 2mm of the ILTMs (%)	Bone resorption >3mm of the second molar (%)	Caries of the second molar (%)	Caries of the ILTMs (%)
Mesioangular	16 (0.9)	204 (11.4)	276 (15.4)	409 (22.9)
Vertical	43 (2.4)	7 (0.4)	37 (2.1)	74 (4.1)
Horizontal	1 (0.1)	104 (5.8)	48 (2.7)	38 (2.1)
distoangular	13 (0.7)	0 (0)	16 (0.9)	33 (1.8)
others	2 (0.1)	2 (0.1)	2 (0.1)	1 (0.1)
P-value	0.001*	0.001*	0.001*	0.001*

Caries on the distal surface of second molars, caries affecting the ILTMs and radiolucency in the distal surface of ILTMs

were significantly more common in molars with level A impaction. Bone loss in the distal aspect of second molars was found to be significantly more common in cases with level C (Table 3).

Table 3- Frequency of pathologic changes associated with ILTMs based on the depth of impaction

Impaction depth	Pathologic conditions			
	Radiolucency >2mm of the ILTMs (%)	Bone resorption >3mm of the second molar (%)	Caries of the second molar (%)	Caries of the ILTMs (%)
level A	50 (2.8)	82 (4.6)	293 (16.4)	493 (27.6)
level B	22 (1.2)	116 (6.5)	61 (3.4)	58 (3.2)
level C	3 (0.2)	119 (6.7)	25 (1.4)	4 (0.2)
P-value	0.001*	0.001*	0.001*	0.001*

Caries in the second and third molars and bone loss in the distal surface of second molars were significantly higher in cases with class I impaction. In addition, radiolucency greater than 2.5 mm in the distal surface of ILTMs was significantly more common in cases with class II impaction (Table 4).

Table 4- Frequency of pathologic changes related to ILTMs according to impaction in the anterior border of the ramus

Impaction	Pathologic conditions			
	Radiolucency >2mm of the ILTMs (%)	Bone resorption >3mm of the second molar (%)	Caries of the second molar (%)	Caries of the ILTMs (%)
class I	7 (0.4)	129 (7.2)	253 (14.2)	387 (21.7)
Class II	38 (2.1)	67 (3.7)	66 (3.7)	114 (6.4)
Class III	30 (1.7)	121 (6.8)	60 (3.4)	54 (3)
P-value	0.001*	0.001*	0.001*	0.001*

Discussion

General dentists and maxillofacial surgeons have commonly had difficulty in developing a consistent approach for treating asymptomatic impacted third molars. However, there is little dispute that impacted third molars should be extracted when they cause pathologic changes and severe symptoms[18,19]. Some researchers contend that the risk of pathologic changes resulting from impacted third molars has been overstated. Third molar surgery is not without risk and can lead to significant discomfort and complications[20]. Several studies have been conducted in Iran to examine impacted third molars, but few have specifically examined the pathologies associated with these teeth [9,13,14]. As a result, this study investigated common pathologies related to ILTMs in patients attending a radiology center in Kerman, Iran.

According to the current survey, the impaction of mandibular third molars was more prevalent in women than in men. This finding aligns with previous researches [8, 12, 21]. Women typically stoptheir growth spurt earlier than men, so when the third molars erupt, men continue to experience jaw growth, providing more space for the molars to develop [12]. While some studies do not report gender differences in the impaction of mandibular third molars, the present study highlights a notable disparity [22].

According to this study, mesioangular impaction angle was the most common in ILTMs, followed by vertical and horizontal impaction, that is consistent with studies by Hassan [22], Hashmipour et al.[12], Queck et al.[21], Eshgpour et al.[8], and Bokhari et al.[23]. However, in some limited studies, vertical impaction has been reported as the most common angle [18, 24]. The high prevalence of mesioangular impaction can be attributed to factors such as delayed formation of third molars, growth path, and limited space in the mandible at older ages.

Regarding the impaction level, level A was significantly more common than levels B and C. Similarly, in the study by Hashmipour et al. [12] in Kerman, as well as the researches of Obiechina et al. [6] in Nigeria, and Monaco et al. [25] in Italy, level A was reported as the most frequent type of impaction in ILTMs. Contrary to the findings observed in this survey, in some studies such as Hassan [22], Queck et al. [21] and Eshgpour et al. [8], level B impaction has been reported as the most frequent impaction depth, while in the study of Knutsson et al. [24] level C impaction was the most common. The differences observed in different studies could be attributed to variations in entry criteria and classification systems. In some of the mentioned studies, the ILTMs impaction level has been investigated based on the level of the cemento-enamel junction (CEJ) of the third molar in relation to the alveolar bone, not in comparison to the occlusal plane of the adjacent second molar tooth [14]. Alsaegh et al.[26] have also reported that approximately 25% of Emirati individuals assessed had at least one impacted ILTM, with class II, level B, and mesioangular impactions being the most common observed patterns. In the present study, most ILTMs were class I, with a significant difference compared to class II and III. In a study in Hamadan,[8] Class II impactions have been reported as the most common type, contrary to our results.

In this study, Impaction of ILTMs was slightly more common on the right side compared to the left. Other studies have shown no significant difference in impaction prevalence between the

two sides of mandible [8, 12, 21, 22].

Among the pathologies evaluated in this study, third molar caries was the most prevalent, followed by second molar caries, bone loss in the distal aspect of second molars, and radiolucency in distal aspect of ILTMs. In a retrospective study, the frequency of caries in second molars, caries in ILTMs, distal radiolucency in ILTMs, and reduction in alveolar bone surface were 31.6%, 9.9%, 6.5%, and 6%, respectively [19].

The prevalence of caries in ILTMs in this study was higher than the other studies and was close to the prevalence rate reported in the study by Knutsson et al.[24]. In the survey by Mohedian et al.[14] in Shiraz, 13.4% of the impacted third molars showed evidence of caries. The prevalence of caries in ILTMs in Turkey [16] was lower than the other studies and was reported as 5.3%.

Several researchers have highlighted the association between the angulation and depth of third molars with pathologic problems [7, 16, 24, 27]. Knutsson et al.[24] found that the majority of third molars linked with pathologic changes were vertical or mesioangular. This may be due to the higher prevalence of vertical and mesioangular molars than horizontal and distoangular ones. In the present study, mesioangular and vertical molars were more common than the other types. We observed a higher prevalence of ILTMs caries in cases with level A, class I, and mesioangular molars. Hadad et al.[15] reported higher risk of pathology associated with mesioangular and horizontal impaction. This finding is consistent with the results of earlier studies [1, 9, 16, 28, 29]. This is probably caused by the fact that level A and class I cases erupt more in the oral cavity than other cases. As a result, they are more exposed to environmental caries-causing factors such as diet, fluoride exposure, and oral hygiene practices[30]. Also, in mesioangular ILTMs, the plaque accumulation between the third molar and the adjacent second molar is higher, and as a result, the expectation of caries is higher. Distal caries in second molars were found in 21.2% of cases in this study. The research conducted by of Bokhari et al.[23] reported significantly higher caries than the other studies (39%). The rate of caries reported in the study of Mohahdian et al.[14] was similar to the present study. Similar to Polat et al.'s study[16], in this study, distal caries of second molars were significantly higher in cases with level A impaction, class I molars, and mesioangular position. In the survey of Knutsson et al.[24] and Mokhtar et al.[9], caries was more common in second molars next to mesioangular and level A ILTMs.

The depth and angulation of impaction of ILTMs affect the second molar's caries. Some researchers have reported that partially erupted third molars, which are mesioangular or horizontal, cause plaque formation on the distal aspect of second molars, and as a result, they are prone to caries[15]. Furthermore, gingival recession and exposed roots cause caries in the distal root aspect of the second molars. About 5% of the third molars are extracted because of the distally located cervical caries in second molars[31]. The survey conducted by Nunn ME et al.[32] showed that second molars without an adjacent third molar were at the lowest risk of caries development. In contrast, the second molars next to impacted third molars were reported to have the highest caries risk. Raheem et al.[18] stated that most cases (39.9%) with distal caries of the second molars were attributed to third molars positioned horizontally.

This study found no significant difference in the prevalence of caries in third and second molars between the two genders. However, in the researches conducted by Bokhari et al.[23] and Qirreish et al.[33], caries of second molars next to to ILTMs were significantly more prevalent in men than in women.

Radiolucency in the distal aspect of ILTMs and bone loss in the distal aspect of the lower second molar are also considered pathological conditions related to ILTMs[16, 29]. Periodontal problems associated with ILTMs have been investigated in various studies[34]. Kindler et al.[5] suggested that impacted third molars are associated with greater probing depth in the adjacent second molars. Blakey et al.[35] observed that one-fourth of 329 asymptomatic third molars had at least one pocket with a probing depth more than 5 mm. Nance et al.[36] found that 52% of erupted third molars had at least one periodontal pocket with a depth more than 4 mm. Sun et al.[37] stated that removing non-impacted third molars was related to better periodontal status in second molars.

This study found that in 17.7% of cases, more than 3 mm bone resorption was observed in the distal aspect of second molars. In contrast, Chu et al.'s study[38] revealed that 9% of mandibular second molars exhibited over 5 mm of bone loss at their distal aspect. Similarly, Polat et al.'s study[16] showed that 9.8% of second molars had more than 3 mm of distal bone loss. In contrast, Knutsson et al.'s[24] study indicated that 8% of cases showed bone loss in second molars. Stanley et al.'s review[20] revealed a lower rate of 4.5%. Additionally, Mehdizadeh et al.'s study[13] found that bone loss was observed in 52.17% of cases in the distal of second molars next to ILTMs, significantly higher than the values reported in other studies. We observed that bone loss was significantly higher in cases with level C impaction, consistent with Mukhtar et al.'s study[9]. Similar to Polat et al.'s study[16], mesioangular and class I molars exhibited significantly higher bone loss in the distal of second molars, possibly due to increased mass and plaque accumulation and subsequent inflammation. We found that bone loss in distal of second molars was significantly more common in men than in women, which has not been mentioned in other studies.

The present findings indicated that in 4.3% of ILTMs, radiolucency greater than 2.5mm was detected in the distal of third molars. Alkhateeb et al.'s study[7] reported a greater prevalence of impacted third molars exhibiting distal radiolucency. In Polat et al.'s study[16], the rate was reported as 9.7%, which is also higher than our findings. We discovered that vertical ILTMs showed more substantial evidence of radiolucency in the distal aspect, consistent with a study conducted in Turkey[16]. Yildrim et al.[39] and Hounsome et al.[40]

suggested that the prophylactic removal of third molars that are vertically and mesioangularly impacted, particularly those at level A of eruption, can help prevent associated complications. However, Nivedita et al.[10] suggested that with a regular follow-up schedule and good oral hygiene, prophylactic extraction of ILTMs may not be necessary.

Conclusion

The findings of this study revealed that mesioangular ILTMs had higher caries in the third molars, caries in the distal of second molars, and bone loss greater than 3 mm in the distal of second molars. In comparison, cases with vertical impaction had higher distal bone loss of the ILTMs. Furthermore, a greater prevalence of pathologies was observed in molars with level A of impaction and class I cases. As a result, the angulation and depth of impaction of the ILTMs should be considered when deciding whether to remove or retain the tooth. It seems that prophylactic extraction of the mesioangular ILTM is considerable, especially in cases with level A impaction.

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H.M.: Conceptualization, Investigation, Methodology, Supervision, Visualization, Writing- Original Draft; M.K: Conceptualization, Investigation, Methodology, Supervision, Visualization, Writing- Original Draft; S.M.: Conceptualization, Investigation, Methodology, Formal Analysis, Supervision, Resource, Visualization, Writing-Original Draft; F.D.: Investigation, Data Curation, Software, Writing- Original Draft. Yasamin Shahsavani: Investigation, Data Curation, Software, Writing- Original Draft, Writing-Review & Editing.

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Data Availability Statement: The datasets generated and/or analyzed during the current study can be obtained from the corresponding author upon reasonable request.

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Conflict of Interest: The authors declare that there is no conflict of interest.

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