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Original article

Analysis of mandibular third molar impaction classification with different skeletal malocclusions

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ABSTRACT

Background: *Since the third molar teeth are the last to erupt in the oral cavity, they can become more impacted than other teeth. Insufficient retromolar space and the eruption direction of the third molars can affect this situation. The condition, distribution, and prevalence of impacted third molars in skeletal Class I, II, and III anomalies are important in treatment predictability.* ***Purpose:*** *The aim of this study is to classify impacted lower third molars in patients with different skeletal malocclusions.* ***Methods:*** *This retrospective study examined panoramic X-ray records of patients treated at Inonu University Faculty of Dentistry, Department of Orthodontics, between 2014 and 2021. In total, 1219 mandibular third molar teeth were considered. Impacted mandibular third molar teeth of individuals with different skeletal structures were grouped according to the Pell and Gregory, Winter, and Archer classifications.* ***Results:*** *In this study, 37.74% of the participants were male, and 62.26% were female; 40.94% of examined teeth were skeletal Class I, 41.84% were Class II, and 17.23% were Class III. It was determined that 91.63% of all examined teeth were impacted, and 8.37% had erupted. According to the Pell and Gregory classification, 21.41% of teeth were Grade (I), 38.06% were Grade (II), and 40.53% were Grade (III). According to the Winter classification, 3.12% of examined teeth were buccal, 6.89% were horizontal, 23.71% were mesioangular, and 66.28% were vertical. According to the Archer classification, 14.44% of examined teeth were in position A, 30.02% were in position B, and 55.54% were in position C. No statistically significant relationship was established between grades and gender ($p>0.05$).* ***Conclusion:*** *A relationship was ascertained between the impacted positions of mandibular third molars in different skeletal structures.*

Keywords: *Archer; mandible third molar; malocclusion; medicine; Pell and Gregory; Winter*
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INTRODUCTION

An impacted tooth is defined as the complete or partial absence of a tooth's eruption long after the average eruption age. Tooth impaction is caused by many factors divided into local and systemic factors. An impacted tooth can be caused by a lack of space or eruptive force as well as the presence of a physical barrier such as mucosa or a supernumerary tooth. Teeth that cannot fully erupt within the expected period for a tooth are called impacted teeth. This may occur for different reasons. Insufficient space for the tooth to erupt or mucous-related reasons are some examples.[1] Impaction of third molars is the most common, and mandibular third molars are impacted more often than maxillary third molars.[2] Because the third molar is the last tooth to erupt, it can be impacted due to many factors, including facial growth retardation, insufficient mandibular growth, distal eruption of other teeth, reverse growth direction, insufficient retromolar distance, and premature loss of mandibular second molars.[3,4] Impacted teeth can cause pain, pericoronitis, caries, and root resorption in adjacent teeth as well as periodontal disease and cyst and tumor formation. The condition of impacted teeth in the jaw can be the harbinger of many complications.[5]

It can be challenging to treat impacted teeth due to their anatomical positions, condition and shape anomalies, and canal variations. In order to minimize the

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complications that may occur during the surgical extraction of impacted teeth, it is essential to perform the necessary radiological examinations before the operation, take a comprehensive anamnesis, and perform a clinical examination. Various classification methods are applied to determine impacted teeth positions depending on different criteria.[6]

The Pell and Gregory classification is one of the most commonly used methods for grading teeth impaction. In this method, the mesiodistal dimension of the impacted mandibular third molar teeth and the distance between the anterior edge of the ramus and the mandibular second molar teeth are evaluated and form the basis of the classification.[7] Another classification method, developed by Winter, is based on the long axes of mandibular third molars. In the Winter classification, impacted wisdom teeth are classified as vertical, mesioangular, horizontal, buccal and distoangular, based on the angle between the impacted third and second molars.[8] The Archer classification grades wisdom teeth according to the relationship of the second molars with the crown, collar, and root region or the depth of the tooth in the bone.[9] Panoramic radiography is most commonly used to evaluate the positions and pathological conditions of impacted teeth in classifications. Despite some limitations, many researchers consider panoramic radiography the most suitable visualization method for evaluating impacted teeth.[10,11]

Impaction of third molars has been established to be associated with some dental and skeletal features that are controversial and differ among various populations.[12] Inadequate retromolar space has been determined to be an important etiological factor for mandibular third molar impaction[13] and results from insufficient mandibular growth.[12] The frequency of the impaction of the third molars after the extraction of the second molars is low. This situation is thought to facilitate decreased frequency of impacted third molars in the lower and upper jaw due to premolar tooth extraction in case space is needed for orthodontic treatment.[14] In light of these studies, the lower-maxillary third molar's impaction is related to the second molar's distance from the ramus. For this reason, studies have been conducted on the relationship between impacted mandibular third molar teeth and face type. It has been demonstrated that there is a significant difference between mandibular third molar impaction based on facial growth pattern; however, some studies discovered no significant difference between the mandibular third molar position based on different skeletal face types.[15] Therefore, further studies are needed to evaluate the impaction status of impacted mandibular teeth. Not many studies have been conducted on the effect of skeletal Class I, II, and III malocclusions on the impaction status of mandibular third molars. Thus, the aim of this study is to detect impacted lower third molars on panoramic X-rays in patients with skeletal Class I, II, and III malocclusions and classify them according to the Pell and Gregory, Winter, and Archer classifications.

MATERIALS AND METHODS

Approval for this study was obtained from the Scientific Research and Publication Ethics Committee of Inonu University (ethics committee decision no. 2022/3576, dated 26/07/2022). The study was conducted at Inonu University Faculty of Dentistry.

In our study, 1219 mandibular teeth were examined by analyzing the panoramic x-ray records of patients treated at Inonu University Faculty of Dentistry, Department of Orthodontics, between 2014 and 2021. Panoramic X-rays were generated by Planmeca proline XC (2009.60–80 kVp, 4–12 mA, 18 sec exposure time, Helsinki, Finland). While examining the X-rays, it was ascertained that there was at least one impacted or erupted tooth, as well as a mandibular third molar tooth.

The inclusion criteria comprised: an ANB angle between 0° and 4° for skeletal class 1, an ANB angle greater than 4° for skeletal class 2, over 15 years of age, no history of maxillofacial trauma, no syndromic disorder, no impacted or missing teeth other than third molars, and no history of orthodontic treatment. Patients with an ANB less than 0° for skeletal class III were included. Patients under the age of 15, or those with missing and impacted teeth other than the third molar, and a history of orthodontic treatment and trauma were not included in the study.

During the examination of panoramic X-rays, it was determined whether teeth 38 and 48 were impacted. The remaining impacted teeth were grouped according to the Pell and Gregory, Winter, and Archer classifications. According to the Winter classification, vertical impaction 80° to 100°, mesioangular impaction 10° to 80°, horizontal impaction 350° to 10°, distoangular impaction greater 100° and bucco-lingual impaction.

The group classified as "other" included mesio-invert, disto-invert, and disto-horizontal impacted teeth. The depth of impacted lower third molars relative to the occlusal plane was evaluated according to the Pell and Gregory classification as follows: Grade (I) (completely erupted), Grade (II) (partially erupted in the bone; the enamel-cementum junction is under the bone), Grade (III) (teeth completely below the bone level).

The Archer classification is based on the relationship of wisdom teeth and adjacent second molars with the crown, collar, and root region or the depth of the tooth in the bone. Position A denotes that the occlusal surface of the lower wisdom tooth is at the same level or higher than the other teeth. Position B signifies that the occlusal aspect of the lower wisdom tooth is above the level of the collar of the second molar but below the level of the occlusal. Position C indicates that the lower wisdom tooth's occlusal surface is below the second molars' level.

All records were carefully examined by the same professionals (two orthodontists and a surgeon). The data were evaluated using the IBM SPSS V 21 package program. Shapiro–Wilk and/or Kolmogorov–Smirnov

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tests were employed after the normality test. A p-value of p<0.05, indicating the level of significance in the results, was accepted.

RESULTS

In this study, 37.74% of the participants were male, and 62.26% were female; 40.94% were Class I, 41.84% were Class II, and 17.23% were Class III. It was determined that 91.63% of all investigated teeth were impacted, and 8.37% had erupted. According to the Pell and Gregory classification, 21.41% were Grade (I), 38.06% were Grade (II), and 40.53% were Grade (III). According to the Winter classification, 3.12% were buccal, 6.89% were horizontal, 23.71% were mesioangular, and 66.28% were vertical. According to the Archer classification, 14.44% were in position A, 30.02% were in position B, and 55.54% were in position C (Table 1). Data in Figure 1 shows no statistically significant relationship between classes and gender (p>0.05).

There was a statistically significant relationship between classes and buried status (p<0.05): 92.79% of Class I, 96.47% of Class II, and 77.14% of Class III teeth were buried; 7.21% of Class I, 3.53% of Class II, and 22.86% of Class III cases persisted.

A statistically significant correlation was observed between grades and Pell and Gregory status (p<0.05). The Pell and Gregory status of 38.28% of those with Class I, 47.25% with Class II, and 29.52% with Class III was Grade

Table 1. Chi-Square test result of the relationship between classes and parameters

Parameter		Class								Chi-Square Test	
		Class I		Class II		Class III		Total			
		n	%	n	%	n	%	n	%	Chi-Square	p
Gender	Male	185	37.07	184	36.08	91	43.33	460	37.74	3.49	0.175
	Female	314	62.93	326	63.92	119	56.67	759	62.26		
	Total	499	100	510	100	210	100	1219	100		
Impacted Status	Impact	463	92.79	492	96.47	162	77.14	1117	91.63	73.937	0.001
	Erupt	36	7.21	18	3.53	48	22.86	102	8.37		
	Total	499	100	510	100	210	100	1219	100		
Pell and Gregory	I	110	22.04	79	15.49	72	34.29	261	21.41	37.919	0.001
	II	198	39.68	190	37.25	76	36.19	464	38.06		
	III	191	38.28	241	47.25	62	29.52	494	40.53		
	Total	499	100	510	100	210	100	1219	100		
Winter	Buccal	15	3.01	11	2.16	12	5.71	38	3.12	22.998	0.001
	Horizontal	37	7.41	38	7.45	9	4.29	84	6.89		
	Mesioangular	116	23.25	142	27.84	31	14.76	289	23.71		
	Vertical	331	66.33	319	62.55	158	75.24	808	66.28		
	Total	499	100	510	100	210	100	1219	100		
Archer	A	63	12.63	43	8.43	70	33.33	176	14.44	78.542	0.001
	B	162	32.46	155	30.39	49	23.33	366	30.02		
	C	274	54.91	312	61.18	91	43.33	677	55.54		
	Total	499	100	510	100	210	100	1219	100		

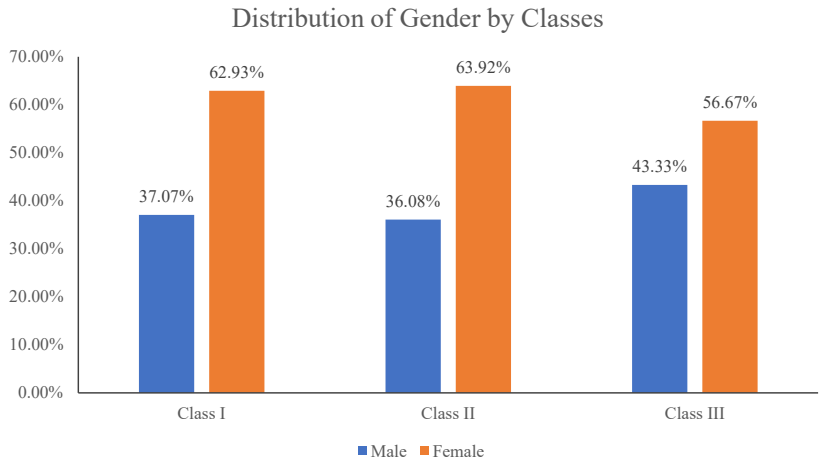

Figure 1. Gender distribution by classes.

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(III), and that of 22.04% of Class I, 15.49% of Class II, and 34.29% of Class III patients was Grade (I).

There was a statistically significant relationship between classes and Winter status (p<0.05): 66.33% of Class I, 62.55% of Class II, and 75.24% of Class III were vertical; 3.01% of Class I, 2.16% of Class II, and 5.71% of Class III were buccal.

A statistically significant relationship was observed between classes and Archer status (p<0.05). The Archer status of 54.91% of Class I, 61.18% of Class II, and 43.33% of Class III patients was position C. In comparison, the Archer status of 12.63% of Class I, 8.43% of Class II, and 33.33% of Class III patients was position A.

There was a statistically significant relationship between Winter status and burial in Class I (p<0.05). According to Winter status, in Class I, 100% of buccal, 100% of horizontal, 98.28% of mesioangular, and 89.73% of vertical teeth were buried, while 1.72% of mesioangular and 10.27% of vertical ones persisted.

A statistically significant relationship was observed between Winter status and burial in Class II (p<0.05). According to Winter status, in Class II, 100% of buccal,

Table 2. Chi-Square test results for the relationship between Winter status and impact status by grades

Parameter		Winter										Chi-Square Test	
		Buccal		Horizontal		Mesioangular		Vertical		Total			
		n	%	n	%	n	%	n	%	n	%	Chi-Square	p
Class I	Impact	15	100	37	100	114	98.28	297	89.73	463	92.79	13.889	0.003
	Erupt	0	0	0	0	2	1.72	34	10.27	36	7.21		
	Total	15	100	37	100	116	100	331	100	499	100		
Class II	Impact	11	100	38	100	142	100	301	94.36	492	96.47	11.172	0.011
	Erupt	0	0	0	0	0	0	18	5.64	18	3.53		
	Total	11	100	38	100	142	100	319	100	510	100		
Class III	Impact	11	91.67	9	100	29	93.55	113	71.52	162	77.14	11.668	0.009
	Erupt	1	8.33	0	0	2	6.45	45	28.48	48	22.86		
	Total	12	100	9	100	31	100	158	100	210	100		

Table 3. Chi-Square test results for the relationship between Pell and Gregory status and impact status by grades

Parameter		Pell and Gregory								Chi-Square Test	
		I		II		III		Total			
		n	%	n	%	n	%	n	%	Chi-Square	p
Class I	Impact	77	70	195	98.48	191	100	463	92.79	109.775	0.001
	Erupt	33	30	3	1.52	0	0	36	7.21		
	Total	110	100	198	100	191	100	499	100		
Class II	Impact	63	79.75	188	98.95	241	100	492	96.47	77.133	0.001
	Erupt	16	20.25	2	1.05	0	0	18	3.53		
	Total	79	100	190	100	241	100	510	100		
Class III	Impact	24	33.33	76	100	62	100	162	77.14	119.259	0.001
	Erupt	48	66.67	0	0	0	0	48	22.86		
	Total	72	100	76	100	62	100	210	100		

Table 4. Chi-Square test results of the relationship between the Archer status and impact status according to classes

Parameter		Archer								Chi-Square Test	
		A		B		C		Total			
		n	%	n	%	n	%	n	%	Chi-Square	p
Class I	Impact	29	46.03	161	99.38	273	99.64	463	92.79	235.464	0.001
	Erupt	34	53.97	1	0.62	1	0.36	36	7.21		
	Total	63	100	162	100	274	100	499	100		
Class II	Impact	26	60.47	154	99.35	312	100	492	96.47	178.924	0.001
	Erupt	17	39.53	1	0.65	0	0	18	3.53		
	Total	43	100	155	100	312	100	510	100		
Class III	Impact	23	32.86	49	100	90	98.9	162	77.14	116.81	0.001
	Erupt	47	67.14	0	0	1	1.1	48	22.86		
	Total	70	100	49	100	91	100	210	100		

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100% of horizontal, 100% of mesioangular, and 94.36% of vertical teeth were buried, and 5.64% of the vertical ones in Class II persisted.

There was a statistically significant relationship between Winter status and burial in Class III ($p<0.05$). In Class III, according to Winter status, 91.67% of buccal, 100% of horizontal, 93.55% of mesioangular, and 71.52% of vertical teeth were buried, and 8.33% of buccal, 6.45% of mesioangular, and 28.48% of vertical teeth persisted (Table 2).

A statistically significant correlation was observed between Pell and Gregory status and buriedness in Class I ($p<0.05$). In Class I, according to the Pell and Gregory classification, 70% of Grade (I), 98.48% of Grade (II), and 100% of Grade (III) teeth were impacted, and 30% of Grade (I) and 1.52% of Grade (II) teeth persisted.

A statistically significant relationship was observed between Pell and Gregory status and buriedness in Class II ($p<0.05$). In Class II, according to the Pell and Gregory classification, 79.75% of Grade (I), 98.95% of Grade (II,) and 100% of Grade (III) teeth were buried, and 20.25% of Grade (I) and 1.05% of Grade (II) teeth persisted.

A statistically significant relationship was established between Pell and Gregory status and buriedness in Class III ($p<0.05$). In Class III, according to the Pell and Gregory classification, 33.33% of Grade (I), 100% of Grade (II), and 100% of Grade (III) teeth were impacted, and 66.67% of Grade (I) teeth persisted (Table 3).

A statistically significant relationship was observed between the Archer status and burial in Class I ($p<0.05$). In Class I, according to the Archer classification, 46.03% of those with position A, 99.38% of those with position B, and 99.64% of those with position C teeth were impacted; 53.97% of those with position A, 0.62% of those with position B, and 0.36% of those with position C teeth had erupted.

There was a statistically significant relationship between Archer status and burial in Class II ($p<0.05$). According to the Archer classification, in Class II, 60.47% of those with position A, 99.35% of those with position B, and 100% of those with position C teeth were impacted; 39.53% of those in position A and 0.65% of those in position B erupted.

There was a statistically significant relationship between the Archer status and burial in Class III ($p<0.05$). In Class III, according to the Archer classification, 32.86% of those with position A, 100% of those with position B, and 98.9% of those with position C teeth were impacted; 67.14% of those with position A and 1.1% of those with position C teeth had erupted (Table 4).

DISCUSSION

The prognosis of third molars is an important issue for orthodontists to ensure successful orthodontic treatment, and the presence or absence of third molars is particularly significant when the distalization for first or second molars is required.[12,16] Types and proportions of impacted teeth may differ based on racial and geographic factors; consequently, studies similar to ours have been conducted in various regions of the world at different times.[6]

After considering panoramic images showing the skeletal condition of 1219 patients, the age factor was evaluated according to demographic characteristics such as gender; impacted mandibular third molar teeth were classified according to their positions; and the results were compared with the literature. Although many intraoral and extraoral methods exist to evaluate impacted mandibular wisdom teeth radiologically, panoramic radiographs are most commonly used because they are accessible and inexpensive.[17] Therefore, we also used panoramic radiographs in our study.

Examination of impacted mandibular third molars established that these were more common in women than men, as reported by most studies. Researchers have explained that this may be due to the smaller jaw structure of women.[18] In our study, we obtained results similar to the existing literature in each group that we separated skeletally. Despite these results, some studies have reported no difference between the sexes regarding impacted teeth.[18,19]

In our study, analysis of impacted mandibular teeth according to the Winter classification established that 3.12% were buccal, 6.89% were horizontal, 23.71% were mesioangular, and 66.28% were vertical. In addition, when evaluated skeletally, 66.33% of Class I, 62.55% of Class II, and 75.24% of Class III teeth were vertical, while 3.01% of Class I, 2.16% of Class II, and 5.71% of Class III teeth were buccal.

In the study conducted by Göksu et al.,[6] according to the Winter classification, it was reported that the most common (49.71% in female patients) angular shape was vertical, and the least reported impaction position was distoangular (5.93%).[20] In the studies of Al-Dajani et al.[19] and Yilmaz et al.,[20] vertical impaction was found to be the most common position. In addition, the study of Passi et al. [7] reported that 49% of the impacted mandibular third molars examined were in the mesioangular position and 24% in the vertical position, and the rate of impaction in the distoangular position was 4%. Shokri et al.[14] reported that the highest impacted mandibular third molar tooth position was mesioangular, with a rate of 59%. Although some studies considered in the literature review are compatible with the present research, others are not. Dimensional differences in jaw-tooth development may be due to various factors such as ethnicity, diet, and genetics. Structural differences in studies may differ according to the characteristics of the region. We think these parameters are the reason for the differences in our study.

In this study, examination of impacted mandibular teeth according to the Pell and Gregory classification highlighted that 21.41% were Grade (I), 38.06% were Grade (II), and 40.53% were Grade (III). The skeletal evaluation revealed that the Pell and Gregory status of 38.28% of Class I,

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47.25% of Class II, and 29.52% of Class III impacted teeth was Grade (III). The Pell and Gregory status of 22.04% of Class I, 15.49% of Class II, and 34.29% of Class III patients was Grade (I).

In their study, Passi et al.[7] reported that impacted lower wisdom teeth were often in Grade (II) and Grade (III) positions. Jaroń et al.,[21] on the other hand, reported that 75% of impacted lower wisdom teeth were Grade (II), 18% Grade (I), and 7% Grade (III). The results of our study and the data using this classification are compatible with the literature. In our research, we believe that impacted mandibular teeth may occur due to lack of space.

Our investigation of impacted mandibular teeth according to the Archer classification revealed that 14.44% were in position A, 30.02% in position B, and 55.54% in position C. Skeletal evaluation illustrated that the Archer status of 54.91% of Class I, 61.18% of Class II, and 43.33% of Class III patients was position C, while that of 12.63% of Class I, 8.43% of Class II, and 33.33% of Class III patients was position A.

Passi et al.[7] reported that 64 % of the related teeth were in position B, 24 % in position A, and 11% in position C. Hashemipour et al.[3] reported position A as the predominant impaction level. The data we obtained in our study are among these different results in the literature.

Our current study found the most impacted mandibular teeth in the Class II group, followed by Class I and Class III. A study by Abu Alhaija et al.[22] found that, although Class III groups had a larger mandible than Class I and Class II groups, they also recorded more impacted third molars. We can explain the higher incidence of impactions in the Class II group compared to other classes by the relationship between a shorter mandible and skeletal Class II tooth base.

Tassoker et al.'s study,[13] which sought to determine whether skeletal facial growth patterns are associated with impacted third molars, reported that mandibular third molar impaction was 1.5 times more common in dolicofacials than brachyfacials. The authors explained this situation by the larger growth potential in the brachyfacial growth pattern, allowing more remodeling resorption of the anterior edge of the ramus. In addition, the mandibular length is short in individuals with a dolicofacial growth pattern, so the impaction rate of third molars is high.[13] A long, ascending ramus and short mandibular length indicate mandibular third molar impingement. The growth patterns of individuals should also be considered when examining the burial status in different skeletal classifications.

Using various methods to evaluate impacted mandibular third molars according to skeletal classification will facilitate surgical and orthodontic planning. In conclusion, a proportional relationship was found between the impacted positions of the mandibular third molar teeth of patients with different skeletal structures. However, further prospective studies are required with other parameters besides skeletal classification.

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