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Investigation of the Relationship Between Mandibular Gonial Angle and Impacted Mandibular Third Molar

Yiğit Ali ÖZKUBAT[1] Nesrin SARUHAN KÖSE[2] Yasin Çağlar KOŞAR[3] Görkem TEKİN[4*] Ömür DERECİ[5]

[1] Private Practice, Oral and Maxillofacial Surgeon, İzmir, Türkiye, yigitaliozkubat@gmail.com
[2] Assoc. Prof. Eskişehir Osmangazi University, Faculty of Dentistry, Eskişehir, Türkiye, dt_nesrin@yahoo.com
[3] Assist. Prof. Eskişehir Osmangazi University, Faculty of Dentistry, Eskişehir, Türkiye, ycaglarkosar@hotmail.com
[4] Assist. Prof.. Eskişehir Osmangazi University, Faculty of Dentistry, Eskişehir, Türkiye, dt.gorkemtekin@gmail.com
[5] Prof, Eskişehir Osmangazi University, Faculty of Dentistry, Eskişehir, Türkiye, omurdereci@hotmail.com

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ABSTRACT

Aim: The aim of this study is to investigate changes in the gonial angles of impacted lower third molars and associated parameters in individuals with impacted lower third molars aged twenty years and below.
Material and Methods: A retrospective study included 963 patients with impacted third molars. Impaction classification was done according to Pell-Gregory criteria. The teeth were divided into eight main groups based on their relationship with the ramus and second molar (1, 2, 3) and the depth within the bone (A, B, C). Teeth classified as erupted in 1A were excluded from the study. Gonial angle, mesiodistal distance (MDM), retromolar eruption distance (RED), retromolar eruption ratio (RER), A° (angle between the Gonion-symphysis plane and the long axis of the third molar), and B° (angle between the Gonion-symphysis plane and the long axis of the second molar) were evaluated. Panoramic radiographs were analyzed using specialized software to measure angles and distances. The angles and measurements were compared among impacted groups and genders. Statistical analyses including Pearson correlation and ANOVA tests were used to assess relationships between measurements and impact parameters. A significance level of $p<0.05$ was considered statistically significant.
Results: In females, the A□ was found to be significantly larger than in males ($p<0.05$). In males, however, RSM and RSO were found to be significantly larger than in females ($p<0.05$). There was no significant variation in gonial angle among the impaction groups. A angle was the narrowest in group 3/B and the largest in group 2/A.
Conclusion: While gonial angle are not a definitive indicator of impacted third molars, the study emphasizes the importance of A° and RED in predicting impaction.

Mandibular Gonial Açı ile Gömülü Mandibular Üçüncü Molar Arasındaki İlişkinin Araştırılması

Makale Bilgisi

Makale Geçmişi

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Sınıflama,
Üçüncü molar.

ÖZET

Amaç: Bu çalışmanın amacı, alt yirmi yaş dişlerine sahip bireylerde gömülülük gösteren dişlerin gonial açıları ve bu durumla ilişkili parametrelerdeki değişiklikleri araştırmaktır.
Gereç ve Yöntemler: Retrospektif olarak yapılan araştırmada gömülü üçüncü molar dişleri olan 963 hasta çalışmaya dahil edildi. Gömülülük sınıflaması Pell-Gregory kriterlerine göre yapıldı. Dişin ramus ve 2. molar ile olan ilişkisine göre (1, 2, 3) ve dişin kemik içerisindeki derinliğine (A, B, C) göre sekiz ana gruba ayrılmıştır.1A sınıflamasındaki dişler sürmüş kabul edilerek çalışma dışı bırakılmıştır. Gonial açı, meziodistal mesafe (MDM), retromolar sürme mesafesi (RSM), retromolar sürme oranı (RSO), A° (Gonion-simfiz noktaları arasına çizilen düzlem ile 3. molar diş uzun ekseni arasındaki açı) ve B° (Gonion-simfiz arasına çizilen düzlem ile 2. molar dişin uzun ekseni arasındaki açı) değişkenleri değerlendirilmiştir. Panoramik radyografiler özel bir yazılım kullanılarak açılar ve mesafeler ölçülerek analiz edildi. Açı ve ölçümler gömülü grupları ve cinsiyetler arasında karşılaştırıldı. Ölçümler ve etki parametreleri arasındaki ilişkileri değerlendirmek için Pearson korelasyonu ve ANOVA testlerini içeren istatistiksel analizler kullanıldı. İstatistiksel anlamlılık değeri $p<0,05$ olarak kabul edilmiştir.
Bulgular: Kadınlarda A açısı, erkeklere göre anlamlı olarak daha büyük bulunmuştur ($p<0,05$). Erkeklerde ise RSM ve RSO, kadınlara göre anlamlı olarak daha büyük bulunmuştur ($p<0,05$). Gömülülük grupları arasında gonial açı bakımından anlamlı değişim bulunamamıştır. A açısı 3/B grubunda en dar açı iken 2/A grubunda en büyük açıya sahiptir.
Sonuç: Gonial açı üçüncü molar dişlerin gömülü kalmasının kesin bir göstergesi olmasa da, çalışma A° ve RSM'nin gömülü kalmayı öngörmedeki öneminin altını çizmektedir.

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***Corresponding Author:** Görkem TEKİN, *dt.gorkemtekin@gmail.com*

INTRODUCTION

Teeth that remain partially or completely within bone or soft tissue, failing to reach the occlusion level despite the time for eruption into the mouth, are referred to as impacted teeth.[1] The development and eruption processes of third molars are affected by many parameters, and studies report that the reason for impaction is that there is not enough distance between the ramus and the second molar tooth.[2] However, there is no consensus on primary mechanisms, corpus length, ramus angle, the congruence of mandibular development time with eruption time, or a combination of these and other factors.[3]

Third molars demonstrate great variation in terms of size, shape, position, root formation, development time, and eruption direction. Orthodontists frequently face challenges in predicting the eruption or impaction of these teeth in young patients during treatment planning. This prediction is typically based on radiographic assessments, which frequently result in ambiguous outcomes. Many of these studies are based on lateral cephalometric measurements[4] Additionally, periapical radiographs, bite-wing radiographs, and anterior-posterior imaging have been used.[5]

Panoramic imaging, which is increasingly used in dental practice, can also be utilized to predict the development of the third molars and could be beneficial in this regard.[6] As mandibular third molar impaction has a complex etiology, a definitive predictable method has not been developed. Factors such as insufficient space in the third molar area, angulation and ectopic position, obstruction in the eruption path, and late third molar mineralization have been suggested in previous studies related to third molar impaction. Moreover, gender, race, socio-economic differences, genetic and endocrinological factors can also affect eruption.[7] An inappropriate eruption pathway, excessive mesial angulation, and minimal upward orientation during eruption may potentially escalate the rate of impaction.[8]

The gonial angle, along with measures like the mandibular plane angle, is used to define facial growth patterns.[9] The gonial angle is a crucial parameter for determining growth patterns, and panoramic radiography is a suitable method for measuring it. The value of the gonial angle is considered important for early assessment of third molar development and eruption.[10]

This study aims to investigate whether there is a significant change in the gonial angles of individuals with lower third molars showing impaction, as indicated in the Pell and Gregory[11] classification. By observing tooth and jaw development better, it will allow us to predict tooth positions that may cause extraction difficulties.

MATERIAL AND METHODS

The summary text of this study was presented as an oral presentation at the Turkish Association of Oral and Maxillofacial Surgery 26th International Scientific Congress. Ethical approval was procured prior to the commencement of this study, which was structured as a retrospective investigation (Non-Interventional Clinical Research Ethics Committee Approval No:80558721/G-79). The study encompassed patients aged between 20 and 25, who sought treatment at the Oral and Maxillofacial Surgery Clinics. The inclusion criteria consisted of: patients with Class I dental occlusion, possessing intact lower third molars without any form of radiological data loss, having no history of orthodontic treatment, and no previous tooth loss. Patients were excluded from the study if they presented with radiographic data loss, were under the age of 20 or above 25, or exhibited pathological formations, impacted canines, or supernumerary teeth.

For each participant included in our study, a single mandibular third molar, whether on the right or left, was evaluated. The radiographic images studied were procured

using the Planmeca ProMax X-Ray Unit, an orthopantomography device, under parameters set at 90 kV, 10 mA, and 1 s. All images were reviewed and assessed using the specialized Romexis Reviewer© 4.3.0.R software, associated with the device, and measurements were conducted in millimeters using the same software. Consistent standards and radiological values were meticulously maintained during the acquisition of all panoramic radiographs.

The classification of tooth impaction was done according to the Pell-Gregory[11] classification. The Pell-Gregory[11] classification was formulated taking into consideration the distance of the anterior edge of the ramus to the 2nd molar tooth (Class 1, 2, 3) and the depth of impaction of the third molar tooth relative to the 2nd molar tooth (Position A-B-C) and is as follows;

In our study, teeth classified as class 1/A were considered erupted and were not included in the study, while the others were described as impacted and partially impacted, and evaluated under 8 groups as 1/B, 1/C, 2/A, 2/B, 2/C, 3/A, 3/B, 3/C.

Panoramic Radiography Measurements

The values measured are defined in Table 1. The parameters evaluated in the study are shown in Fig 1 and the measurements on the panoramic radiograph are displayed in Fig 2. Angles were measured in degrees (˚), and distances in millimeters (mm).

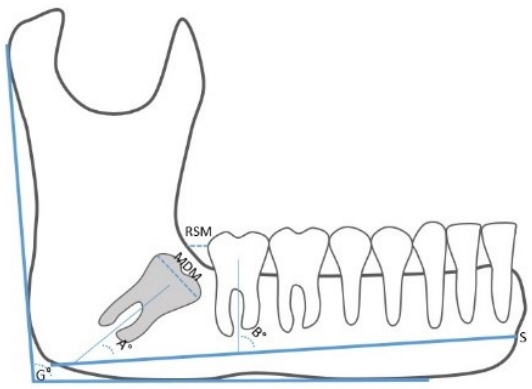

Fig 1. *Parameters evaluated in the study*

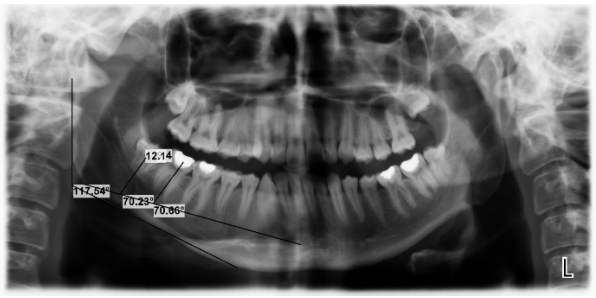

Fig 2. Measurement of panoramic radiography

Table 1. Measurements taken and their definitions

Values	Definitions
Gonial angle (G˚)	The angle formed at the intersection point of a line drawn tangent to the posterior ramus and a line drawn tangent to the mandibular corpus.
Mezio-distal distance (MDD)	The mesio-distal distance of the impacted third molar tooth.
Retromolar Eruption Distance (RED)	The distance between the ramus and the most prominent point of the distal region of the second molar tooth.
Retromolar Eruption Ratio (RER)	The ratio of RED to MDD.
A angle (A˚)	The angle between the plane drawn from gonion to the symphysis and the long axis of the third molar tooth.
B angle (B˚)	The angle between the plane drawn from gonion to the symphysis and the long axis of the second molar tooth.

Statistical Analysis

A frequency table containing the minimum, maximum, average, median, and standard deviations of all measurements was created. The relationship between the measurements made on the radiographic image and the determined impaction parameters was determined by Pearson correlation analysis. Whether the variations in impaction parameters among impaction groups were statistically significant was determined by the ANOVA test. The degree of statistical significance of the variations in impaction parameters between genders was determined by the Independent Sample t-test, and $p<0.05$ was accepted as statistically significant.

RESULTS

A total of 963 patients within the age bracket of 20-25 were incorporated into the study. The mean and standard deviation values for age, B˚, A˚, G˚, MDD, RED, RER of teeth

with varying degrees of impaction are presented in Table 2. The minimum, standard deviation, median, and maximum values for age, B˚, A˚, G˚, MDD, RED, RER of teeth with varying degrees of impaction are presented in Table 2.

337 (35%) male and 627 (65%) female were included in the study. The age range of male is 20-25 and the average age is 21.82±1.79. The age range of female was between 20-25 and the average age was 21.63±1.71.

Table 2. Descriptive statistics of all impacted group teeth

	1/B (n=12)	1/C (n=14)	2/A (n=254)	2/B (n=450)	2/C (n=168)	3/A (n=8)	3/B (n=34)	3/C(n=24)
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Age	21.83±0.36	21.36±0.51	21.72±0.11	21.79±0.08	21.54±0.12	21.88±0.74	21.41±0.30	21.17±0.33
B˚	74.53±2.17	73.97±3.24	76.47±0.45	78.06±1.6	74.65±0.47	82.59±4.63	83.79±1.86	79.09±1.96
A˚	55.72±6.53	44.41±4.60	72.2±1.9	39.24±1.25	40.47±1.62	46.08±14.32	29.99±4.45	38.98±4.75
G˚	114.81±2.12	113.95±2.75	114.77±0.41	114.32±0.31	113.78±0.5	117.83±2.65	111.72±3.2	115.50±1.25
MDD	10.27±0.22	10.05±0.33	10.96±0.05	11.06±0.05	11.24±0.53	10.88±0.28	11.18±0.13	10.91±0.20
RED	10.28±0.24	10.31±0.29	6.11±0.11	6.21±0.09	6.47±0.14	2.89±1.14	0.89±0.26	1.8±0.46
RER	1±**0.02**	1.03±0.03	0.56±0.01	0.57±0.01	0.60±0.01	0.28±0.12	0.08±0.02	0.17±0.04

SD, Standard deviation

In this study, no substantial correlation was identified between the B˚ and impaction (p>0.05). A weak and negative association might be inferred between the B˚ and the A˚ (r<0.3). Similarly, a weak and positive correlation appears to exist between the B˚ and the G˚ (r<0.3). A weak and positive association was established between the B˚ and MDD (r<0.3). A weak and negative association was perceived between the B˚ and RED (r<0.3).

No substantial correlation was observed between the gonial angle and impaction in this study (p>0.05). There appears to be a weak and positive correlation between the G˚ and the B˚ (r<0.3). It can be inferred that a weak and positive association exists between the G˚ and the A˚ (r<0.3). A weak and negative correlation was identified between the G˚ and MDD (r<0.3). A mild and positive correlation was observed between the G˚ and RED (r<0.3).

In our study, no substantial correlation was observed between MDD and impaction (p>0.05). A weak and negative association might be inferred between MDD and the A˚ (r<0.3). Similarly, a weak and positive correlation seems to exist between MDD and the G˚ (r<0.3). A weak and positive association was established between MDD and the B˚ (r<0.3). A weak and negative correlation was observed between MDD and RED (r<0.3). (Table 3)

Table 3. Correlations

	B˚	***A˚***	***G˚***	***MDD***	***RED***
B˚	1				
A˚	-0.09533	1			
G˚	0.04977	0.07818	1		
MDD	0.006087	-0.01126	-0.03081	1	
RED	-0.11294	0.177995	-0.03209	-0.00554	1

The A˚ was found to be larger in females compared to males (p<0.05). RED and RER measurements were observed to be larger in males compared to females (p<0.05). No statistically significant divergence was detected between the averages of the B˚, G˚, and MDD in both genders (p>0.05). (Table 4)

Table 4. Comparison of mean values between genders

	t-test		
	t	**std.**	**p**
B˚	0.905	962	0.366
A˚	-3.774	962	**0.000***
G˚	-1.031	962	0.303
MDD	1.691	962	0.091
RED	3.855	962	**0.000***
RER	1.954	962	**0.049***

Std., Standard deviation. * significance level p < 0.05. t-test, independent samples t test

Significant differences were identified between the averages of the A˚, RED, and RER across different groups ($p<0.05$). When categorized based on the magnitude of the A˚, the 3/B group was found to have the narrowest angle, followed by an incremental pattern in the 3/C, 2/B, 2/C, 1/C, 3/A, 1/B groups, with the 2/A group exhibiting the largest value. The narrowest RED was recorded in the 3/B group, demonstrating an ascending trend with the widest distance in the 1/C group, followed by an incremental pattern in the 3/C, 3/A, 2/A, 2/B, 2/C, 1/B groups. The highest RER was noted in the 1/C group, demonstrating a decreasing trend in the 1/B, 2/C, 2/B, 2/A, 3/A, 3/C groups, with the lowest value in the 3/B group (Table 5).

Table 5. Comparison of mean values among groups

		Sum of Squares	Std.	Mean Squares	F	p
B˚	**Inter-group**	3587.157	7	512.451	0.902	0.504
	Within-group	542965.683	956	567.956		
	Total	546552.840	963			
A˚	**Inter-group**	206642.391	7	29520.342	41.488	**0.000***
	Within-group	680234.446	956	711.542		
	Total	886876.837	963			
G˚	**Inter-group**	466.539	7	66.648	1.214	0.292
	Within-group	52488.051	956	54.904		
	Total	52954.591	963			
MDD	**Inter-group**	30.139	7	4.306	0.478	0.851
	Within-group	8604.884	956	9.001		
	Total	8635.023	963			
RED	**Inter-group**	1928.361	7	275.480	85.241	**0.000***
	Within-group	3089.573	956	3.232		
	Total	5017.934	963			
RER	**Inter-group**	17.832	7	2.547	91.917	**0.000***
	Within-group	26.495	956	0.028		
	Total	44.328	963			

Std., Standard deviation. *significance level $p < 0.05$.

DISCUSSION

The surgical extraction of the third mandibular molar is one of the most commonly performed operations by oral surgeons. Alhadi et al.[12] have shown that 22.8% of the population has at least one impacted lower third molar. Venta et al.[13] have reported that the incidence of impacted third molars varies between 22.3% and 66.6%.

In the present study, we have conducted an assessment on the relationships between the gonial angle, A˚, B˚, RED, MDD, and RER parameters with the status of impacted mandibular third molars. This was conducted according to the Pell-Gregory[11] impaction classification across a sample of 963 patients. It is important to note that our study specifically focused on partially impacted and fully impacted teeth. Therefore, teeth classified under Pell-Gregory[11] class 1/A, representing fully erupted teeth, were not incorporated into our analysis.

In our study, no significant relationship was identified between the G˚ and impaction. It was observed that there is a weak, positive correlation between the G˚ and A˚. A weak and positive relationship can be asserted between the G˚ and A˚. A weak, negative correlation has been determined between the G˚ and MDD. A mild, affirmative correlation was noted between the G˚ and RED. In the study conducted by Uthman et al.[5], it was noted that the G˚ was not a definitive reference. In some studies, a higher prevalence of impaction was observed in patients with narrower gonial angles.[14] This observation does not coincide with our study. In their research, Moshfeghi et al.[15] found no significant difference between G˚ and impaction. In the study conducted by Verma et al.[16], it was suggested that there exists a weak, negative correlation between the G˚ and eruption. Hattab ve Alhaija[17], indicated an

increase in the impaction rate in patients with smaller and steeper gonial angles. Begtrup ve ark.[18] were unable to detect any correlation between jaw angles and third molar eruption. For this reason, they stated that the G˚ is not a reliable measure in determining the impaction of the third molar. The study conducted by Kaur et al.[19] demonstrated that the G˚ displays the least variation. It was proposed that the gonial angle does not provide information about the eruption of the third molar.[6]

In our study, a significant difference was observed between the A˚ and impaction groups classified according to the Pell-Gregory[11] classification. When ranked by the size of A˚, the 3/B group has the narrowest angle, followed by an increase in the 3/C, 2/B, 2/C, 1/C, 3/A, 1/B groups, and the 2/A group has the largest value. During tooth development, the likelihood of the third molar remaining impacted increased as the angle of the third molar (A˚) decreased. Some researchers have proposed that for the third molar to properly emerge into the mouth, A˚ should be greater than 40º at the age of 10. Subsequently, with an appropriate increase in this angle, they have claimed that the third molar can fully erupt into the mouth.[20-22] A˚ was found to be higher in female when compared according to gender ($p<0.005$).

In a study conducted by Kaur et al.[19] in which two researchers independently measured 200 patients, A˚ was found to be significantly lower in the fully impacted group compared to the erupted group, and it was indicated that the chance of eruption decreases as the angle narrows. Nevertheless, in the partially impacted group, A˚ was measured to be larger compared to the erupted group, as wider A˚ vertical and distoangular impactions are more common in partially erupted teeth. A narrow A˚ is mostly due to mesioangular inclination in the fully impacted group.[20,21] In our study, a decrease in A˚ was observed as the Pell Gregory[11] impaction degree increased. The reason why the 3/C group is not the narrowest angle could be because the follicle forms in a location closer to the postero-inferior of the ramus.

In our study, no significant relationship was identified between B˚ and impaction, but a weak and negative correlation exists between B˚ and A˚. Similarly, a weak, positive correlation was observed between B˚ and the G˚. A weak, positive correlation has been identified between B˚ and MDD. A weak, negative relationship was observed between B˚ and RED. In their study, Kaur et al[19] demonstrated that B˚ shows the least variation. It has been proposed that B˚ does not provide information about the eruption of the third molar.[6] In the study of Uthman et al.[5], it was asserted that the second molar angulation does not serve as a definitive reference.

In our study, a significant difference was identified between the RED and impaction. The narrowest distance was measured in the 3/B group, which then increased sequentially in the 3/C, 3/A, 2/A, 2/B, 2/C, 1/B groups, and the widest distance was detected in the 1/C group. Numerous global studies have delved into the origins of third molar impaction, revealing a multitude of factors that may contribute to this condition. Limited space beyond the permanent second molar, postponed development of the third molar, and accelerated physical maturation are among the factors to consider.[23] RED was found to be higher in male when compared according to gender ($p<0.005$).

In their study, Verma et al.[16] analyzed panoramic radiographs of 90 patients, ranging in age from 21 to 45 years, categorizing the teeth as either impacted or erupted. They concluded that there is a strong positive correlation between RED and eruption; the likelihood of eruption increases as the RED increases. In contrast, Balla et al.[24] found inadequate RED in most cases of impacted third molars. On the other hand, Saputri[2] argued that the presence of sufficient space does not necessarily indicate whether the third molar will erupt or not. Hattab ve Alhaija[17] indicated that the RED was greater in erupted teeth, noting that lack of space was the most significant cause of impaction among all measurements evaluated. Venta et al.[6] asserted that there is a 100% chance of eruption when the RED is

greater than 16.5 millimeters. In their research, Mollaoğlu et al.[25] found that the RED in impacted third molars was smaller than that in erupted third molars. In line with other studies, Hattab and Alhaija's[17] research revealed that the RED was larger in erupted third molars compared to impacted ones, again highlighting space shortage as the principal cause of impaction.[17]

In our research, we did not discern a notable correlation between the MDD and tooth impaction. There appears to be a faint negative correlation between MDD and A˚. In a similar vein, a mild positive correlation is evident between MDD and the G˚. A slight positive correlation has been identified between MDD and B˚. We've observed a weak negative correlation between MDD and RED. In a study by Quiros[26], which involved panoramic radiograph measurements of 300 patients ranging in age from 12 to 30, MDD of the third molar was measured at approximately 15.8 mm, which is notably higher than the findings in our current study. This divergence in results could possibly be attributed to the different panoramic imaging devices utilized in the studies.

In some studies, although not definitively, the MDD in impacted teeth has been found to be wider compared to the erupted teeth.[6,17,27] The radiographic appearance of mandibular third molars is variable depending on the tooth's position in the dental arch and its orientation to the film. In panoramic imaging, third molars tilted lingually tend to appear larger compared to those tilted buccally. According to Sewerin[28], 65% of lower third molars are oriented buccally, 4% are tilted lingually, while 39% are directed towards the midline.

A noticeable difference between RER and embedment has been detected in our study. RER is predominantly present in Class 1/C, while showing a decrease in other groups as follows: 1/B, 2/C, 2/B, 2/C, 3/A, and reaching the lowest value in Group 3/B. Niedzielska et al.[29] evaluated the ratio of retromolar space to crown width (Gnass ratio) and claimed that it serves as a suitable reference for determining the position of the third molar. In a study conducted by Kaur et al.[19] RSO was found to be smaller in partially and fully impacted teeth compared to erupted teeth. Mollaoğlu et al.[25] reported an average RER of 1.1 in erupted third molars and 0.6 in impacted third molars. In a study, it was claimed that when RER is at least 1, 69% of third molars can erupt. [30] In the present study, similar to the A angle and RED, the lowest value of RER was found in Group 3/B. Despite being at a higher level vertically compared to Group 3/C, factors such as resorption of the anterior bone of the ramus, posterior movement of the anterior border of the ramus relative to the alveolar border, advancement of dentition, increase in mandibular length, sagittal growth of the mandible, and lesser sagittal eruption of teeth may explain why the lowest value is observed in Group 3/B. RER was found to be higher in male when compared according to gender ($p<0.005$).

According to the study by Eroz et al.[31] , the A˚ was found to be significantly larger in females compared to males ($p<0.05$). On the other hand, the RED and RER were found to be significantly larger in males compared to females ($p<0.05$). There were no significant differences between genders in terms of the G˚, B˚, and MDD averages ($p<0.05$). In our current study, out of 963 patients, 627 were females with an average MDM of approximately 10.7 mm, while 339 males had an average MDD of approximately 11.2 mm. In the study conducted by Kaur et al. [19], the MDD and RER values were found to be higher in males compared to females. In our study, similar to many international studies on third molar embedment, no gender differences were observed.[32] However, some studies have reported a higher prevalence of third molar embedment in females, which contradicts the findings of this study.[33,34] The higher occurrence of embedment in females has been attributed to developmental differences between males and females. Female body development generally stops at the onset of third molar eruption, whereas in males, mandibular development continues during the eruption of third molars, allowing for more

space. Nevertheless, a large majority of international studies still report no significant gender differences.[34]

In our study, according to the Pell-Gregory classification[11] out of 963 patients, 450 were classified as Class 2/B, 250 as Class 2/A, 168 as Class 2/C, 34 as Class 3/B, 24 as Class 3/C, 14 as Class 1/C, 12 as Class 1/A, and 8 as Class 3/C. In the study conducted by Hassan et al.[35] the level of embedment was calculated based on the cementoenamel junction (CEJ) level relative to alveolar bone height and was not associated with the occlusal surface of the adjacent second molar. Therefore, third molars that were erupting normally were excluded from the evaluation. In this study, Level B was found to be the most common level of embedment in both the maxilla and mandible. This finding is consistent with the study by Quek et al.[36] , but differs from the study by Hugoson and Kugelberg.[33] Hugoson and Kugelberg[33], correlated the third molar with the occlusal surface of the neighboring second molar, leading to variations in the occurrence of erupted molars and their frequencies at each level.

CONCLUSION

There was not a significant discrepancy concerning the gonial angle amongst the various impaction groups. However, considering that the eruption direction of wisdom teeth varies depending on multiple factors, there is a need for long-term studies that include reference points encompassing jaw and facial growth patterns.

Ethical Approval

The necessary ethical approval for this study was received by the Eskişehir Osmangazi University Non-Interventional Clinical Research Ethics Committee (80558721/G-79).

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Conflict of Interest

The authors deny any conflicts of interest related to this study.

Author Contributions

Concept: YAÖ, ÖD. Design: YAÖ, ÖD. Supervision: YAÖ, ÖD. Fundings: YAÖ. Materials: YAÖ. Data Collection and/or Processing: YAÖ, ÖD. Analysis and/or Interpretation: ÖD. Literature Search: YAÖ. Writing Manuscript: YAÖ, YÇK, NSK, GT, ÖD. Critical Review: YAÖ, YÇK, NS, GT, Ö.D.

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