Primljen / Received on: 26.7.2024..
Revidiran / Revised on: 25.8.2024.
Prihvaćen / Accepted on: 01. 09. 2024.

ORIGINALNI RAD
ORIGINAL ARTICLE
doi: 10.5937/asn2490891J

PROCENA RADIOGRAFSKIH RAZLIKA U TIPOVIMA IMPAKTRANIH I IZNIKLIH MANDIBULARNIH TREĆIH MOLARA

EVALUATION OF RADIOGRAPHIC DIFFERENCES IN TYPES OF IMPACTED AND ERUPTED MANDIBULAR THIRD MOLARS

Lokam Janeswari, Koneru Jyothirmai, Reddy Sudhakara Reddy, Tatapudi Ramesh, Beeraboina Ananda Babu, Kantheti Harshitha

[1]ORALNA MEDICINA I RADIOLOGIJA, VISHNU DENTAL KOLEDŽ, BHIMAVARAM, OKRUG ZAPADNI GODAVARI, ANDRA PRADEŠ, INDIJA-534201

[1]ORAL MEDICINE AND RADIOLOGY, VISHNU DENTAL COLLEGE
VISHNU DENTAL COLLEGE, BHIMAVARAM, WEST GODAVARI DISTRICT, ANDHRA PRADESH, INDIA-534201

Sažetak

Uvod: *Smatra se da faktori poput neusklađenosti između veličine zuba i vilice, širine ramusa i donje okluzalne ravni igraju značajnu ulogu u impakciji donjeg trećeg molara (M3M).*
Cilj *studije bio je procenjivanje radiografske razlike u angularnim i linearnim merama kod različitih tipova impakcije donjeg trećeg molara (M3M)*
Materijal i metode: *Uključeni su ortopantomogrami i lateralni cefalogrami 300 pacijenata starosti 18–30 godina. Procenjena su linearna merenja kao što su visina ramusa, meziodistalna širina prvog molara donje vilice i M3M, retromolarni prostor, odnos retromolarnog prostora prema širini meziodistalnog tipa udarnog panoramskog radiografa na M3M. Ugaona merenja, kao što je gonijalni ugao, procenjena su na bočnim cefalogramima.*
Rezultati: *Srednje vrednosti studije su otkrile statistički značajne razlike između grupa sa impaktirani i neimpaktirani u smislu gore navedenih radiografskih parametara sa razlikom među polovima. Pronađene su značajne razlike između retromolarnog prostora, širine prvog molara donje vilice i odnosa retromolarnog prostora i meziodistalne širine M3M u sva tri nivoa Pell i Gregori klasifikacije, kao i značajne razlike u širini M3M u sva četiri tipa Vinterove klasifikacije.*
Zaključak: *Studija identifikuje ključne anatomske faktore kao što su odnos retromolarnog prostora i meziodistalne širine M3M retromolarnom prostoru, visinom ramusa i gonijalnim uglom da bi značajno uticali na rizik od M3M impakcije. Ovi nalazi povećavaju sposobnost stomatologa da predvide impaktaciju i poboljšaju ishode lečenja.*

Ključne reči: *impakcija trećeg molara, visina ramusa, retromolarni prostor, gonijalni ugao, mezodistalna širina, mandibularni treći molar, prvi molar*

Corresponding author:
Lokam Janeswari
Vishnu Dental College,Andhra Pradesh, India
Email: lokamjaneswari98@gmail.com
Mobile no: 9908305815

Abstract

Introduction: *Factors like mismatches between tooth and jaw sizes, the width of the ramus, and alignment of lower back teeth are thought to play significant roles inmandibular third molar impaction (M3M).*
Aim *of the study was to evaluate the radiographic differences in angular and linear measurements between various types of impacted and erupted M3Ms.*
Material and Methods: *Orthopantomographs and Lateral cephalograms of 300 patients aged 18–30 were included and linear measurements such as ramus height, mesiodistal width of mandibular first molar and M3M, retromolar space, the ratio of retromolar space to mesiodistal width of M3M, type of impaction were assessed on panoramic radiographs. Angular measurements, such as gonial angle, were assessed on Lateral cephalograms.*
Results: *The study's mean values revealed statistically significant differences between impacted and non-impacted groups in terms of the above-mentioned radiographic parameters and were also significant across genders. Significant differences were found between retromolar space, mandibular first molar width, and retromolar space to M3M mesiodistal width ratio across all three levels of Pell and Gregory classification, as well as significant differences in M3M width across all four types of Winter's classification.*
Conclusion: *The study identifies key anatomical factors such as retromolar space to M3M mesiodistal width ratio followed by retromolar space, ramus height and gonial angle to significantly influence the risk of M3M impaction. These findings enhance the ability of dental professionals to predict impaction and improve patient outcomes.*

Key words: *third molar impaction, ramus height, retromolar space, gonial angle, mesiodistal width, mandibular third molar, first molar*

Introduction

Peterson defined the impaction of teeth as “Fail in eruption within anticipated timeframe”[1]. The function of M3Ms in the oral cavity has been the subject of extensive research over the years. M3Ms are the teeth most often susceptible to incomplete eruption, often resulting in impaction[2]. Clinically, impacted M3Ms result in issues such as pain, swelling, caries, and root resorption[2,3]. Even though devoid of noticeable symptoms, M3M impaction is capable of being linked to various pathological conditions, ranging from pericoronitis to cysts and neoplastic lesions[4]. Prophylactic removal is estimated to be performed in 54% of mandibular M3Ms, even in the absence of subjective symptoms, which may aid in preventing the above-mentioned complications[2,3].

The complexity of surgical removal of M3Ms depends largely on their position within the jaw. Numerous classification systems have been developed to categorize the positions of mandibular M3M teeth, with Winter (1926) and Pell and Gregory (1933) classifications being the most commonly followed[2]. These classification systems might provide valuable insights into potential challenges associated with these prophylactic extractions.

Despite this, in most cases, M3Ms are not directly considered in orthodontic treatment planning, but they may play a crucial role while framing an orthodontic treatment plan. By prophylactic extraction, we can eliminate anterior teeth crowding. As the etiology of M3M impaction is complex, no precise predictive method has been developed[4].

Prediction of impaction or eruption of M3Ms would offer significant clinical benefits in dentistry. Various methods for predicting the eruption of M3Ms have been introduced since Henry and Morant's initial data in 1936. Most of these studies rely on lateral cephalographic measurements, while other techniques, such as anteroposterior views, periapical films, and bitewings are also utilized. Additionally, panoramic tomograms have been employed in studies by Ganss et al.[5] and Venta[6]. As panoramic tomograms become increasingly accessible to most practicing dentists and they are also cost-effective and easily obtained, utilizing such projections for predicting the future development of M3Ms could prove advantageous[7]. The pitfall of panoramic radiography includes distortion and magnification[8].

The exact causes of M3M impaction remain unclear, but factors such as differences in jaw and tooth sizes, the width of the ramus, and alignment of mandibular back teeth are believed to contribute[9]. Several parameters, including the width of the mandibular first molar, ramus height, gonial angle and retromolar space to the width of M3M ratio, have been investigated in various studies. However, there is inconsistency among these studies regarding the predictive value of these parameters for the eruption or impaction of M3Ms.

Due to limited documentation on the usefulness of all radiographic parameters in our population, a study was designed to evaluate the radiographic differences in angular and linear measurements between various types of impacted and erupted M3Ms.

Material and Methods

This study contained Orthopantomo-graphs and Lateral cephalograms of 300 individuals aged 18–30, equally distributed by gender. The study respondents were divided into two groups: 150 respondents with impacted (75 males, 75 females) and 150 of them with erupted (75 males, 75 females) M3Ms. The study design was thoroughly scrutinized and got approval from the Institutional Review Board [IRB] and Ethical Committee IECVDC/2022/PG01/OMR/IVT/04. The following inclusion and exclusion criteria were met:

Inclusion Criteria

- Radiographs of patients under the age group of 18–30 years
- Orthopantomograph (OPG) and LC (Lateral Cephalograph) with impacted and erupted M3Ms
- OPG and LC with permanent mandibular first molars without proximal caries and any restorations
- Radiographs with complete mandibular permanent dentition and without any impactions of remaining tooth other than M3Ms
- OPG and LC should have to meet the standard radiographic quality

Exclusion Criteria

- Panoramic images without mandibular M3Ms
- Subjects with any developmental anomalies or syndromes
- Subjects with any pathologies and fractures in the region of interest
- Panoramic images with absence of mandibular permanent first molars

• Individuals who were undergoing or previously had undergone any orthodontic treatment or surgical orthognathic surgeries

Study Procedure

All panoramic and lateral cephalometric images were taken for each individual with an Orthopantomogram machine (Satellec X-Mind-Panoceph) using photostimulable phosphor plates (PSP, Soredex) along with standard exposure parameters as recommended by the manufacturer by a single operator and head position was standardized to the greatest extent possible. By using Scanora, and accompanying software final images were obtained in DICOM format. Impacted M3Ms were categorized based on the Pell and Gregory (Figure 1) and Winter classifications (Figure 2). The below listed linear measurements were performed on panoramic radiographs and angular measurements were performed on Lateral cephalograms. The obtained data were statistically analyzed using SPSS software version 22.0.

Linear measurements:

The following linear measurements were done in OPG:

1. Ramus height (O1–O2)—the edge point of the condyle on the lateral aspect (O1) and edge point of the ramus on the lateral aspect (O2) were identified on OPG. O1–O2 was measured and defined as ramus height1 (Figure 1)

2. Retromolar space (Figure 2)—distance from the second molar distal contact point to the line at right angles to the Z plane (A tangent drawn along the descending anterior border of the mandibular ramus)2

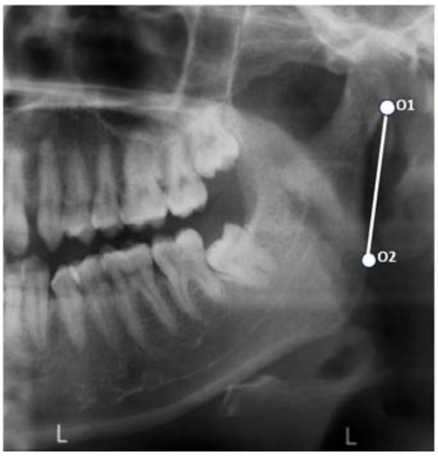
3. Mesiodistal width of permanent mandibular first molar (Figure 3A)1

4. Mesiodistal width of M3M (Figure 3B)2

5. Retromolar space to mesiodistal width of M3M ratio2

Angular measurements:

7. Gonial angle (Figure 4)—gonial angle was measured on lateral cephalograms. It is the angle obtained by joining articular, gonion and menton points1



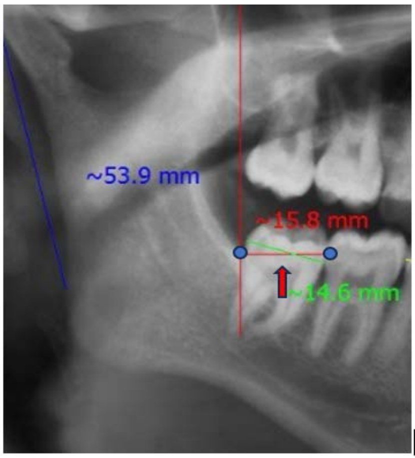


Figure 1**:** Ramus height ***Figure 2:*** Retro-molar space (marked in red color)

Figure 3: Mesio distal width of mandibular (A) First molar (B)M3M

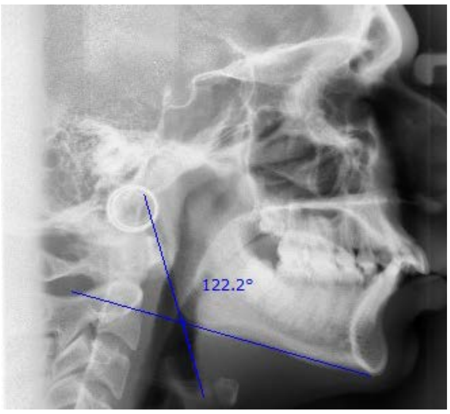


Figure 4. LC showing Gonial angle

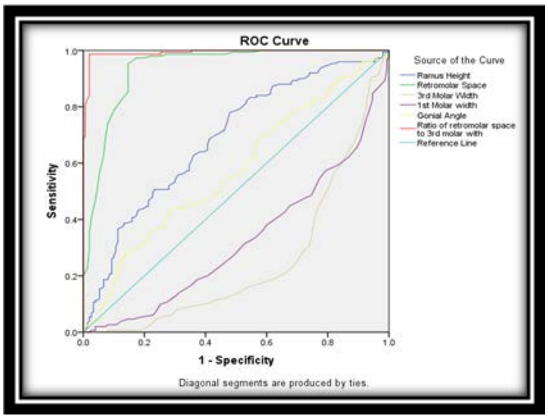


Figure 5. ROC ANALYSIS

Statistical analysis

The obtained data were compiled and analysed statistically by using SPSS software (version 22). Data analysis was done by using Mann–Whitney U test to draw inter-group comparisons among the non-impacted and impacted groups and to calculate mean values for ramus height, retromolar space, mesiodistal width of the mandibular permanent first molar, mesiodistal width of M3M, the ratio of retromolar space to mesiodistal width of mandibular permanent M3M. Kruskal–Wallis test and one-way ANOVA were used to calculate intra-group (impacted) comparison of the mean values of ramus height, retromolar space, mesiodistal width of mandibular first molar, mesiodistal width of M3M, retromolar space to mesiodistal width of permanent M3M ratio of the Winter classification (horizontal, mesioangular, vertical and others group) and Pell and Gregory classification (levels of impaction A, B, C). A p-value of < 0.05 was considered statistically significant.

The receiver operating characteristic curve (ROC) curve was plotted with a 95% confidence interval.

Results

The mean values of ramus height, retromolar space, mesiodistal width of M3M, mesiodistal width of the mandibular first molar, the ratio of retromolar space to mesiodistal width of permanent M3M width, and gonial angle showed a statistically significant difference between the impacted and non-impacted groups where ramus height, retromolar space, gonial angle, ratio of retromolar space to mesiodistal width of M3M were greater among the non-impacted group when compared with the impacted group and mesiodistal width of the mandibular permanent first molar, mesiodistal width of permanent M3M were comparatively less for the impacted group than the non-impacted group (Table 1).

The mean values of ramus height, retromolar space, mesiodistal width of permanent M3M width showed statistically significant differences where all three parameters were greater in males when assessed with females (Table 2).

A statistically significant difference between retromolar space, mesiodistal width of the mandibular permanent first molar, and the ratio of retromolar space to mesiodistal width of mandibular permanent M3M width was observed between all three levels of Pell and Gregory classification groups where the three parameters were more for level A type of impaction followed by level B and C (Table 3).

The mean value of mesiodistal width of M3M showed a significant difference among all four types of the Winter classification groups, where the vertically impacted group has smaller mesiodistal width compared to other impacted groups (Table 4).

A receiver operating characteristic (ROC) analysis was performed to appraise reliable marker for impaction by plotting sensitivity versus specificity for the results obtained in between non-impacted and impacted groups in terms of gonial angle, ramus height, mesiodistal width of M3M, mesiodistal width of the first molar, retromolar space, ratio of retromolar space to mesiodistal width of M3M (Figure 5).

According to ROC analysis performed in the present study, the ratio of retromolar space to 3rd molar width covers the highest area of the graph and is a reliable marker to distinguish between impacted and non-impacted groups followed by retromolar space, ramus height and gonial angle.

Discussion

Under normal circumstances, M3Ms eruption takes place between the ages of 18 and 24 years. By this age, growth typically reaches completion, and the M3Ms reach complete root formation[10]. So, individuals aged 18–30 years in our study group were included for this reason.

To prevent bias and ensure a balanced representation, an equal gender distribution was implemented, with an equivalent number of male and female samples considered. This approach aimed to achieve a meaningful comparison between the parameters utilized in the study.

The impaction of M3Ms persists as a significant concern in dental practice due to its frequent and potential clinical implications.4 They are also implicated in various issues including crowding in the lower arch, temporomandibular joint (TMJ) disorders, as well as neuralgias and vague orofacial pain[11,12].

There are limited data pertaining to the relationship between M3M impaction and the mesiodistal width of the first molar, it is believed that a larger mesiodistal width of the first molar could create limited space within the dental arch, potentially hindering the natural eruption pathway of the M3M.

Table 1: Mean values of linear and angular measurements between impacted and non-impacted groups

Radiographic parameters	IMPACTION	No.	Mean ± ST deviation	P-value
Ramus height	IMPACTED NON-IMPACTED	150 150	44.19 ± 4.75 47.14 ± 5.38	0.000*
Retromolar space	IMPACTED NON-IMPACTED	150 150	8.6 ± 3.15 14.24 ± 1.86	0.000*
Mesiodistal width mandibular of M3M	IMPACTED NON-IMPACTED	150 150	14.13 ± 1.25 13.07 ± 1.08	0.000*
Mesio-distal width of mandibular first molar	IMPACTED NON-IMPACTED	150 150	14.87 ± 1.17 13.42 ± 1.16	0.000*
Gonial angle	IMPACTED NON-IMPACTED	150 150	120.46 ± 6.5° 122.03 ± 6.5°	0.030*
Ratio of retromolar space to mesiodistal width of mandibular M3M	IMPACTED NON-IMPACTED	150 150	0.60 ± 0.21 1.09 ± 0.12	0.000*

Table 2 Mean values of linear and angular measurements between genders

	IMPACTION	No.	Mean ± ST deviation	P-value
Ramus height	MALE FEMALE	150 150	47.17 ± 5.55 44.16 ± 4.54	0.000*
Retromolar space	MALE FEMALE	150 150	11.89 ± 3.61 10.95 ± 3.99	0.026*
Mesiodistal width of M3M	MALE FEMALE	150 150	14.57 ± 1.81 13.43 ± 1.33	0.029*
Mesiodistal width of mandibular first molar	MALE FEMALE	150 150	14.59 ± 1.28 13.67 ± 1.2	0.06
Gonial angle	MALE FEMALE	150 150	120.4 ± 7.05^{o} 122.07 ± 5.9^{o}	0.055
Ratio of retromolar space to mesiodistal width of M3M	MALE FEMALE	150 150	0.86 ± 0.28 0.82 ± 0.31	0.33

Table 3: Mean values of linear and angular in all Pell and Gregory Classification groups

	Level	Mean ST deviation	P-value
Ramus height	A	45.24 ± 5.18	0.191
	B	43.56 ± 4.52	
	C	43.28 ± 4.09	
Retromolar space	A	9.43 ± 3.1	0.004*
	B	8.66 ± 2.95	
	C	7.41 ± 3.05	
Mesiodistal width of M3M	A	14.21 ± 1.37	0.806
	B	14.09 ± 1.15	
	C	14.07 ± 1.18	
Mesiodistal width of mandibular first molar	A	14.44 ± 1.15	0.044*
	B	14.06 ± 1.07	
	C	13.9 ± 1.22	
Gonial angle	A	120.58 ± 6.81	0.495
	B	120.8 ± 5.94	
	C	120.01 ± 6.61	
Ratio of retromolar space to mesiodistal width of M3M	A	0.66 ± 0.21	0.005*
	B	0.61 ± 0.2	
	C	0.52 ± 0.22	

Table 4: Mean values of linear and angular radiographic parameters for all Winter Classification groups

	Type	Mean ST deviation	P-value
Ramus height	Horizontal	44.32 ± 4.95	0.979
	Mesioangular	44.23 ± 4.67	
	Vertical	44.13 ± 4.86	
	Others	43.2 ± 1.3	
Retromolar space	Horizontal	8.34 ± 3.07	0.276
	Mesioangular	8.89 ± 3.75	
	Vertical	8.68 ± 2.72	
	Others	5.83 ± 1.5	
Mesiodistal width of M3M	Horizontal	14.98 ± 1.12	0.001*
	Mesioangular	13.98 ± 1.18	
	Vertical	13.81 ± 1.25	
	Others	14.8 ± 0.91	
Mesiodistal width of mandibular first molar	Horizontal	14.36 ± 1.4	0.237
	Mesioangular	13.88 ± 0.97	
	Vertical	14.27 ± 1.07	
	Others	14.13 ± 2.4	
Gonial angle	Horizontal	119.7 ± 7.3^{O}	0.731
	Mesioangular	120.4 ± 6.1^{O}	
	Vertical	120.5 ± 5.6^{O}	
	Others	127.7 ± 14.02^{O}	
Ratio of retromolar space to mesiodistal width of M3M	Horizontal	0.56 ± 0.21	0.128
	Mesioangular	0.63 ± 0.26	
	Vertical	0.62 ± 0.19	
	Others	0.39 ± 0.11	

Table 5: Roc analysis

Variables	Area under the graph	P-value	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
Ramus height	.687	0.000*	.628	.747
Retromolar space	.937	0.000*	.910	.965
Mandibular 3rd molar width	.249	0.000*	.193	.305
Mandibular 1st molar width	.324	0.000*	.264	.384
Gonial angle	.572	0.030*	.508	.637
Ratio of retromolar space to 3rd molar width	.992	0.000*	.984	1.000

The current study showed considerable variation statistically among the impacted and non-impacted groups, pertaining to the first molar width with 14.8 mm among the impacted group and 13.4 mm in the non-impacted group and the current study results were in contradiction to the results of Jéssica de Fátima Segantin[13] study where they reported there was no statistical significance observed with values 9.3 mm and 9.5 mm among erupted and impacted groups respectively. In a study conducted by Hung-Huey Tsai[3] et al. in the Taiwanese population, the mesiodistal crown dimension of the mandibular permanent first molar among males was 8.4 mm in the impacted group and 7.4 mm in the non-impacted group, in females, it was 7.5 mm in impacted group and 7.2 mm in the non-impacted group, mesiodistal width of the lower permanent first molar was greater among the impacted group when compared to the non-impacted group, which is consistent with the results of the present study.

Genetic diversity can affect tooth size and shape which can lead to different mesiodistal width of molars in different ethnic groups, Environmental and dietary factors also play a role; diets requiring more chewing can promote larger jaw sizes and teeth, leading to variations in dental measurements across different populations. M3M impaction might be due to increased width of M3M[3].

The Kaur R[14] et al. study on the Turkish population and the Hung Huey Tsai[3] study on the Taiwanese population revealed that M3Ms exhibited greater width in partially or non-erupted groups compared to fully erupted ones, which is similar to our current findings. However, the results of Talat Hasan Al-Gunaid[9] and Nur Mollaoglu[15] showed there was no significance in M3M width between subjects with erupted and impacted M3Ms, which was contradictory to the present study.

Quiros's[16] panoramic study of 300 individuals found the M3M's mesiodistal width (MDW) to be about 15.8 mm, which is slightly more than in the present study. This difference may stem from using a conventional panoramic machine, which magnifies images by 15% to 20%. These variations could potentially account for differences in measurements in other studies too.

The development of the retromolar space involves several factors, including thinning of the anterior margin of the ramus. The anteroposterior dimension of the retromolar spaces expands, allowing for the accommodation of permanent molars due to the posterior repositioning of the ramus[17]. Ganss[5] et al. found that the likelihood of M3M eruption reaches 70% when measurements of retromolar space were 13.9 mm for women and 14.3 mm for men and E. S. J. Abu Alhaija[18] et al.'s observation on the Arabian population revealed significant difference among gender, which was consistent with current study results.

In a study performed by Selmi Yilmaz[19] on the Turkish population, the retromolar space was categorized according to Pell and Gregory as levels A, B, and C with measurements of 14.7 mm, 11.1 mm, and 10.3 mm, respectively. These results were statistically significant and consistent with the findings of the present study.

In studies conducted by Talat Hasan Al-Gunaid[9] and Nur Mollaoglu[15], the average ratio of retromolar space to mesiodistal width of M3M was higher amongst the non-impacted group compared to the impacted group and there was a considerable disparity between the non-impacted groups and the impacted. The findings of the above-mentioned studies were similar to those of the present study, with ratios of 0.60 ± 0.21 for the impacted group and 1.09 ± 0.12 for the non-impacted group respectively. Earlier research by Mollaoglu[15] indicated that 69% of M3M eruptions occurred when the ratio of retromolar space to M3M width was at least one.

Gonial angle measurements are typically conducted using Lateral cephalograms. Studies suggest that measurements taken from panoramic radiographs are comparable to those from lateral cephalograms (Radhakrishnan et al.[20], 2017). However, some research indicates that there are significant differences between the two methods (Kundi and Baig, 2018)[2]. So, in the study, a lateral cephalometric radiograph was chosen for angular measurements. Björk et al.[21] (1956) suggested that individuals with a large jaw angle might possess greater posterior space within the dental arch. They hypothesized that this could result from predominantly condylar growth in a sagittal direction, consequently elongating the distance from the interdental area to the anterior border of the mandibular ramus[22].

In the present study, a notable distinction was observed between the impacted and non-impacted groups with the values of 120.46o and 122.03o, respectively. Studies by Kaur R et al.[14] and Al-Gunaid et al.[9] reported a more acute gonial angle in the impacted group compared to non-impacted group. These findings are similar to the findings of the present study. However, our results are contradictory to those of Al-Gunaid et al., who found no association between gonial angle magnitude and M3M impaction[9]. These variations could be due to the geographical distribution of the population or sampling differences in the study group.

The current study revealed no substantial association between positions and levels of M3M impaction classified according to Pell and Gregory as Level-A, Level-B, Level-C for gonial angle with values of 120.5o, 120.8o, 120.01o, respectively, which is similar to that of Oğuzhan Demirel et al.[23].

Lower facial height results in impaction and pattern of agenesis in M3M[24,25]. A decline in gonial angle and facial height was linked to an ascending rotation of the mandible due to decreased alveolar height. This increased rotation rate may be attributed to the faster growth in the condyle in vertical compared to the alveolar bone and some of the facial sutures[26]. The present study revealed that the mean values of ramus heights classified according to Pell and Gregory classification were ranked as A > B > C. This observation indicating the increase of depth among vertical impaction correlates with ramus height reduction, supporting the aforementioned theory. These findings are consistent with the results of Gumrucku[2] et al.

In the non-impacted group, it was found that ramus heights were higher (47.14 ± 5.38) compared to the impacted group (44.19 ± 4.75), with statistical significance observed between both groups. Additionally, males exhibited greater ramus height (47.17 mm) in comparison to females (44.16 mm), with a significant difference noted between genders. These findings closely align with those reported by Talat Hasan Al-Gunaid et al.[9], i.e., 46.22 mm in the non-impacted group and 44.32 mm in the impacted group with males having a ramus height of 47.25 mm and females 40.17 mm in the Saudi population.

According to ROC analysis performed in the present study, the ratio of retromolar space to 3rd molar width covers the highest area of the graph and could serve as a reliable marker to distinguish between the impacted and non-impacted groups followed by retromolar space, ramus height and gonial angle.

Racial variation, dietary patterns, masticatory habits, and genetic inheritance all influence the size of the jaw and teeth. The variability in facial growth, jaw and tooth size, across various ethnic groups and inhabitants, demonstrates distinct inheritance patterns. The differences in the above-mentioned features lead to variations in results. When predicting M3M eruption or impaction, it is crucial not to rely solely on one or two variables. Therefore, it is advisable to conduct longitudinal studies to validate the effectiveness of this method.

Limitations

The sample was derived from a single orthodontic practice, which may not represent the broader population. The study focused exclusively on panoramic and cephalometric radiographs which have inherent limitations. Moreover, it did not differentiate between bilateral and unilateral impactions which may have distinct characteristics and predictive factors. One of the limitations is reliance on a classification system based solely on observation of radiographs. Additionally, participants who did not have M3Ms and were missing other molars were excluded, raising the possibility that some of the missing M3M might be due to agenesis. The inability to explore this factor represents another limitation of the study.

Conclusion

The study identifies key anatomical factors—lower retromolar area to M3M mesiodistal width ratio, insufficient retromolar area, shorter ramus height, larger gonial angle, wider first molar, wider M3M in order of importance according to ROC analysis and significantly influence the risk of M3M impaction. Understanding these factors is essential for effective diagnosis, treatment planning, and patient management, aiding in space management and early intervention strategies.

These findings enhance the ability of dental professionals to predict impaction, improve patient outcomes, and reduce complications, providing a strong basis for clinical guidelines.

Conflicts of Interest

The authors have no conflicts of interest to declare pertinent to this investigation.

Acknowledgements

The authors would like to thank the Department of Oral Medicine and Radiology, Vishnu Dental College for their kind support during the entire study.

Financial Support: None

LITERATURA/REFERENCES

1. Peterson LJ. Principles of management of impacted teeth. Contemporary Oral and Maxillofacial Surgery, 3rd ed. St. Louis: Mosby. 1998:215-48.
2. Gümrükçü Z, Balaban E, Karabağ M. Is there a relationship between third-molar impaction types and the dimensional/angular measurement values of posterior mandible according to Pell & Gregory/Winter Classification. Oral radiology. 2021 Jan; 37:29-35.
3. Tsai HH. Factors associated with mandibular M3M eruption and impaction. Journal of Clinical Paediatric Dentistry. 2006 Jan 1;30(2):109-14.
4. Capelli Jr J. Mandibular growth and M3M impaction in extraction cases. The Angle Orthodontist. 1991 Sep 1;61(3):223-9.
5. Ganss C, Hochban W, Kielbassa AM, Umstadt HE. Prognosis of M3M eruption. Oral Surg Oral Med Oral Pathol 1993; 76(6): 688e693.
6. Ventä I, Murtomaa H, Ylipaavalniemi P. A device to predict M3M eruption. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 1997 Dec 1;84(6):598-603.
7. Ghougassian SS, Ghafari JG. Association between mandibular M3M formation and retromolar space. The Angle Orthodontist. 2014 Nov 1;84(6):946-50.
8. Camargo IB, Sobrinho JB, Andrade ES, Van Sickels JE. Correlational study of impacted and non-functional M3M position with occurrence of pathologies. Progress in orthodontics. 2016 Dec; 17:1-9.
9. Al-Gunaid TH. Sex-related variation in the dimensions of the mandibular ramus and its relationship with M3M impaction. Journal of Taibah University Medical Sciences. 2020 Aug 1;15(4):298-304.
10. Gonca M, Gunacar DN, Kose TE, Karamehmetoglu I. Evaluation of mandibular morphologic measurements and trabecular structure among subgroups of impacted mandibular M3Ms. Oral Radiology. 2021 Apr 18:1-9.
11. Dachi SF, Howell FV. A survey of 3, 874 routine full-month radiographs. II. A study of impacted teeth. Oral Surg Oral Med Oral Pathol 1961; 14: 1165-1169 [PMID: 13883048]
12. Bishara SE, Andreasen G. M3Ms: a review. Am J Orthod 1983; 83: 131-137 [PMID: 6572040]
13. Segantin JD, Bisson GB, Chihara LL, Ferreira Júnior O. Tomographic analysis of relationship of mandibular morphology and M3Ms eruption. BMC Oral Health. 2023 Nov 23;23(1):915.
14. Kaur R, Kumar AC, Garg R, Sharma S, Rastogi T, Gupta VV. Early prediction of mandibular M3M eruption/impaction using linear and angular measurements on digital panoramic radiography: A radiographic study. Indian journal of dentistry. 2016 Apr;7(2):66.
15. Mollaoglu N, Çetiner S, Güngör K. Patterns of M3M impaction in a group of volunteers in Turkey. Clinical oral investigations. 2002 Jul; 6:109-13.
16. Quiros O. The mandibular M3M. A method of predicting its eruption. Available at: http://www.oc.g.com/3rdmolar/quirosocamelot.rect.ucv.ve. Accessed March 2007.
17. Saputri RI, De Tobel J, Vranckx M, Ockerman A, Van Vlierberghe M, Fieuws S, Thevissen P. Is M3M development affected by M3M impaction or impaction-related parameters. Clinical Oral Investigations. 2021 Dec; 25:6681-93.
18. Abu Alhaija ES, AlBhairan HM, AlKhateeb SN. Mandibular M3M space in different antero-posterior skeletal patterns. The European Journal of Orthodontics. 2011 Oct 1;33(5):570-6.
19. Yilmaz S, Adisen MZ, Misirlioglu M, Yorubulut S. Assessment of M3M impaction pattern and associated clinical symptoms in a central anatolian turkish population. Medical Principles and Practice. 2016 Feb 1;25(2):169-75.
20. Radhakrishnan PD, Varma NK, Ajith VV. Dilemma of gonial angle measurement: Panoramic radiograph or lateral cephalogram. Imaging science in dentistry. 2017 Jun;47(2):93.
21. Björk A, Jensen E, Palling M. Mandibular growth and third molar impaction. Acta odontologica scandinávica. 1956 Jan 1;14(3):231-72
22. Begtrup A, Grønastøð HÁ, Christensen IJ, Kjær I. Predicting M3M eruption on panoramic radiographs after cephalometric comparison of profile and panoramic radiographs. The European Journal of Orthodontics. 2013 Aug 1;35(4):460-6
23. Demirel O, Akbulut A. Evaluation of the relationship between gonial angle and impacted mandibular M3M teeth. Anatomical science international. 2020 Jan;95(1):134-42.
24. Sanchez MJ, Vicente A, Bravo LA. M3M agenesis and craniofacial morphology. Angle Orthod. 2009; 79:473–8.
25. Sugiki Y, Kobayashi Y, Uozu M, Endo T. Association between skeletal morphology and agenesis of all four M3Ms in Japanese orthodontic patients. Odontology. 2018; 106:282–8.
26. Endo T, Yoshino S, Ozoe R, Kojima K, Shimooka S. Association of advanced hypodontia and craniofacial morphology in Japanese orthodontic patients. Odontology. 2004; 92:48–53.