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ORIGINAL ARTICLE

Third molar impaction in the Jazan Region: Evaluation of the prevalence and clinical presentation

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KEYWORDS

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Abstract *Objective:* To provide information on the prevalence and clinical features of impacted third molar teeth in the South-Western region of Saudi Arabia.

Material and methods: In this cross-sectional study, 1200 panoramic radiographs (50% males and 50% females) were retrieved from the electronic clinical records of patients at the College of Dentistry, Jazan University from December 2014 to December 2016, and impacted third molars were evaluated. Data on clinical and radiographic presentation were analyzed.

Results: Overall, there were 291 (24.3%) patients with impacted third molars among 1200 radiographs. The distribution of impacted third molars according to the number of impacted teeth was as follows: one impaction in 121 (41.6%); two impactions in 90 (30.9%); three impactions in 42 (14.4%); and four impactions in 38 (13.1%) patients. There was a high prevalence of all impaction

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types among females (54.5%). Maxillary vertical angulation was most common (50%) followed by mandibular mesioangular angulation (48.3%). The depth of impaction in maxillary teeth was higher than in mandibular teeth. Pain was uncommon (4.5% of patients).

Discussion: Clinically, vertical impaction in the maxilla was present in 50% of patients because of limited posterior space, and mesioangular angulation in the mandible was present in 48% of patients because of inadequate space between the ramus and the second molar. These findings are similar to other reports. Vertical impaction of the maxillary wisdom tooth is mostly related to the discrepancy between the mesiodistal size of the tooth crown and the limited retromolar space.

Conclusion: Noiseless presentation of an impacted third molar requires raising the population's awareness about the need for diagnosis and treatment of the problem to avoid any further complications. The study can be to guide surgical procedures. This study documented the prevalence, pattern, and clinical features of impacted third molars in South Western region of Saudi Arabia.

1. Introduction

An impacted tooth is described as a "tooth that cannot or will not erupt into its normal functioning position, and is therefore pathologic and requires treatment" (AAOMS, 1998). In 1954, Mead defined tooth impaction as a tooth that is prohibited from erupting into its normal location because of malposition, deficiency of space, or other obstructions (Archer, 1966). Local factors that are responsible for tooth impaction include mechanical impediment by a cyst, tumor, or supernumerary tooth, and inadequate space in the dental arch results from micrognathia, premature exfoliation of deciduous teeth, and discrepancy in tooth arch size. In addition, genetic disorders, endocrine disturbances, and previous jaw irradiation are some of the systemic factors that are responsible for impacted teeth (Pursafar et al., 2011). Generally, when a tooth fails to erupt greater than 1 year after the common age for eruption, it is considered to be an "impacted tooth" (Kamiloglu and Kelahmet, 2014).

It is generally believed that third molar agenesis or impaction occurs because of the ongoing evolutionary decrease in the size of the human jaw, which increases the difficulty for accommodating the corresponding molars (Grover and Lorton, 1985). These changes are associated with jaw development and altered dietary habits (Goyal et al., 2016). The modern refined diet does not require the necessary masticatory forces that are required to stimulate growth of the jaws, leading to smaller jaws with impacted teeth. It has been suggested that the major cause of impacted third molars in the adults in developed nations is artificial feeding of babies, oral habits that are developed during childhood, interbreeding, and excessive consumption of refined foods by children and young adults, which causes a disproportion between the jaws and teeth (Ajith et al., 2014). Animal studies have shown a greater association between masticatory forces and jaw growth (Yamada and Kimmel, 1991; Ciochon et al., 1997).

The global prevalence of impacted teeth is reported to be somewhere between 16.7 and 68.6% (Shah et al., 1978; Quek et al., 2003). The mandibular third molar was found to be the most commonly impacted tooth followed by the maxillary third molars, maxillary canines, and mandibular premolars (Pedro et al., 2014; Chu et al., 2003). The third molars also seem to be congenitally missing in some Jordanian students (9.1%) (Hattab et al., 1995).

The frequency of impacted third molars by age was consistent, which means that the presence of completely impacted third molar teeth was not related to age variations (Yamaoka et al., 1995). Generally, wisdom teeth erupt at between 17 and 21 years of age and their eruption time varies with ethnicity (Akarslan and Kocabay, 2009). Mandibular wisdom teeth may erupt as early as age 14 years in Nigerians, and as late as 26 years in Europeans (Otuyemi et al., 1997). The chronology of third molar eruption is strongly influenced by the mandibular trigone space and masticatory unit activity, which is probably the reason for early eruption of third molars in rural Nigerians who used to have non-refined highly fibrous food (Odusanya and Abayomi, 1991). The average age for mandibular third molar eruption in males is approximately 3 to 6 months before that of females (Brakus et al., 2010). Most authors claim that the incidence of mandibular third molar impaction is higher in females (Brakus et al., 2010). These variable rates may have occurred because of a different age group, eruption time, or sample size, or because of different radiographic criteria for dental development and eruption (Obuekwe and Enabulele, 2017; Padhye et al., 2013). A study in Finnish adolescents showed that earlier eruption in females and the difference between males and females was most clearly seen in the second phase of mixed dentition (Pahkala et al., 1991).

Impaction can be predicted by the retromolar space and the probability of eruption is 70%, which is 19.9 mm in women and 14.3 mm in men. If the retromolar space is at least 16.5 mm, then the probability of eruption becomes 100% (Hattab and Alhaija, 1999). Multiple impactions are mostly seen in association with syndromes such as cleidocranial dysplasia, Gardner's syndrome, Gorlin–Sedano syndrome, and Yunis–Varon syndrome (Bayar et al., 2008; Sujatha et al., 2012).

Impaction of the third molar occurs in different angulations, which are guided by local causative factors (Akarslan and Kocabay, 2009). According to Winter's classification, angulation of the third molar can be vertical, mesioangular, horizontal, and distoangular impactions (Quek et al., 2003). Although most impacted teeth are asymptomatic, some can cause complications such as pain, infection, cysts, tumors, resorption of the adjacent teeth, jaw fractures, malpositioning of mandibular anterior teeth, and marginal bone resorption near the adjacent teeth (Chu et al., 2003 Removal

of the impacted teeth is the most common oral surgical procedure, but many investigators have questioned the necessity of removing them in asymptomatic patients. This is mainly based on the opinion that long-term retention of impacted teeth is associated with little risk of pathological change in the tooth or of adverse effects on adjacent structures (Almendros-Marqués et al., 2008).

Currently, there is no available data on the prevalence of an impacted third molar in population of Jazan. The aim of this study is to evaluate the prevalence, types, clinical features, and treatment of the impacted third molar in the South-Western (Jazan) region in the Kingdom of Saudi Arabia.

2. Materials and methods

This study is a hospital-based, cross-sectional study based on the clinical records and panoramic radiographs that were archived in the dental clinics at the College of Dentistry, Jazan University, Jazan. The population of Jazan is approximately 1,365,110 and it has a geographical region stretching for 300 km along the Southern Red Sea coast, which covers an area of 11,671 km^2. The College of Dentistry is the main referral center for the Jazan region because of the availability of state-of-the-art dental clinics and all dental specialties. We, therefore, consider the population that attends the Dental College clinic to be representative of the population of Jazan. We decided to select a sample size with an equal number of male (6 0 0) and female (6 0 0) patients within the age group of 21 to 50 years from the available Orthopantomogram (OPG) radiographs that were taken from December 2014 to December 2016. The mean age of patients in this group was 30.8 years. However, there is no published population mean age for third molar eruption in the Jazan region. Patients less than 21 years of age and who had any associated syndromes were excluded from the study. There were 24,100 patients who attended the College of Dentistry clinics during the study period. The sample selection was based on the availability of OPG radiographs for patients in the age group (21–50 years) and we selected 1200 of those patients with impaction. The proposal was approved by the institutional ethics committee.

In this study, the third molar tooth was considered to be impacted based on the amount of tooth that was covered by the anterior border of the ramus, the depth of the impaction relative to the adjacent tooth, and the angulation of the third molar relative to the neighboring second molar. Digital panoramic images were examined in a standardized manner under good lighting conditions and using a standardized screen brightness and resolution. The angulation of impaction was measured using the long axes of the impacted third molar and adjacent teeth, as described by Schersten et al. (1989). It was measured as mesioangular, distoangular, horizontal, vertical, and others. The depth of the mandibular third molars impaction was measured using Winter's lines. Winter described three imaginary lines that indicated the depth of the tooth in the bone, which is categorized as soft tissue impaction, or mild (<5 mm), moderate (5–9 mm), or deep (>9 mm) impaction (Aitasalo et al., 1972). The radiographs were interpreted by an experienced clinician with vast experience in oral radiology. Intra-examiner variability was removed by randomly repeating 10% of the radiographs to determine the consistency of the study.

Data were entered into a spreadsheet and transferred to the Statistical Package for Social Sciences (IBM SPSS Statistics 20.0) for statistical analysis. Descriptive statistics were calculated to remove outlying data. A parametric *t*-test was used for age and sex, and a non-parametric Chi-square–Pearson test ,was used to estimate the prevalence, the level of significance considered is $P < 0.05.3$. Results

Analysis of the impacted third molars among the 1200 patients' radiographs showed that these molars were impacted in 291 patients (24.3%). The distribution of the impacted third molar according to the number of teeth impacted is shown in Table 1; 121 patients (41.6%) had one; 90 patients (30.9%) had two; 42 patients (14.4%) had three; and 38 patients (13.1%) had all four teeth impacted. A digital panoramic radiograph showing the impacted third molars in all four quadrants is shown in (Fig. 1). The overall impaction was higher among females (55.3%). A *t*-test for age and sex variation was significant only for females with three and four quadrants of impaction ($P < 0.05$).

The prevalence of impacted mandibular third molars was 152 in males and 170 in females. This was significantly more than that of maxillary third molars, which was 111 in males and 144 in females. Bilateral impaction in the mandible was observed in 8.8% of patients and in the maxilla in 7% of patients. The right side ipsilateral was found in 5% of patients and contralateral tooth impaction was found in 4.8% of patients. All types of impaction were generally found more fre-

Table 1 Distribution of impacted third molars according to the number of teeth.

Number of Impacted Teeth	Sex	Number of cases (%)	Mean age	SD	P value	95% CI of the Difference	
						Lower	Higher
One impacted tooth	Males	46 (38.0)	33.47	14.4	0.379	−6.77	2.72
	Females	75 (62.0)	35.50	8.76			
Total		**121(41.6)**					
Two impacted teeth	Males	49 (54.4)	29.91	9.25	0.429	−2.1	4.91
	Females	41 (50.6)	28.50	7.18			
Total		**90 (30.9)**					
Three impacted teeth	Males	20 (47.6)	24.31	3.53	0.037*	−5.55	−0.18
	Females	22 (52.4)	27.18	4.98			
Total		**42 (14.4)**					
Four impacted teeth	Males	15 (39.5)	23.82	3.09	0.019*	−12.35	−1.21
	Females	23(60.5)	30.61	12.37			
Total		**38(13.1)**					

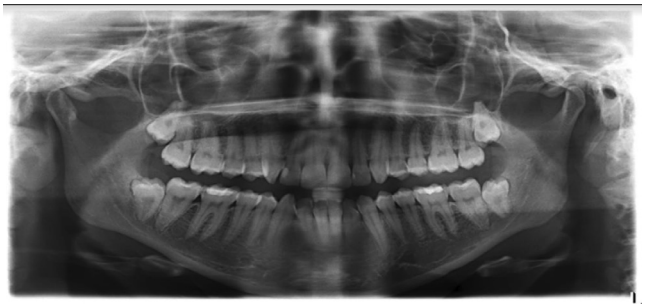

Fig. 1 Digital panoramic radiograph showing impacted third molars in all four quadrants.

quently in females (54.5%). Most cases (53.2%) were reported before 26 years of age. The distribution of the third molar impaction based on the jaw quadrant and on age and sex is shown in (Table 2).

The angulation of impaction was mostly vertical in maxillary teeth (50%), while it was mesioangular in the mandible (48.3%). However, the least frequent angulation was distoangular in mandible (7.8%), and 85% of patients with this angulation type were female. In the maxilla, only two patients (0.75%) presented with horizontal impaction (Table 3). The Chi-square test for angulation by sex variation was significant only for right mandibular teeth ($P < 0.05$).

The depth of impaction of most impacted third molars was mild to moderate and many of them were found within the soft tissue. Generally, impaction was deeper in females compared to males and it was also deeper in the maxilla compared to the mandible (Table 4). A Chi-square test for depth by sex variation was significant only for the right and left maxillary teeth ($P < 0.05$).

Generally, few patients (4.5%) presented with varying degrees of pain. Most of the impacted third molars (95.5%) were observed in radiographs from patients who presented for other reasons that were not related to impaction. These symptomatic teeth were commonly reported in patients over 26 years of age and most of these patients were female (Table 5). A Chi-square test for clinical symptoms by sex variation was significant only for the left mandibular teeth ($P < 0.05$).

3. Discussion

This is the first large-scale study of this type in the Jazan region of South Western Saudi Arabia. The College of Dentistry at the University of Jazan is the only educational dental institute in the region. It provides dental services for all patients who attend the clinic to seek dental treatment in Jazan region. However, both the College and the Ministry of Health annually provide dental services for all population of the Jazan

Table 2 Distribution of third molar impaction based on the jaw quadrant.

Position	Male N(%)	Female N(%)	P value	Age < 26 N(%)	Age ≥ 26 N(%)	P value	Total N(%)
Right Mandibular	76 (48.4)	81(51.6)	0.129	84(53.5)	73(46.5)	0.001*	157*
Left Mandibular	76 (46.1)	89 (53.9)	0.661	86 (52.1)	79 (47.9)	0.009*	165
Right Maxillary	52 (44.1)	66 (55.9)	0.864	66(55.9)	52 (44.1)	0.003*	118
Left Maxillary	59 (43.1)	78 (56.9)	0.603	68 (50.7)	66 (49.3)	0.092	137*

Table 3 Distribution of impacted third molars by angulation.

Angulation	Male N(%)	Female N(%)	Age < 26 N(%)	Age ≥ 26 N(%)	Total N(%)
Right Mandibular third Molar (157); P-value = 0.032*					
Mesioangular	38 (47.5)	42 (52.5)	48 (60.0)	32 (40.0)	80 (51)
Distoangular	1 (9.1)	10 (90.9)	6 (54.5)	5 (45.5)	11(7)
Vertical	25 (54.3)	21 (45.7)	27 (58.7)	19 (41.3)	46(29.3)
Horizontal	12 (60.0)	8 (40.0)	3 (15)	17 (85)	20(12.7)
Left Mandibular third molar (165); P-value = 0.180					
Mesioangular	35 (46.7)	40 (53.3)	45 (60.0)	30 (40.0)	75 *(45.5)
Distoangular	3(21.4)	11 (78.6)	6 (42.9)	8 (57.1)	14(8.5)
Vertical	24 (46.2)	28(53.8)	29 (55.8)	23 (44.2)	52(31.5)
Horizontal	14(58.3)	10 (41.7)	6 (25)	18 (75)	24(14.5)
Right Maxillary Third Molar (118); P-value = 0.284					
Mesioangular	4 (33.3)	8(66.7)	4 (33.3)	8(66.7)	12 (10.2)
Distoangular	15 (34.1)	29 (65.9)	18 (40.9)	26 (59.1)	44 (37.3)
Vertical	32 (52.5)	29 (47.5)	44 (72.1)	17 (27.9)	61 (51.7)
Horizontal	1 (100)	0	0	1 (100)	1(0.8)
Left Maxillary third molar (137); P-value = 0.350					
Mesioangular	8 (38.1)	13 (61.9)	5 (23.8)	16 (76.2)	21(15.3)
Distoangular	18 (36.7)	31 (63.3)	19 (38.8)	30 (61.2)	49(35.8)
Vertical	33 (50)	33(50)	46 (69.7)	20 (30.3)	66(48.2)
Horizontal	0	1(100)	0	1 (100)	1(0.7)

Table 4 Distribution of the impacted third molar by the depth of impaction.

Depth of Impaction	Male N(%)	Female N(%)	< 26 N(%)	≥ 26 N(%)	Total N(%)
Right Mandibular third molar (157); P-value = 0.68					
Soft tissue	26(54.2)	22 (45.8)	23 (47.9)	25 (52.1)	48(30.6)
Mild	26(43.3)	34 (56.7)	35 (58.3)	25 (41.7)	60(38.2)
Moderate	23 (48.9)	24(51.1)	26 (55.3)	21 (44.7)	47(29.9)
Deep	1(50.0)	1 (50.0)	0	2 (100)	2(1.3)
Left Mandibular third Molar (165); P-value = 0.99					
Soft tissue	19 (45.2)	23 (54.8)	25(59.5)	17 (40.5)	42(25.5)
Mild	35(46.1)	41 (53.9)	37 (48.7)	39 (51.3)	76(46)
Moderate	21 (46.7)	24 (53.3)	24 (53.3)	21 (46.7)	45(27.3)
Deep	1(50)	1 (50)	0	2 (100)	2(1.2)
Right Maxillary third molar (118); P-value = 0.004*					
Soft tissue	9 (75)	3 (25)	7 (58.3)	5 (41.7)	12(10.2)
Mild	22 (56.4)	17 (43.6)	22 (56.4)	17 (43.6)	39(33)
Moderate	15 (30.6)	34 (69.4)	32 (65.3)	17 (34.7)	49(41.5)
Deep	6 (33.3)	12 (66.7)	5 (27.8)	13 (72.2)	18(15.3)
Left Maxillary third Molar impaction (137); P-value = 0.008*					
Soft tissue	10 (66.7)	5 (33.3)	9 (60)	6 (40)	15(11)
Mild	19 (52.8)	17 (47.2)	22 (61.1)	14 (38.9)	36(26.3)
Moderate	27 (41.5)	38 (58.5)	35 (53.8)	30 (46.2)	65(47.4)
Deep	3 (14.3)	18 (85.7)	4 (19.0)	17 (81.0)	21(15.3)

Table 5 Distribution of impacted third molar based on clinical symptoms.

Clinical Symptoms	Male N(%)	Female N(%)	Age < 26	Age ≥ 26	Total N(%)
Right Mandibular third molar(157); P-value = 0.065					
Pain	1 (11.1)	8 (88.9)	3 (33.3)	6 (66.7)	9(5.7)
None	75(50.7)	73(49.3)	81 (54.7)	67 (45.3)	148(94.3)
Left Mandibular third molar(165); P-value = 0.005*					
Pain	0	11 (100)	5 (45.5)	6 (54.5)	11(6.7)
None	76(49.4)	78(50.6)	81 (52.6)	73 (47.4)	154(93.3)
Right Maxillary third molar(118); P-value = 0.484					
Pain	1 (20)	4 (80)	1 (20)	4 (80)	5(4.2)
None	51 (45.1)	62 (54.9)	65 (57.5)	48 (42.5)	113(95.8)
Left Maxillary third molar(137); P-value = 0.837					
Pain	1 (50.0)	1 (50.0)	0	2 (100)	2(1.5)
None	58 (43)	77 (57)	70 (51.9)	65 (48.1)	135(98.5)

region. Although the limitation of this study is that the samples were drawn from patients who attended the College of Dentistry clinic for free dental services, it covers the highest percentage of the population who seek dental services in Jazan. We, therefore, consider that our sample is largely representative of the population of Jazan.

The anticipated complications of impacted third molars include development of caries in the impacted tooth or the neighboring second molar, resorption of the root of the second molar tooth, periodontal involvement of the second molar tooth, development of cysts and growth of tumors, and relatively greater morbidity that often occurs with the removal of impacted teeth in older individuals,

However, the challenge in the study was to perform the statistical analysis. Although we spent much time and effort to design the questionnaire for data collection while keeping this difficulty in mind, we expected to face the complexity of having to analyze non-parametric data from the population using four quadrants that were distributed in four different locations, with different orientations and positions (left and right and upper and lower). We, therefore, applied Pearson's Chi-square test to perform the analysis. We also used a parametric analysis with a *t*-test to analyze the differences in the age and sex distribution, which were not statistically significant.

The important findings of the study showed a significantly high prevalence of all impaction characteristics among females, which is supported by several reports. The high frequency of lesions in females was attributed to their higher attendance frequency at hospitals because they are more aware of their appearance and oral health care, but we selected an equal number of men and women. Women inherited small jaws compared to males, which is justified by the type and nature of their diet, as shown in the literature (Yamada and Kimmel, 1991; Ciochon et al., 1997). Maturation of females is usually completed when the third molars just begin to erupt, whereas in males, their jaw bones continue to grow while the third molars are erupting, which creates more space for the third molar eruption (Bishara, 1992).

We then applied a Chi-square test and estimated the difference, which was not statistically significant ($P > 0.05$).

The data presented is expected to increase our understanding of etiology of impaction in the Jazan region and aid in their management and prevention. The discussion requires more input on the etiological factors, and the College or Ministry

of Health can play a role in prevention. Other aspects will discussed in manuscripts 2–5.

For the pattern of impaction angulation, the study showed that vertical impaction is the most frequent (50%) in the maxilla followed by mandibular mesioangular impaction (48%), while horizontal is the least frequent and common in the mandible compared to the maxilla. Mesioangular impaction of both jaws showed a higher prevalence among females, and it was also common in the younger age group including patients who were < 26 years of age. Distoangular impaction was more frequent in the maxilla than in the mandible, which was similar to the findings of Eshghpour et al. (2014) who conducted a cross-sectional study on the pattern of mandibular third molar impaction in northeast of Iran.

Depth of impaction within the soft tissue was found to be higher in the mandible than in the maxilla and deeper in females compared to males, and the depth of the impaction was greater in the maxilla compared to the mandible (Table 4).

The impaction of third molars is an interruption in their eruption because of insufficient space, including factors such as resorption of bone from the anterior border of the ramus, backward gradient of the anterior border of the ramus in relation to the alveolar ridge, forward movement of the dentition growth in length, and direction of the mandible. The space behind the second molar was reported to be reduced in 90% of patients compared to the third mandibular impaction. This result was supported by Ganss et al. (1993) who found that when the retromolar area space in women is 19.9 mm and that in men is 14.3 mm, the possibility of eruption is 70%. If the retromolar spaces is at least 16.5 mm, the possibility of eruption becomes 100%. In our present study we did not measure the retromolar space, but these studies are in agreement with our finding that the prevalence was higher among women than among men.

4. Conclusion

This study can be used for information to guide surgical procedures. The study documented the prevalence, pattern, and clinical features of impacted third molars in the South Western region of Saudi Arabia. Asymptomatic presentation of impacted third molars requires increasing the awareness within the population about the need to diagnose and treat the problem to avoid any further complications. Further studies on the incidence of impaction in the Jazan region are needed because impacted teeth are mostly asymptomatic. However, they may become symptomatic, and treatment for symptomatic teeth is required at a convenient time. A protocol for recommending the type of intervention is required for asymptomatic impaction.

Declaration of Competing Interest

The authors declared that there is no conflict of interest.

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