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Molar impaction patterns and skeletal malocclusions

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ABSTRACT

Objectives: Impacted teeth fail to erupt fully into the oral cavity within the expected time due to interferences with the jaw bone, adjacent tooth, or even the gingivae. The third molar impaction frequency is related to space deficiency in dental arches. This study investigated different patterns of third molar impaction in various skeletal malocclusions in anteroposterior and vertical dimensions.

Materials and Methods: In this study, 362 panoramic and lateral cephalograms of the patients with orthodontic treatment indications were verified and investigated. The malocclusion type was determined and diagnosed using lateral cephalogram tracing.

Results: 39.2% of the patients were male, and 60.8% were female. The mean age of all the patients was 19.2 years; 35.6% of patients exhibited deep bite, and 32% had class II malocclusion. 44.5% of patients had two impacted third molars, and 23.5%, 20.7%, and 11.3% had four, one, and three impacted third molars, respectively. The frequencies of the mesio-angular pattern were 80.8% and 83.5% in the left and right quadrants of the mandible, respectively. The disto-angular pattern frequencies in the left and right quadrants of the maxilla were 91.1% and 93.3%, respectively.

Conclusion: The current study revealed that the highest incidence of third molar impaction was in the deep bite and class II malocclusions. The most common pattern of impaction was mesio-angular and disto-angular in the mandible and maxilla, respectively. Statistical analysis showed no significant relationship between the numbers and patterns of third molar impaction and skeletal malocclusion types.

Keywords: Third molar impaction; Skeletal malocclusion; Hypodontia.

Introduction

Tooth impaction is defined as a condition in which a tooth does not fully erupt during the expected period [1]. Different reasons have been reported for the impaction of a tooth; however, in short, when the path of eruption for a tooth is abnormal, the tooth might interfere with the adjacent teeth during eruption, resulting in the occlusion of its path of eruption and traumas to the adjacent teeth [2,3]. Usually, a deficiency in the available space is the most common reason for tooth impaction; therefore, usually, the teeth that erupt late in the dental arch become impacted. As a result, impaction primarily affects maxillary canines and mandibular premolars. In other words, lower premolars and upper canines should erupt in areas where the adjacent teeth have already erupted and possibly have impinged on the spaces required by the erupting tooth for various reasons. Based on Peterson's opinion, the general principle to manage impacted teeth is that all the impacted teeth should be extracted unless the extraction process is contraindicated [1]. The problems that an impacted tooth might cause, to a great extent, depend on the impaction pattern and the severity of impaction. Bone loss distal to the second molar tooth is the most common lesion during the impaction of the third molar tooth [4]. One of the serious problems possibly associated with impacted teeth is pathological lesions; dentigerous cysts (DC) are among the most common pathological lesions associated with impacted teeth. As mentioned above, one of the main reasons for tooth impaction is the lack of adequate space for tooth eruption.

The high prevalence of mandibular third molar impaction might be explained by space deficiency. Studies have shown that in 90% of cases of third molar impaction, adequate space does not exist in the dental arch for the eruption of this tooth [5]. Therefore, individuals with a larger mesiodistal width of their teeth require more space for tooth eruption, and they will not possibly have adequate space for the eruption of third molars [6]. Another issue that might be related to the impaction or impaction pattern of third molas is the patient's skeletal parameters [7]. On the other hand, some studies have shown that the amount of space in the retromolar area is directly related to the possibility of the third molar impaction [5,8]. The retromolar space depends on the amount of bone loss in the anterior border of the ramus, and the resorption of the anterior border of the ramus is affected by the skeletal growth pattern [8,9]. It can be inferred from these studies that impaction might be attributed to the skeletal growth pattern and the resultant skeletal parameters such as skeletal malocclusion. Previous studies have reported the prevalence of tooth impaction in different communities. Different studies have reported different statistics since tooth impaction is affected by genetic and ethnic factors [10-12]. There is no consensus on the higher prevalence of mandibular or maxillary third molars [13,14]. In addition, although researchers have not reported a significant relationship between skeletal malocclusion and impaction patterns, some research has shown that the growth pattern and its final outcome affect the amount of space in the retromolar area by influencing the extent of bone resorption in the anterior border of the mandibular ramus. This space has been reported differently in different skeletal patterns [15-19]. Therefore, further studies are necessary in this respect. In the present study, 360 patients referring to the Department of Orthodontics, Zahedan Faculty of Dentistry, to clarify the third molar impaction patterns and their relationship with skeletal malocclusion.

Materials and Methods

The protocol of the present descriptive/analytical retrospective study was approved by the local medical ethics committee under the code IR.ZAUMS.REC.1398.451. The panoramic and lateral cephalometric images of 181 patients were evaluated in the vertical dimension, and the same images of another 181 patients were evaluated in the anteroposterior dimension, randomly selected from the archives of orthodontic patients>18 years of age, referring to Zahedan Faculty of Dentistry and private orthodontic clinics in Zahedan in the last two years. The inclusion criteria consisted of no history of orthodontic treatment, no congenital deformities such as cleft palate, the presence of third molars and radiographs, absence of congenital missing of teeth #1 to #7 in both quadrants in both jaws, no pathological osseous lesions, no oral cancers and genetic disorders with jaw signs and good quality of the radiographs. Due to the continuous growth of the ramus and a change in the space required for the eruption of third molars, patients>18 years of age were selected.

A third molar tooth is considered impacted when it does not fully erupt at the expected time interval. The baseline panoramic views were used to determine the presence of the third molar dental follicle in both jaws, based on which the impaction patterns were determined according to the Winter's method [20]. All the lateral cephalometric images were traced to determine skeletal malocclusion in the vertical and anteroposterior dimensions. ANB angles of 1-5°, >5°, and <1° were considered for Cl I, Cl II, and Cl III malocclusions in the anteroposterior dimension [21]. The classifications were confirmed by the Wits criteria. SN-GoMe and gonial angles were evaluated to determine skeletal malocclusion in the vertical dimension. The SN-MP angles of <27°, 27-37°, and >37° were considered for convergence (deep bite), normal, and divergence (open bite) conditions [21]. All the measurements were made by a dental student under the supervision of an orthodontist in a dark room to ensure accuracy and improve precision. All the panoramic and lateral cephalometric images were coded by the supervising professor to mask which image belonged to which patient to prevent observer bias (the dental student). In addition, the observer was blinded to the patients' skeletal patterns. The third molar impaction patterns were determined in terms of gender, the impaction pattern relative to the axial angle of the third molar, the number of impacted third molars, and jaw-skeletal malocclusion patterns. The data were collected in datasheets, and SPSS 26 was used to analyze the frequency distributions of the study variables. One-way ANOVA was used to compare the mean number of impacted teeth in the study groups. Statistical significance was set at P<0.05.

Results

In the present study, 181 cephalograms were evaluated in the anteroposterior dimension, and 181 cephalograms were evaluated in the vertical dimension, adding up to 362 patient cephalograms that were evaluated in terms of the number and pattern of third molar impaction and malocclusion type. The data were recorded for each sample and analyzed with SPSS 26. In the first step, frequency tables of the study variables were prepared. The mean age of the subjects was 19-21 years with a standard deviation of 2.2 years. Of all the studied samples, 220 (60.8%) and 142 (39.2%) were female and male, respectively. In addition, 40 patients (11.0%) and 322 (89.0%) had maxillary and mandibular third molar impaction, respectively, indicating an almost 8-fold higher incidence of impaction in the mandibular than in the maxilla.

Table 1 presents the frequencies of different malocclusions in the anteroposterior and vertical dimensions. In the anteroposterior dimensions, Cl II was the most prevent malocclusion (64.1%), and Cl III and Cl I exhibited relative frequencies of 33% and 3.9%, respectively. In the vertical dimension, 71.3% of the subjects had skeletal deep bite, which was more prevalent than other types of malocclusion. In addition, 23.8% of the subjects had anterior open bite, and 5% had normal bite. Table 2 presents the frequencies of the number of impacted teeth in each patient. Based on the data presented in the Table, 44.5% of the subjects had two impacted third molars, and having two impacted third molars was more prevalent than having 1, 3, and 4 impacted third molars.

Table 3 presents the frequencies of different types of impaction in each quadrant. Of 362 samples evaluated, 266 samples (73.5%) had an impacted molar tooth on the right side of the mandible; 83.6% of these impacted teeth were mesio-angular, 13.2% were horizontal, and only 3.4% were disto-angular. On the left side of the mandible, third molar tooth impaction was more prevalent, and 79.3% of the subjects exhibited an impacted third molar on the left side. Similar to the right side of the mandible, mesio-angular impaction (80.8%) was more prevalent than other types. The relative frequencies of horizontal disto-angular types of impaction were 14.3% and 4.9%, respectively.

Of all the participants, 149 samples (41.2%) had an impacted third molar on the right side of the maxilla, and 158 samples (43.6%) had an impacted third molar on the left side of the maxilla. The most prevalent type of impaction of the third molar on the right side of the maxilla was disto-angular (93.3%), with a relative frequency of 91.1% on the left side of the maxilla. The prevalence of the mesio-angular impaction was much lower than the disto-angular impaction, with relative frequencies of 6.7% and 8.9% on the right and left sides of the maxilla, respectively.

Table 4 presents the results of descriptive analyses and ANOVA concerning the number of impactions in each sample in different malocclusion types in vertical and anteroposterior dimensions and the genders. Although the mean number of impacted third molar teeth was slightly higher in deep-bite subjects, there was no significant relationship between the number of impacted molars and the type of malocclusion in the vertical dimension. In the anteroposterior dimension, although the mean number of impacted third molar teeth was slightly higher in Cl I patients, again, there was no significant relationship between the number of impacted third molars and the type of malocclusion in the anteroposterior dimension. In addition, the results of ANOVA to analyze the relationship between the number of impacted third molars and gender showed no significant relationship between the number of impacted third molars and gender in the subjects in the present study. Crosstab analysis and chi-squared test were used to evaluate the relationship between the third molar impaction pattern and the type of malocclusion. The results of statistical analyses are presented in Tables 5 and 6 based on this test for each quadrant in the vertical and anteroposterior dimensions. The results showed no significant relationship between the impaction pattern and the type of malocclusion in any of the quadrants at P<0.05 level of significance (P>0.05).

Table 1. The frequencies of different types of malocclusion in the anteroposterior and vertical dimensions.

	Malocclusion	Frequency	Percentage
Anteroposterior	Cl I	7	3.9
	Cl II	166	64.1
	Cl III	58	32.0
	Total	181	100.0
Vertical	Deep bite	129	71.2
	Open bite	43	23.8
	Normal	9	5.0
	Total	181	100.0

Table 2. The frequencies of the number of impacted third molars.

The number of impacted teeth	Frequency	Percentage
1	75	20.7
2	161	44.5
3	41	11.3
4	85	23.5
Total	362	100.0

Table 3. The frequencies of different types of impaction in each quadrant.

Third molar	Type of impaction	Frequency	Percentage	Total	Third molar	Type of impaction	Frequency	Percentage	Total
Mandibular, right	Mesio-angular	222	61.3	83.5	Mandibular, left	Mesio-angular	232	64.1	80.8
	Disto-angular	9	2.5	3.3		Disto-angular	14	3.9	4.9
	Horizontal	36	9.7	13.2		Horizontal	41	11.3	14.3
	Total	266	73.5	100.0		Total	287	79.3	100.0
Maxillary, right	Mesio-angular	10	2.8	6.7	Maxillary, left	Mesio-angular	14	3.9	8.9
	Disto-angular	139	38.4	93.3		Disto-angular141584	144	39.8	91.1
	Total	149	41.2	100.0		Total	158	43.6	100.0

Table 4. The relationship between the number of impacted third molars and gender and malocclusion in the antero-posterior and vertical dimensions.

	Number	Mean	SD	Standard error	95% confidence interval for mean		p-value
					Upper bound	Lower bound	
Deep bite	128	2.46	1.064	.094	2.65	2.27	.180
Open bite	43	2.14	1.104	.168	2.48	1.80	
Normal	9	2.11	0925	.309	2.82	1.40	
Total	180	2.37	1.072	.080	2.52	2.21	
Cl I	7	2.86	1.215	.459	1.73	3.98	.446
Cl II	116	2.34	1.031	.096	2.16	2.53	
Cl III	58	2.41	1.077	.141	2.13	2.70	
Total	181	2.39	1.051	.078	2.23	2.54	
Male	141	2.30	1.061	.089	2.12	2.47	.259
Female	220	2.43	1.060	.071	2.29	2.57	
Total	361	2.38	1.060	.056	2.27	2.49	

Table 5. The relationship between the third molar impaction pattern and the type of malocclusion in the vertical dimension.

Malocclusion	Quadrant	Group	Type			P-value
			Mesio-angular	Disto-angular	Horizontal	
Vertical	Mandibular, right	deep bite	76	4	12	.284
		open bite	29	0	7	
		normal	4	1	1	
	Mandibular, left	deep bite	75	9	17	.228
		open bite	27	0	7	
		normal	3	1	0	
	Maxillary, right	deep bite	5	57		.524
		open bite	0	10		
		normal	0	5		
	Maxillary, left	deep bite	4	58		.271
		open bite	2	10		
		normal	1	3		

Table 6. The relationship between the third molar impaction pattern and the type of malocclusion in the anteroposterior dimension.

Malocclusion	*Quadrant*	*Group*	*Type*			*P-value*
			Mesio-angular	*Disto-angular*	*Horizontal*	
Anteroposterior	*Mandibular, right*	*Cl I*	*5*	*0*	*1*	*.396*
		Cl II	*73*	*4*	*12*	
		Cl III	*35*	*0*	*2*	
	Mandibular, left	*Cl I*	*7*	*0*	*0*	*.660*
		Cl II	*77*	*3*	*13*	
		Cl III	*43*	*1*	*4*	
	Maxillary, right	*Cl I*	*0*	*4*		*.181*
		Cl II	*5*	*39*		
		Cl III	*0*	*24*		
	Maxillary, left	*Cl I*	*0*	*3*		*.537*
		Cl II	*3*	*43*		
		Cl III	*4*	*27*		

Discussion

The present study was undertaken to determine the pattern of third molar impaction in orthodontic patients with different types of skeletal malocclusion. To this end, 362 samples were evaluated. The patients' lateral cephalograms were used to evaluate skeletal malocclusion in the anteroposterior dimension, and panoramic radiographs were used to evaluate the presence of impacted third molars and determine the impaction pattern. The males and females comprised 39.2% and 60.8% of the subjects in this study, respectively. Evaluation of the frequency distribution of the variables showed a higher prevalence of impaction in the mandible than the maxilla, with frequencies of 89% and 11% in the mandible and maxilla, respectively. Therefore, based on the observations in the present study, the prevalence of impaction in the mandible was eight folds that in the maxilla.

In a study by Hashemipour et al (2013) in Kerman, the prevalence of impaction in the mandible was 1.9 times higher than that in the maxilla [13], which is much lower than the present study. Such a discrepancy in the results might be attributed to the differences in the communities evaluated. In the study above, the subjects were those referring to the radiology department, and the study was carried out using panoramic images, while in the present study, the study population consisted of patients referring to the department of orthodontics. The present study used lateral cephalograms and panoramic images. Several studies have evaluated the reasons for a higher rate of tooth impaction in the mandible. Some studies have attributed the higher prevalence of third molar impaction to the lack of sufficient space for the eruption of this tooth [5,6,22,23], and some others have attempted to attribute this space deficiency to skeletal growth [7-9,24]. The mandibular third molar tooth is inclined mesially during its formation and development, and if it cannot rotate due to space deficiency, tissue barrier, etc., it will remain impacted. In the present study, in mandibular impactions and in both quadrants, the mesio-angular pattern was more prevalent than other impaction patterns; more precisely speaking, 61.3% and 64.1% of the studied patients exhibited mesio-angular impaction in the right and left quadrants of the mandible. In the study by Hashemipour et al, 48.3% of mandibular impactions were of the mesio-angular type [13]. In a study by Ryalat et al, 66.1% of impactions were mesio-angular [25]. In addition, in a study by Eshghpour et asl, 48.6% of mandibular impactions were of the mesio-angular type [26]. In other studies, researchers have reported almost similar results [3,19,21]. In a study by Kumar et al (2014) in India, 1100 panoramic radiographs were evaluated, it was concluded that the vertical impaction pattern in the mandibular third molars was more common than other impaction patterns, and the mesio-angular pattern ranked the second for that tooth [27]. Contrary to the mandible, the third molar tooth does not have a mesial inclination in the maxilla. Therefore, it does not need to rotate toward the vertical angle; thus, it is predictable that the vertical impaction pattern is more prevalent than other impaction patterns, and the mesio-angular impaction pattern is less prevalent in the maxilla [13,19,28]. In the present study, the mesio-angular and disto-angular patterns were considered, and the vertical pattern was not considered because due to the mean young age of the subjects (19.21 years) in the present study, the vertical angulation of an unerupted third molar tooth in the maxilla does not necessarily mean impaction. The observations in the present study showed that in the third molar tooth of the maxilla, the disto-angular pattern in both the left (39.8%) and right (38.4%) quadrants of the maxilla was more prevalent than the mesio-angular pattern. In the present study, in none of the samples, transverse and reverse impaction patterns of Winter's classification were observed. In the present study, the most prevalent malocclusion in the vertical dimension was deep bite (35.6% of all the samples and 71.3% of malocclusions in the vertical dimension), followed by Cl II (32% of all the subjects and 64% in the anteroposterior dimension).

In the present study, since the prevalence of impaction in the mandible was eight times higher than that in the maxilla, the higher prevalence of third molar impaction in Cl II and deep bite cases might be attributed to space deficiency in the mandible [5,6,22,24]. According to a study by Behbahani et al, the horizontal rotation of the mandible might be related to increased odds of the impaction of the mandibular third molar tooth [9]. Therefore, by considering the possibility of the horizontal rotation of the mandible in deep bite, such rotation might be considered another factor for the higher prevalence of impaction in deep bite patients. In a study by Jain et al (2019) to evaluate the prevalence of third molar impaction in anteroposterior malocclusions [19], the most common malocclusion was Cl II (60.65%). The observations made by Kumar et al in studying the mandibular tooth impactions showed that the most prevalent malocclusion was Cl I [14]. In that study, only anteroposterior malocclusions were considered, and the study was confined to the mandibular third molar impactions. Concerning the frequencies of third molar impactions in the present study, 44.5% of the participants had two impacted third molars, 23.5% had four impacted third markers, 20.8% had one impacted third molar, and 11.4% had three impacted third molars. Therefore, having two impacted third molar teeth was more prevalent than others. A study by Al-Anqudi et al (2014) showed that 41% of the subjects had two impacted teeth, and having two impacted third molar teeth was the most prevent condition [29]. In the study above, contrary to the present study, having an impacted third molar tooth ranked second, followed by having three and four impacted third molars. The subjects in that study were those referring to dental clinics and not necessarily those referring to orthodontic clinics, which might explain the differences between the results in that study and the present study, i.e., differences in the study populations. The statistical analyses in the present study showed no significant relationship between the number of impacted third molar teeth and their impaction patterns on the one hand and the different types of malocclusion on the other hand. In the study by Jain et al, too, there was no significant relationship between the impaction pattern and different malocclusion types in the anteroposterior dimension [19].

In the study by Breilk et al (2008), the relationship between the facial skeletal patterns and the odds of third molar impaction was evaluated, and it was observed that in the brachiocephalic form, compared to the dolichocephalic form, the odds of third molar impaction were lower due to the more space available for tooth eruption [30], which was confirmed by a study by Tassoker et al (2019) [31]. Several studies have reported that space deficiency is the reason for third molar impaction [5-9, 22-24]. The reason for the lack of a significant relationship between the number and pattern of third molar impaction and the type of malocclusion might be that in skeletal malocclusions, the discrepancy and lack of proportionality are evident between the jaws, and space deficiency in one jaw and the subsequent increase in the odds of third molar impaction in that jaw might be accompanied by an increased space in the other jaw.

Conclusion

In the present study, the prevalence of impaction in the mandible was eight times that of the maxilla. The most prevalent pattern for third molar impaction in both quadrants in the mandible was mesio-angular, and the horizontal pattern in the mandible was more prevalent than the disto-angular pattern. The most prevalent pattern of third molar impaction in both quadrants in the maxilla was disto-angular. In vertical malocclusions, the prevalence of third molar impaction in deep bite cases was higher than the open bite cases. In anteroposterior malocclusions, the prevalence of third molar impaction was higher in Cl II cases, followed by Cl III and Cl I cases, respectively. Concerning the number of impacted third molars, having two impacted third molars was more prevalent, followed by four, one, and three molars in descending order. The statistical analyses of data showed that the number of impacted third molars and their impaction patterns were not significantly related to the type of malocclusion in the anteroposterior and vertical dimensions.

Conflict of Interest

There is no conflict of interest to declare.

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