Journal of Taibah University Medical Sciences (2020) 15(4), 298–304

Taibah University

Journal of Taibah University Medical Sciences

www.sciencedirect.com

Original Article

Sex-related variation in the dimensions of the mandibular ramus and its relationship with lower third molar impaction

Talat H. Al-Gunaid, PhD

Department of Pediatric Dentistry and Orthodontics, College of Dentistry, Taibah University, KSA

Received 8 March 2020; revised 17 April 2020; accepted 21 April 2020; Available online 27 June 2020

Abstract

Objective: We conducted this study to assess possible sex-related variations in the dimensions of the mandibular ramus.

Methods: We divided 240 patients into two groups: an impacted lower third molar group of 115 subjects (68 men and 47 women) and a normally erupted lower third molar group of 125 subjects (89 men and 36 women).

Results: The study identified multiple sex-related differences between impacted and normally erupted lower molar groups. Men demonstrated greater values in the majority of variables compared to women. Furthermore, men in both the impacted and control groups had greater condylar length, coronoid process length, ramus height, ramal width, retromolar space, and retromolar space ratio than women. By contrast, women in both groups had a larger gonial angle, more upright lower posterior teeth, and more upright impaction than men. Both sexes in the control group had larger values for most measurements than their counterparts in the impacted group. Women in both groups had more upright posterior teeth and less inclined third molars.

Conclusion: In our study, men had greater values for most of the analysed variables compared to women. Configuration of the mandibular ramus is related to the sex, which might enhance the probability of third molar eruption or impaction.

Keywords: Lower third molar impaction; Mandibular dimensions; Mandibular ramus; Sex-related variation

الملخص

أهداف البحث: أجرينا هذه الدراسة لتقييم الاختلاف المحتمل بين الجنسين في أبعاد رأد الفك السفلي.

طرق البحث: تم تقسيم ٢٤٠ مريضا إلى مجموعتين: مجموعة انحشار الضرس السفلي الثالث لعدد ١١٥ شخصا (٦٨ من الرجال و٤٧ من النساء) والمجموعة الأخرى للمرضى بزوغ الضرس الثالث بشكل طبيعي لعدد ١٢٥ شخصا (٨٩ من الرجال و٣٦ من النساء).

النتائج: حددت الدراسة العديد من الاختلافات بين الجنسين بين مجموعات الضروس السفلية المحشورة وتلك التي بزغت بشكل طبيعي. أظهر الرجال قيما أكبر في معظم المتغيرات بالمقارنة بنظرائهم من النساء. بالإضافة إلى ذلك، أظهر الرجال في مجموعة الانحشار ومجموعة التحكم قيما أكبر في الطول اللقمي، وطول الناتىء الأكليلاني، وارتفاع الرأد، وعرض الرأد، والفراغ خلف الرحى ونسبة الفراغ خلف الرحى عن النساء. في المقابل، أظهرت النساء في المجموعتين زاوية رأد أكبر، واستقامة أكثر للأسنان الخلفية السفلية، وانحشار أكثر استقامة عن الرجال. كان كلا الجنسين في مجموعة التحكم لديهم قيما أكبر في معظم القياسات بالمقارنة بنظرائهم في مجموعة الانحشار. وأظهرت النساء في كلا المجموعتين استقامة أكثر للأسنان السفلية الخلفية وأقل ميلا للضروس الثالثة.

الاستنتاجات: في هذه الدراسة، أظهر الرجال قيما أكبر في معظم المتغيرات المحللة عن النساء. تكوين رأد الفك السفلي يتعلق بالجنس، مما قد يزيد من احتمالية بزوغ أو انحشار الضرس الثالث.

الكلمات المفتاحية: أبعاد الفك السفلي؛ رأد الفك السفلي؛ الاختلاف بين الجنسين؛ انطمار الضرس الثالث السفلي

Corresponding address: Department of Pediatric Dentistry and Orthodontics, College of Dentistry, Taibah University, KSA.

E-mail: gunaid2000@hotmail.com

Peer review under responsibility of Taibah University.

ELSEVIER Production and hosting by Elsevier

1658-3612 https://doi.org/10.1016/j.jtumed.2020.04.008

Introduction

Impacted teeth have become a major concern in the last four decades and remain a subject of interest among many researchers.[1] The most frequently affected tooth continues to be the lower third molar. The correlation between lower third molar impaction and its influence on the crowding of anterior teeth is still debated. The aetiology of mandibular third molar impaction is unknown, but contributing factors include a discrepancy between tooth and jaw size, ramus width, and the inclination of the lower posterior dentition.[2] In order to assess impaction, various techniques are commonly used, such as panoramic[3,4] and cephalometric images,[5] cone beam computed tomography,[6] and magnetic resonance imaging.[7] Of these, panoramic images are considered to be the most cost-effective and provide a broad outline of the dentition with less radiation exposure. However, like any method, panoramic images have some disadvantages, including difficulty in assessing skeletal relationships, image distortion, and magnification errors.[8,9] Panoramic images have been used extensively for the evaluation of mandibular body size and height; the accuracy of such measurements has been established and found to be reliable.[4,10]

Using panoramic images, Al-Gunaid et al.[11] focused on the correlation between third molar impaction and ramus dimensions. In terms of the latter, they reported significant differences between subjects with mandibular third molar impaction and those with normally erupted molars. Despite this finding, there are still controversial sex-related variations in lower third molar impaction. The aim of this investigation was to explore the possible sex-related variations in mandibular ramus dimensions, with a focus on subjects with impacted lower third molars compared to those with normally erupted teeth.

Materials and Methods

The Ethics Committee of the Faculty of Dentistry, Taibah University, approved this study. The records of 2981 patients who were seeking dental services at the dental hospital were checked and 240 panoramic radiographs that satisfied our inclusion criteria were selected.

The criteria for inclusion were as follows: the subject was aged ≥21 years, with good panoramic images, fully erupted mandibular dentition, and no previous or ongoing orthodontic treatment.

The patients were divided into two different groups based on the position of the mandibular third molars:

- Impacted group: 115 subjects (68 men [117 sides] and 47 women [86 sides]). Two hundred and three sides showed mesioangular impaction of the mandibular third molar.
- Control group: 125 subjects (89 men [178 sides] and 36 women [71 sides]) with normal eruption of the lower third molar.

The age of subjects ranged from 21 to 54 (mean, 27.2 ± 6.7) years. A panoramic-cephalometric machine was used to obtain the panoramic images (Kodak 8000 C Digital Panoramic and Cephalometric, Netherlands).

Once taken, the panoramic images were exported to Image J 1.48a software, which was used to mark images (Figure 1).

Twelve linear and four angular measurements were made (19 landmarks) (Figures 1–3).

Statistical analyses

Descriptive statistics for the two groups were obtained, and comparisons between the control and impacted groups were made using Student's t-test using SPSS software (V 20, Chicago, USA).

Results

Table 1 shows the comparison of mandibular dimensions of men and women in the impacted group. Men demonstrated significantly greater values in all of the following parameters: condylar length, coronoid process length, ramus heights, ramal width, mandibular body length, sigmoid notch depth, retromolar space, and retromolar space/third molar width ratio ($P < 0.001$), and a larger angle between the condyle and coronoid process ($P < 0.05$) than the women included in the investigation. On the contrary, only three measurements were significantly larger in women than in men: gonial angle ($P < 0.05$), mandibular posterior teeth inclination ($P < 0.001$), and impaction angle ($P < 0.001$).

Table 2 shows a comparison between men and women in the control group. The male subjects demonstrated significantly greater values than female subjects for the following variables: coronoid process length and ramal width ($P < 0.05$), ramus height, total ramus height, retromolar space, and ratio between retromolar space and third molar width ($P < 0.001$). By contrast, women had a deeper posterior ramus notch, deeper anterior ramus notch, more upright lower posterior teeth, and a more upright angle of impaction than men ($P < 0.001$).

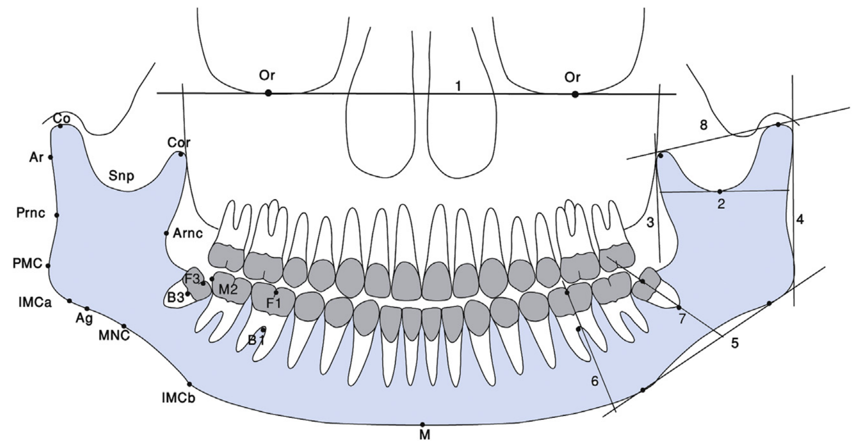

Figure 1: Landmarks and reference planes: Landmarks: Orbitale (Or) = the lowermost point of the bony orbit, condylion (Co) = most superior point of the head of the mandibular condyle, coronoid point (Cor) = most superior point of the coronoid process, sigmoid notch point (Snp) = the deepest point of the sigmoid notch of the mandible, articulare (Ar) = a constructed point at the intersection between the external contour of the cranial base and dorsal contour of the condylar head or neck, PMC = the point of greatest convexity on the posterior border of the angular process of the mandible, posterior ramus notch (Prnc) = the deepest point of the posterior ramus notch concavity, anterior ramus notch (Arnc) = the deepest point of the anterior ramus notch concavity, gonion (Go) = the constructed point of the intersection of the ramus plane and mandibular plane, IMCa = posterior point of the greatest convexity on the inferior border of the mandible, IMCb = anterior points of greatest convexity on the inferior border of the mandible, MNC = the deepest point of the mandibular inferior border notch concavity, antegonion point (Ag) = the point in the antegonial notch of the mandible where the ramus joins the body of the mandible, mandibular midpoint (M) = the most inferior midline point on the mandibular symphysis located by projecting the mental spine on the lower mandibular border, F1 = the midpoint of the occlusal surface corresponding to fossa of the first molar, B1 = the point corresponding to the bifurcation of the first molar, F3 = the midpoint of the occlusal surface corresponding to fossa of the third molar, B3 = the point corresponding to the bifurcation of the third molar, M2 = the distal contact point of lower second molar. Reference Planes: Orbitale plane = the line connecting the bilateral orbitale (Or) points, Sigmoid notch plane = a tangent drawn from the deepest point on the sigmoid notch (Snp) parallel to the orbital plane, Z-plane = a tangent drawn to the descending anterior border of the ramus of the mandible, perpendicular to the sigmoid notch plane, Ramus plane = a tangent to the posterior ramus connecting point Ar with the point of greatest convexity on the posterior border of the angular process of the mandible (PMC), Mandibular plane = a tangent to the lower border of the mandibular body, through the two points of greatest convexity on the inferior border of the mandible (IMCa and IMCb), Long axis of the first molar = a line drawn through the midpoint of the occlusal surface and midpoint of the bifurcation of the first molar, Long axis of the third molar = a line drawn through the midpoint of the occlusal surface and midpoint of the bifurcation of the third molar, Condyle-coronoid plane = a line connecting the condylion (Co) and coronoid (Cor) points.

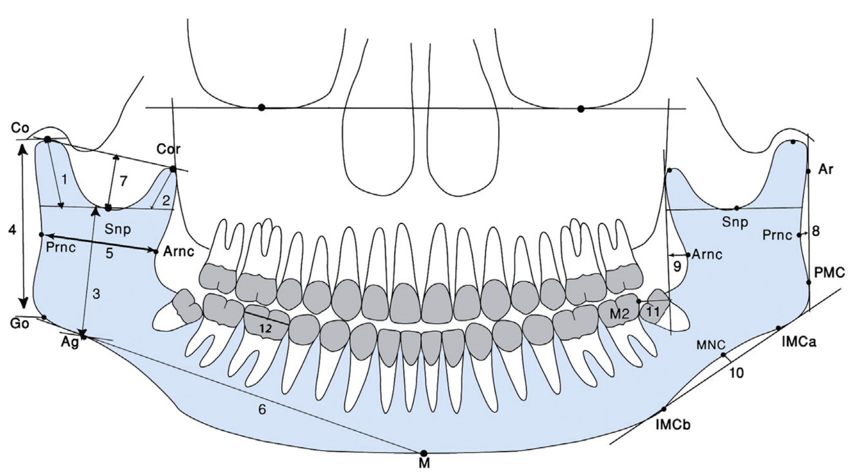

Figure 2: Linear measurements (mm). Condyle length (Co− Snp) = measured from the condylion to the sigmoid notch plane along the long axis of the condylar process, Coronoid length (Cor− Snp) = measured from the coronoid point to the sigmoid notch plane along the long axis of the coronoid process, Ramus height (Snp − Ag) = the distance between the sigmoid notch point to the antegonion point (excluding the condyle and coronoid), Total ramus height (Co-Go) = the distance between the condylion and gonion, Ramus width (Prnc − Arnc) = the distance from the anterior to posterior ramal walls at the level of the mid-point, Mandibular body length (Go − M) = measured from the gonion point to the mandibular midpoint, Sigmoid notch depth = the distance along a perpendicular line from the deepest point of the sigmoid notch to a line extending from the condylion and coronoid process, Posterior ramus notch depth = the distance along a perpendicular line from the deepest point of the ramus notch concavity (Prnc) to a line connecting the point Ar with the point of greatest convexity on the posterior border of the angular process of the mandible (PMC), Anterior ramus notch depth = the distance along a perpendicular line from the deepest point of the anterior ramus notch concavity (Arnc) to Z- line (a line perpendicular to sigmoid notch plane and tangent to descending anterior border of the ramus of mandible, Antegonial notch depth = the distance along a perpendicular line from the deepest point of the mandibular inferior border notch concavity (MNC) to mandibular plane, Retromolar space (M2−Z) = the distance between the distal contact point of the second molar and a line perpendicular to Z plane, Third molar width = the mesiodistal tooth width, Retromolar space/third molar width ratio = retromolar space divided by the third molar width.

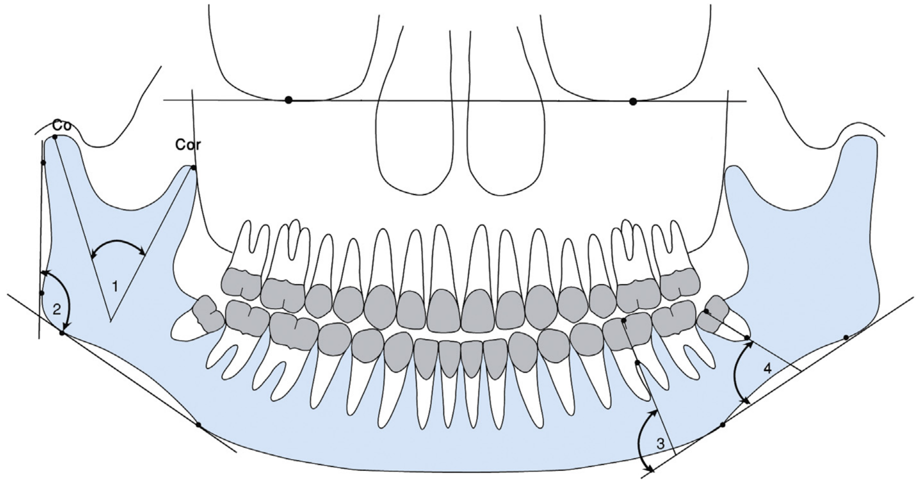

Figure 3: Angular Measurements (degrees). Angle between the condyle and coronoid process (Co−Cor) = Formed by the intersection between the two lines drawn from the Co and Cor along their long axis, Gonial angle (Ar and PMC-IMCa and IMCb) = the angle formed by drawing two lines: the ramus plane (Ar and PMC) and mandibular plane (IMCa and IMCb), Inclination of lower posterior teeth (L6−MP) = the angle formed between the long axis of the first molar (drawn through the midpoint of the occlusal surface and the midpoint of the bifurcation) and the mandibular plane, Angle of impaction (L8−MP) = the angle formed between the long axis of the third molar (drawn through the midpoint of the occlusal surface and midpoint of the bifurcation) and the mandibular plane.

Table 1: Comparison of the means and standard deviations between men and women in the impacted group.

Variable	Males (n = 68)		Females (n = 47)		P-value
	Mean	SD	Mean	SD	
Condyle length (mm)	16.78	3.09	15.34	2.77	0.001
Coronoid length (mm)	13.04	3.10	11.73	2.85	0.003
Ramus height (mm)	47.25	4.05	40.17	4.87	0.000
Total ramus height (mm)	57.70	5.33	49.91	4.97	0.000
Ramal width (mm)	28.68	2.93	26.57	2.94	0.000
Mandibular body length (mm)	89.59	6.37	84.65	8.17	0.000
Sigmoid notch depth (mm)	13.39	2.18	12.29	2.02	0.000
Posterior ramus notch depth (mm)	2.47	0.88	2.58	0.66	0.36
Anterior ramus notch depth (mm)	2.72	1.56	2.87	1.58	0.52
Antegonial notch depth (mm)	1.85	1.03	1.74	0.70	0.39
Third molar width (mm)	10.88	1.02	11.01	0.87	0.32
Retromolar space (mm)	9.34	3.30	6.61	3.09	0.000
Retromolar space/third molar width ratio	0.86	0.31	0.60	0.27	0.000
Angle between condyle and coronoid process (deg)	42.33	8.55	39.62	10.22	0.04
Gonial angle (deg)	124.13	7.81	127.37	8.51	0.01
Inclination of lower posterior teeth (deg)	75.30	6.28	95.64	6.92	0.000
Angle of impaction (deg)	28.67	20.41	53.86	16.98	0.000

n = number of subjects.

Comparison between the impacted and control groups by sex is displayed in Table 3. Men in the control group exhibited a greater total ramus height than those in the impacted group (difference: 2.49 mm, $P < 0.001$), as well as a deeper sigmoid notch (0.62 mm), deeper posterior and anterior notch depths (0.22 mm and 0.46 mm, respectively), larger retromolar space (2.46 mm), greater ratio between retromolar space and third molar width (0.20 mm), a smaller angle between condyle and coronoid process (−2.1°, $P < 0.05$), less inclined lower posterior teeth (1.6°, $P < 0.05$), and finally, a less inclined lower third molar (37.9°, $P < 0.001$).

Regarding women, those in the control group had considerably greater measurements than their counterparts in the impacted group. This was true for all variables with the exception of coronoid process length, antegonial notch depth, third molar width, and angle between the condyle and coronoid process (Table 3).

Table 2: Comparison of the means and standard deviations between men and women in the control group.

Variable	Males (n = 89)		Females (n = 36)		P-value
	Mean	SD	Mean	SD	
Condyle length (mm)	17.41	3.26	18.04	2.95	0.16
Coronoid length (mm)	13.56	3.14	12.43	2.85	0.01
Ramus height (mm)	48.19	5.34	41.91	3.55	0.0000
Total ramus height (mm)	60.20	5.48	54.03	4.17	0.0000
Ramal width (mm)	29.39	3.35	28.40	3.77	0.04
Mandibular body length (mm)	89.23	7.73	87.86	6.89	0.19
Sigmoid notch depth (mm)	14.01	2.36	13.75	2.14	0.42
Posterior ramus notch depth (mm)	2.70	0.87	3.43	0.92	0.0000
Anterior ramus notch depth (mm)	3.19	1.93	4.01	2.26	0.0044
Antegonial notch depth (mm)	1.94	1.11	1.76	0.71	0.21
Third molar width (mm)	11.07	0.87	10.99	1.08	0.56
Retromolar space (mm)	11.81	3.12	8.21	3.33	0.0000
Retromolar space/third molar width ratio	1.07	0.30	0.75	0.30	0.0000
Angle between condyle and coronoid process (deg)	40.23	7.67	38.71	9.97	0.20
Gonial angle (deg)	122.67	7.67	124.61	6.17	0.06
Inclination of lower posterior teeth (deg)	76.97	6.36	92.45	5.28	0.0000
Angle of impaction (deg)	66.67	9.62	86.08	8.62	0.0000

n = number of subjects.

Table 3: Means, standard deviations, differences between means, and standard errors of the difference in the control and impacted groups by sex.

Variable	Men: Control vs. Impacted						Women: Control vs. Impacted					
	Control (n = 89)		Impacted (n = 68)		Difference between means	Std error of difference	Control (n = 36)		Impacted (n = 47)		Difference between means	Std error of difference
	Mean	SD	Mean	SD			Mean	SD	Mean	SD		
Condyle length (mm)	17.41	3.26	16.78	3.09	0.63	0.38	18.04	2.95	15.34	2.77	2.69***	0.46
Coronoid length (mm)	13.56	3.14	13.04	3.10	0.51	0.37	12.43	2.85	11.73	2.85	0.70	0.46
Ramus height (mm)	48.19	5.34	47.25	4.05	0.93	0.58	41.91	3.55	40.17	4.87	1.73*	0.69
Total ramus height (mm)	60.20	5.48	57.70	5.33	2.49***	0.65	54.03	4.17	49.91	4.97	4.11***	0.74
Ramal width (mm)	29.39	3.35	28.68	2.93	0.71	0.38	28.40	3.77	26.57	2.94	1.82*	0.54
Mandibular body length (mm)	89.23	7.73	89.59	6.37	−0.36	0.86	87.86	6.89	84.65	8.17	3.2*	1.23
Sigmoid notch depth (mm)	14.01	2.36	13.39	2.18	0.62*	0.27	13.75	2.14	12.29	2.02	1.46***	0.33
Posterior ramus notch depth (mm)	2.70	0.87	2.47	0.88	0.22*	0.10	3.43	0.92	2.58	0.66	0.85***	0.12
Anterior ramus notch depth (mm)	3.19	1.93	2.72	1.56	0.46*	0.21	4.01	2.26	2.87	1.58	1.14***	0.31
Antegonial notch depth (mm)	1.94	1.11	1.85	1.03	0.08	0.13	1.76	0.71	1.74	0.70	0.01	0.11
Third molar width (mm)	11.07	0.87	10.88	1.02	0.19	0.11	10.99	1.08	11.01	0.87	−0.03	0.15
Retromolar space (mm)	11.81	3.12	9.34	3.30	2.46***	0.38	8.21	3.33	6.61	3.09	1.59**	0.51
Retromolar space/third molar width ratio	1.07	0.30	0.86	0.31	0.20***	0.04	0.75	0.30	0.60	0.27	0.14**	0.04
Angle between condyle and coronoid process (deg)	40.23	7.67	42.33	8.55	−2.1*	0.96	38.71	9.97	39.62	10.22	−0.91	1.63
Gonial angle (deg)	122.67	7.67	124.13	7.81	−1.45	0.92	124.61	6.17	127.37	8.51	−2.76*	1.22
Inclination of lower posterior teeth (deg)	76.97	6.36	75.30	6.28	1.6*	0.75	92.45	5.28	95.64	6.92	−3.19**	1.00
Angle of impaction (deg)	66.67	9.62	28.67	20.41	37.9***	1.77	86.08	8.62	53.86	16.98	32.21***	2.22

n = number of subjects.
*P<0.05, **P<0.01, ***P<0.001.

Discussion

The results of this study revealed multiple sex-related differences between the impacted and control groups, with men demonstrating greater values for most variables in comparison to those in women. This supports the findings of Indira et al.,[10] who reported that all mandibular measurements were greater in men than in women. It was also found that the condyle length and total ramus heights in both men and women in the control group were higher than those in the impacted group. These outcomes are in line with previously reported results.[11]

Al-Gunaid et al.[11] reported a significant but imperceptible correlation between retromolar space and ramus heights. The authors concluded that 'these parameters could be a relevant indicator for predicting the eruption or impaction of third molars'. Regarding mandibular body length (Go−M), no difference was identified between the male subjects in the control and impacted group. By contrast, women in the control group had a mandibular body length that was 3.2 mm ($P < 0.05$) greater than that in women in the impacted group (Table 3). This is consistent with a previous study conducted by Hassan,[12] who reported a significantly shorter mandibular length in impacted female subjects. Additionally, Begtrup et al.[9] reported a significant association between mandibular length and eruption of the third molar. Although this contradicts the current study's finding in male patients, it does agree with the results in female patients.

Both sexes in the control group had a deeper sigmoid notch than members of the impacted group (Table 3). This outcome is supported by Al-Gunaid et al.[11] who attributed the result to the smaller angle between the condyle and coronoid process and longer ramus heights in the control group than those in the impacted group (this results in less backward and forward slope of the posterior and anterior margins of the ramus in the control group). Subsequently, this suggests that the sigmoid notch depth in the control group is more likely to be more in-depth.

The findings of this investigation showed that the posterior and anterior ramus notches were remarkably shallower in both males and females of the impacted group than in those in the control group. Al-Gunaid et al.[11] attributed this difference to 'the failure of remodelling of the anterior and posterior surfaces of the ramus, as well as the more backward and forward slope of the anterior and posterior borders of the ramus presented by the significantly smaller angle between the condyle and coronoid process in the impacted group'.

The current study revealed that the average retromolar space was bigger in the control group than in the impacted group, and this was the case for both sexes. Furthermore, women in both groups had a smaller retromolar space than men (Tables 2 and 3). This partially refutes the findings of Hattab and Alhaija,[13] who found there to be less retromolar space in the female control group only. This disparity may be the result of a difference in the measurement technique.

Additionally, women in the impacted group had a smaller retromolar space (6.61 mm) than women in the control group (8.21 mm), with a mean difference of 1.59 mm (Table 3). This difference is smaller than the 3.05-mm mean difference reported by Hattab and Alhaija.[13]

Ganss et al.[14] determined that the probability of third molar eruption reaches 70% if the retromolar space is 13.9 mm in women, and 14.3 mm in men. Moreover, Venta[15] stated that the probability of eruption becomes higher—with the potential to reach 100%—when the retromolar space is 16.5 mm. Uthman[16] claimed that this space should be larger than 11 mm for women and 12 mm for men. This agrees with the findings for the men in our control group.

The average space/crown width ratio was greater in the control group (1.07 for men and 0.75 for women) than in the impacted group (0.86 for men and 0.60 for women), a result that is relatively similar to that reported by Hattab and Alhaija.[13] This could be attributed to similarities in the inclusion criteria. Previous reports[17] suggested that if the ratio of retromolar space to third molar mesiodistal width is at least one, 69% of third molars erupt, a result that is inconsistent with our present finding. No explanation can be suggested to elucidate this difference.

On review of the current findings, there was no significant difference when comparing the gonial angle between men in the control and impacted groups. However, significant variation was evident in women; measurements were higher in the impacted group than in the control group. Some reports have found a more acute gonial angle in the impacted group than in the normal group,[17] something which was not found in our groups. Our findings are consistent with those obtained by Al-Gunaid et al.,[11] who failed to identify any association between the magnitude of the gonial angle and third molar impaction. However, this does not support the results of Behbehani et al.,[2] who reported that a small mandibular plane and gonial angle are correlated with an increased chance of third molar impaction.

Interestingly, women in both the impacted and control groups had more upright posterior teeth and less inclined third molars. This resulted in less retromolar space in women than in men. No explanation for this difference can be provided. This finding, however, contrasts with that of Alhaija and Wazwaz,[18] who reported that the probability of impaction is greater when the posterior teeth are in a more inclined position. Uthman[16] concluded that the third molar inclination angle should be larger than 40°, as when the angle decreases, the chance of impaction increases, thus agreeing with the results of the present study.

Despite the limitations of this study, as this research ideally should have been performed in young adults, recruiting samples from different racial backgrounds and with different types of malocclusion, some obvious variations detected between the groups could be useful when it comes to prediction and treatment planning.

Conclusion

The male subjects demonstrated greater values for most of the variables compared to the female subjects. The configuration of the mandibular ramus is sex-related, which might enhance the probability of third molar eruption or impaction.

Source of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

The author has no conflict of interest to declare.

Ethical approval

This study was approved by the Ethical Committee, Faculty of Dentistry, Taibah University.

Acknowledgment

The author would like to thank Dr Abdul Kadir Bukhari, College of Dentistry, Taibah University, and Dr Sara M. El Khateeb, College of Dentistry, Princess Noura Bint Abdulrahman University, for their support and valuable time.

References

1. Qamruddin I, Qayyum W, Haider SM, Siddiqui SW, Rehan F. Differences in various measurements on panoramic radiograph among erupted and impacted lower third molar groups. **J Pakistan Med Assoc 2012**; 62(9): 883−887.
2. Behbehani F, Årtun J, Thalib L. Prediction of mandibular third-molar impaction in adolescent orthodontic patients. **Am J Orthod Dentofacial Orthop 2006**; 130(1): 47−55.
3. Sohal KS, Moshy JR, Owibingire SS, Simon EN. Association between impacted mandibular third molar and occurrence of mandibular angle fracture: a radiological study. **J Oral Maxillofac Radiol 2019**: 725−729.
4. Kaur R, Kumar A, Garg R, Sharma S, Rastogi T, Gupta V. Early prediction of mandibular third molar eruption/impaction using linear and angular measurements on digital panoramic radiography: a radiographic study. **Indian J Dent 2016**; 7(2): 66−69.
5. Malik DES, Fida M. Association between maxillary posterior segment discrepancy and the angulation of maxillary molars in patients with different vertical growth patterns. J Ayub Med Coll Abbottabad **31** (4) 496−501.
6. Chen Y, Zheng J, Li D, Huang Z, Huang Z, Wang X, et al. Three-dimensional position of mandibular third molars and its association with distal caries in mandibular second molars: a cone beam computed tomographic study. **Clin Oral Invest 2020**; 14: 1−9.
7. Kindler S, Ittermann T, Bülow R, Holtfreter B, Klausenitz C, Metelmann P, et al. Does craniofacial morphology affect third molars impaction? Results from a population-based study in northeastern Germany. **PloS One 2019**; 14(11):e0225444.
8. Gupta SJS. Orthopantomographic analysis for assessment of mandibular asymmetry. **J Indian Orthod Soc 2012**; 46: 33−37.
9. Begtrup A, Gronastoth HA, Christensen IJ, Kjaer I. Predicting lower third molar eruption on panoramic radiographs after cephalometric comparison of profile and panoramic radiographs. **Eur J Orthod 2013**; 35(4): 460−466.
10. Indira AP, Markande A, David MP. Mandibular ramus: an indicator for sex determination - a digital radiographic study. **J Forensic Dent Sci 2012**; 4(2): 58−62.
11. Al-Gunaid TH, Bukhari AK, El Khateeb SM, Yamaki M. Relationship of mandibular ramus dimensions to lower third molar impaction. **Eur J Dent 2019**; 13(2): 213−221.
12. Hassan AH. Mandibular cephalometric characteristics of a Saudi sample of patients having impacted third molars. **Saudi Dent J 2011**; 23(2): 73−80.
13. Hattab FN, Alhaija ES. Radiographic evaluation of mandibular third molar eruption space. **Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999**; 88(3): 285−291.
14. Ganss C, Hochban W, Kielbassa AM, Umstadt HE. Prognosis of third molar eruption. **Oral Surg Oral Med Oral Pathol 1993**; 76(6): 688−693.
15. Ventä I, Murtomaa H, Turtola L, Meurman J, Ylipaavalniemi P. Clinical follow-up study of third molar eruption from ages 20 to 26 years. **Oral Surg Oral Med Oral Pathol 1991**; 72(2): 150−153.
16. Uthman AT. Retromolar space analysis in relation to selected linear and angular measurements for an Iraqi sample. Oral Surgery. **Oral Med Oral Pathol Oral Radiol Endod 2007**; 104(4): e76−e82.
17. Mollaoglu N, Çetiner S, Güngör K. Patterns of third molar impaction in a group of volunteers in Turkey. **Clin Oral Invest 2002**; 6(2): 109−113.
18. Abu Alhaija ES, Wazwaz FT. Third molar tooth agenesis and pattern of impaction in patients with palatally displaced canines. **Angle Orthod 2019**; 89(1): 64−70.

How to cite this article: Al-Gunaid TH. Sex-related variation in the dimensions of the mandibular ramus and its relationship with lower third molar impaction. J Taibah Univ Med Sc 2020;15(4):298−304.