CBCT Based Evaluation of the Anatomical Variation of Retromolar Canal in A Sample of Egyptian Population. A Retrospective Study

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Abstracts Aim: The goal of this study is to estimate the prevalence of the retromolar in the Egyptian population and to enhance the allocation of the retromolar canals and foramina.

Methodology: Using a Newtom Giano HR CBCT system, radiographic evaluation of 250 CBCT scans was performed. According to the manufacturer's guidelines, multiple FOVs were used with the same voxel size (0.3 mm) to produce distinct scans for different patient sizes. The presence of retromolar canal was checked for, using the CBCT scans. Linear measurements were made from the retromolar foramen to the mandibular foramen in an anteroposterior and a mediolateral directions, as well as to the lower second and third molars, and their courses was divided into three basic classes.

Results: In this study, retromolar canal was absent in sides 207 (82.8%) while was presented in 43 (17%), absence of retromolar canal was significantly higher than its presence as P<0.0001. Regarding distribution, bilateral side (16.3%) was significantly lower than unilateral distribution (83.7%) as P<0.0001. In class distribution, class A (70%) was significantly the highest, while class C (6%) was significantly the lowest.

Conclusion: The prevalence of retromolar canal in the Egyptian population is 17%. When evaluating the retromolar region to identify the presence of the retromolar canal and retromolar foramen to prevent problems after various dental surgical procedures, the use of CBCT is crucial.

Keywords: Retromolar canal, CBCT, Bifid mandibular canal.

1. INTRODUCTION

Dental practice, particularly in the fields of surgery and implant surgical procedures, requires a thorough understanding of the normal morphology of the human mandible and any potential anatomical deviations.1

The mandible and mandibular teeth are primarily innervated and supplied with blood through the mandibular canal (MC) and its branches. The mandible possesses numerous distinct nerve canals when it is an embryo, but most of them vanish or combine into one or more main canals over the following developmental stages.2

The anterior margin of the mandibular ramus, the temporal crest, and the distal surface of the final mandibular molar serve as the boundaries of the retromolar area. A retromolar canal can be seen developing through the retromolar foramen in this region.1

Numerous foramina greater than 0.1 mm in diameter have reportedly been found on the surface of the mandibular posterior segment. These foramina frequently connect to the inferior alveolar nerve or its dental branches or a neurovascular plexus in the spongy part of the mandibular bone. The largest foramina are located in the retromolar area, and the retromolar canals (RMCs) correspond to these foramina (Retromolar foramina 'RMFs'). These canals are occasionally regarded as a specific variety of bifid mandibular canal.3,4

The identification of the retromolar canal has become a clinical problem due to the rising demand for surgical procedures in the mandibular retromolar region. It can complicate surgical treatments in the retromolar region and third molar root canal therapy since the third molar and some of the muscles around the posterior section of the mandible are innervated by it.5

Although the RMC's clinical importance has not been well investigated, the possibility that it contributes to the third molar's innervation can put the success of endodontic therapy for this tooth at risk. Since some of the mandibular nerve's branches reach the mandible through theretromolar canal, its presence can also be thought of as a significant factor in the failure of some mandibular nerve block injections. Additionally, the retromolar foramina allow for the spread of infections and tumours in the retromolar region to other regions. Furthermore, during tooth extraction, bone harvesting, and implant installation, traumatization of the contents of this canal can also be problematic and result in hematomas, bleeding, and sensory impairment in the region around the lower wisdom tooth and its buccal mucosa.6

The retromolar canal's position in the retromolar region distal to the mandibular wisdom makes it extremely significant. Many surgical operations are performed in the retromolar region, including the removal of impacted lower wisdom teeth, sagittal split osteotomies, bone harvesting, and implant insertion. Due to accessory innervation from the retromolar nerve, severe bleeding, facial paresthesia, and traumatic neuromas are just a few of the negative consequences that can result from not being aware of this variation during various dental procedures.7

The detection of all anatomical structures, and in particular the existence of the retromolar canal, cannot be done with the traditional two-dimensional (2D) radiographs such as the orthopantograms. Anatomical differences of the mandibular canal that cannot be seen on panoramic radiographs can now be confirmed with notable accuracy thanks to the widespread availability of CBCT, which was developed expressly for use in dentistry.8,9

Consequently, the purpose of the current study was to assess the frequency of the retromolar canals in CBCT scans and pinpoint their positions and their foramina in order to link them to potential clinical consequences.

MATERIALS AND METHODS

In this retrospective study, 250 CBCT scans were analyzed fulfilling the sample size calculation result based on the previous paper by Alves et al.6

The Ethical Committee of October University of modern sciences and arts has been granted an ethical approval for this research with the number REC-D 828-3.

Using Newtom Giano HR CBCT system, scans with different FOVs of voxel size (0.3 mm (300 μm)) were studied using NNT software viewer. The scans were interpreted by two oral and maxillofacial radiologists (with different experiences) independently and blinded from demographic data of patients and from the results of each other. One radiologist evaluated the images for the presence of RMC twice with a time lag of two weeks between the two reading sessions for intra-observer reliability. If present, its configuration (classification) was registered. The two observers evaluated 40% of the total sample size for inter-observer reliability assessment.

1. Eligibility criteria and selection method: Scans of patients aged from 20 to 75 and showing the retromolar area and the last molars were included, whereas, scans of patients with mandibular lesions, severe metallic artifacts, previous fractures or surgeries and severe bone resorption till the level of the mandibular canal were excluded from this study.

All RMCs were classified according to their course and direction into three main types according to Patil et al.'s classification.10(Fig. 1):

1. Type A in which the RMC branches from the mandibular canal distal to the third molar and course superiorly to open in the retromolar area with RMF. (Fig. 1a) and (Fig. 1b). In 1a, the canal runs in a straight manner superiorly to open in the retromolar area; however, in1b, the canal runs in a curved manner anteriorly then postero-superiorly to open the retromolar area.
2. Type B in which the canal starts from the retromolar area by the RMF and ends in the radicular portion of the 3rd molar (Fig. 1c).
3. Type C in which the canal starts branching early from the mandibular canal near the mandibular foramen and ends in a higher level in the retromolar area (Fig. 1d).

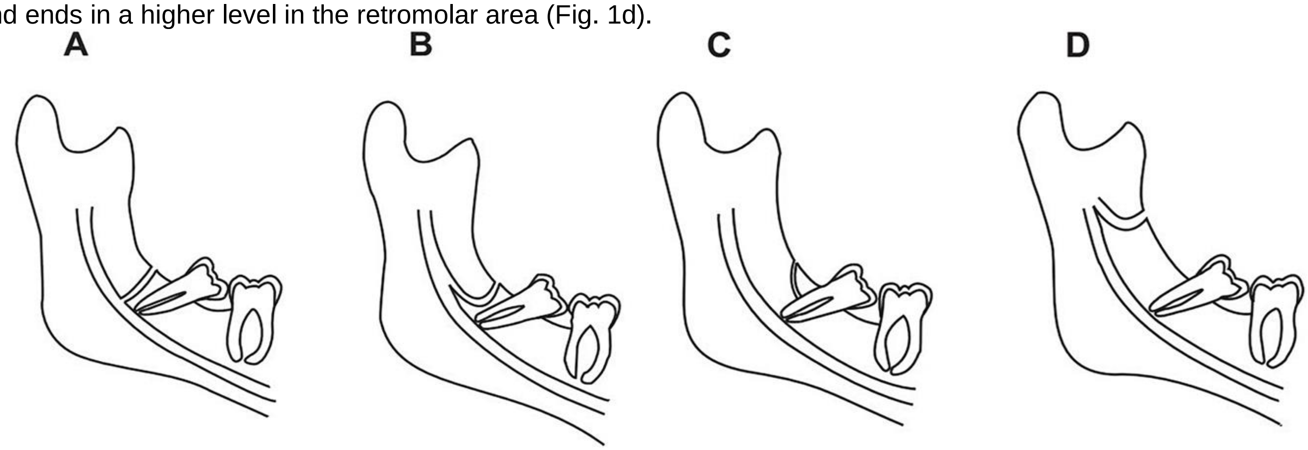

Figure 1 Patil et al.'s classification of the RMC

DETECTION OF THE RETROMOLAR CANAL:

Before analysis of images, all slice thicknesses and inter-slice distances were adjusted to be 0.3 mm. For proper assessment of the mandibular canal, axial cuts were scrolled to reach a cut with the most adequately displayed mandibular foramen. Reference lines were rotated on the axial image, so that the coronal reference line was perpendicular to the mandibular foramen. This step was repeated also at the mental foramen to assess both areas.

Each case was first examined on the multi-planner reconstruction (MPR). Axial, coronal, and sagittal views were scrolled to identify the presence of RMF or RMC. Scans were examined thoroughly for the presence of any opening on the outer surface of the mandible in the retromolar area, which may indicate the RMF or any branching from the inferior alveolar canal. Cross sections, reconstructed panoramic view, and reconstructed slice panoramic view were also scrolled thoroughly in arch-section module to facilitate tracing of the inferior alveolar canal (IAC) and identify any sign of branching in the retromolar area from the IAC indicating the presence of RMC (Fig. 2).

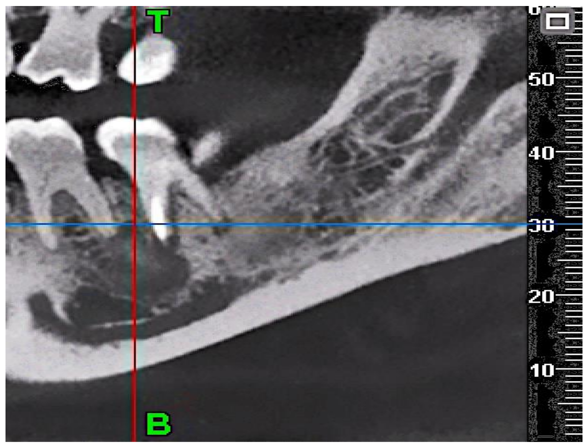

Figure 2 Slice view of sagittal image, showing the RMC class A

When the RMF and RMC are identified, linear measurements were done and recorded for statistical analysis. Sagittal cut was adjusted to be passing through the RMF and the middle of the 2nd and the 3rd molars, and then, linear measurement was done in the anteroposterior direction (Fig. 3). Axial cut was adjusted to be passing through the RMF and the mandibular foramen (MF), and the linear measurements was done between them in both anteroposterior (Fig. 4) and mediolateral directions. Where, a line is drawn from the middle of the RMF perpendicular to the sagittal plane reference line and a line is drawn from the middle of the MF perpendicular to the sagittal plane reference line to measure the distance between RMF and MF in anteroposterior direction. While, a line is drawn from the middle of the RMF parallel to the sagittal plane reference line and another line is drawn from the middle of the MF parallel to the sagittal plane reference line for linear measurements between the RMF and MF in mediolateral directions. Consequently, for linear measurements between the RMF and the 2nd and 3rd molars in anteroposterior direction, in the sagittal cut a line is drawn from the RMF perpendicular to the axial plane reference line and another line tangent to the 3rd molar or 2nd molar distal surface and perpendicular to the axial plane reference line is drawn and distance between them is measured by the software measuring tool.

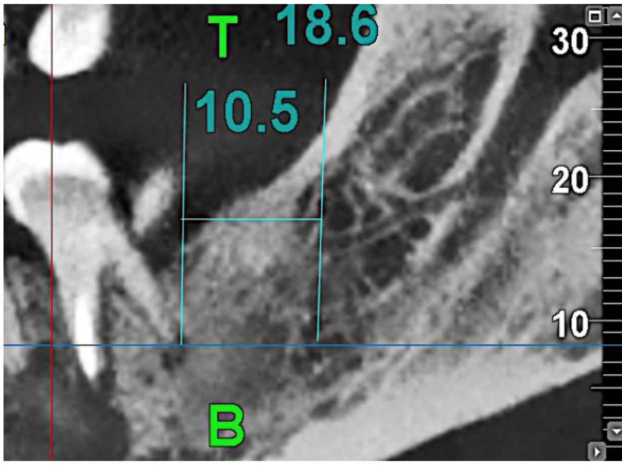

Figure 3 Sagittal cut showing linear measurement between 3rd molar and RMF an anteroposterior direction

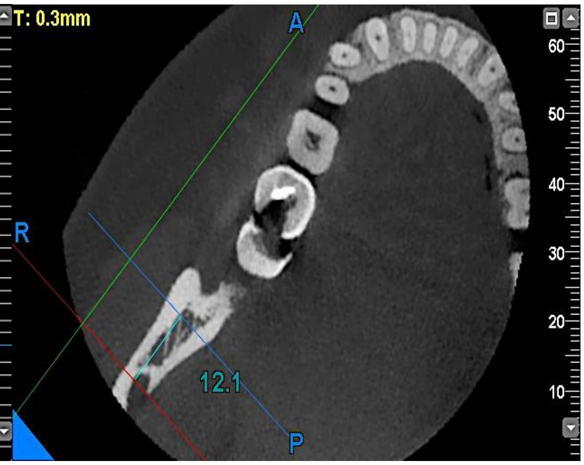

Figure 2 Sagittal cut showing linear measurement between MF and RMF in an anteroposterior direction

STATISTICAL ANALYSIS

In this study, retromolar canal was absent in sides 207 (82.8%) while was presented in 43 (17%), absence of retromolar canal was significantly higher than its presence as P<0.0001. Regarding distribution, bilateral side (16.3%) was significantly lower than unilateral distribution (83.7%) as P<0.0001. In class distribution, class A (70%) was significantly the highest, while class C (6%) was significantly the lowest, as presented in table (1) and figure (5).

Table 1: Frequency and percentages of Retromolar canal incidence , unilateral and bilateral distribution and different classes among all patients (descriptive results):

		N	%	P value
Retro molar canal	Absence	207	82.8	<0.0001**
	Presence	43	17	
Distribution	Bilateral	7	16.3	<0.0001**
	Unilateral	36	83.7	
Class	Class A	35	70	<0.0001**
	Class B	12	24	
	Class C	3	6	

N: frequency %: percentage ** Highly Significant difference as P<0.001

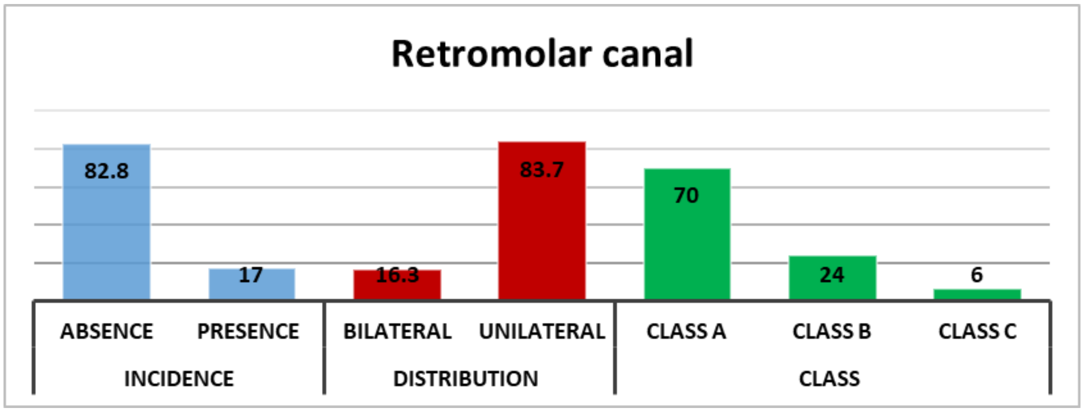

Figure (5): Bar chart representing Retromolar canal incidence , unilateral and bilateral distribution and different classes among all patients.

Distribution of incidence, distribution and class among gender were presented in table (2) and figure (6). Comparison between male and female was performed by using Chi square test which revealed insignificant difference between them as P=0.29, 0.99, and 0.13 regarding incidence, distribution, and class respectively.

Table 2: Distribution of retromolar canal incidence, distribution, and class among gender

		Gender				Chi-Square Tests		
		Male		Female				
		N	%	N	%	Chi-square	Df	P value
Incidence	**Absence**	102	49.30%	105	50.70%	1.119	1	0.29 ns
	Presence	25	58.10%	18	41.90%			
Distribution	**Bilateral**	4	57.10%	3	42.90%	0.006	2	0.99 ns
	Unilateral	21	58.30%	15	41.70%			
Class	**Class A**	23	65.70%	12	34.30%	3.94	2	0.13 ns
	Class B	4	33.30%	8	66.70%			
	Class C	2	66.70%	1	33.30%			

N: frequency **%: percentage** **ns: non-significant difference as P>0.05**

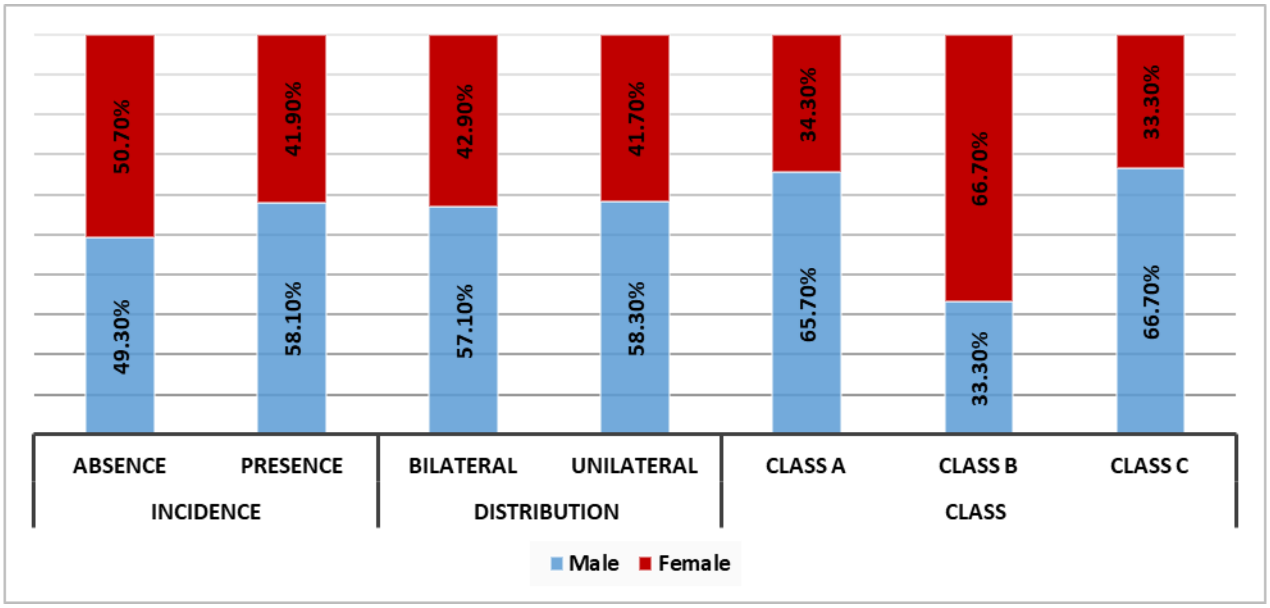

Figure (6): Stacked bar chart representing distribution of Retromolar canal incidence , unilateral and bilateral distribution and different classes among gender.

Minimum, maximum, mean, and standard deviation of RMC and mandibular foramen AP , RMC and mandibular foramen ML, RMC and lower 2nd molar, RMC and lower third molar were presented in table (3) and figure (7).

Table 3: Description of the different linear measurements of retromolar canal

	N	Minimum	Maximum	Mean	Std. Deviation
RMC and mandibular foramen AP	50	11.99	19.22	15.17	2.39
RMC and mandibular foramen ML	50	1.99	4.10	3.04	0.53
RMC and lower 2nd molar	50	13.99	20.23	16.96	2.12
RMC and lower third molar	50	6.88	11.22	9.34	1.36

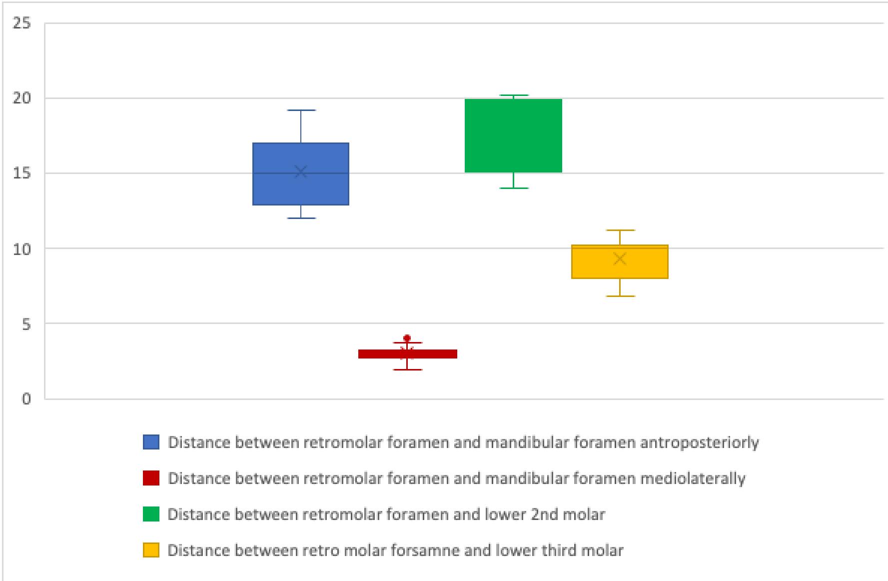

Figure (7): Box plot representing different linear measurements of retromolar canal.

Intra observer (agreement between 1st and 2nd observer) and intraobserver (agreement between 1st and 2nd read in the same observer) was evaluated by using Inter Class Correlation Coefficient which revealed excellent (r>0.9) significant (P<0.0001) agreement in both interobserver and intraobserver reliability as mentioned in table (4).

Table 4: intra and interobserver reliability of the different linear measurements of retromolar canals:

	Interobserver				Intraobserver			
	ICC	95 % CI		P value	ICC	95 % CI		P value
		L	U			L	U	
RMC and mandibular foramen AP	0.987	0.932	0.986	0.0001*	0.999	0.997	1	0.0001*
RMC and mandibular foramen ML	0.991	0.964	0.993	0.0001*	0.999	0.997	1	0.0001*
RMC and lower 2nd molar	0.989	0.932	0.986	0.0001*	0.997	0.992	0.999	0.0001*
RMC and lower third molar	0.993	0.978	0.998	0.0001*	0.998	0.993	0.999	0.0001*

ICC: interclass correlation coefficient.
CI: confidence interval L:lower arm U:upper arm
****Highly significant difference as P<0.001.**

Discussion

The clinician should be aware about the retromolar canal as an anatomical variation because, the mandibular canal is an anatomical structure that houses the inferior alveolar neurovascular bundle. Both the original and its normal variations are imperative for the vascularizations of the dental structures and their surrounding tissues, facilitating appropriate treatment and limiting complications.11

Additionally, lower wisdom tooth extraction, orthognathic surgeries, implant site preparations and implantation procedures, all include the risk of bifid neurovascular bundle injury. Additionally, several problems (such as sealer extrusion or excessive instrumentations) may arise during root canal therapy. The mandibular canal may be directly harmed by this type of injury or may be indirectly harmed through the retromolar canal.4

From study to study, several aspects of bifid mandibular canal and more specifically the retromolar canal have been investigated in the literature. Some investigations used cadavers and orthopantomograms (OPG), while others used cone-beam computed tomography and CT scans. Orthopantomogram (OPG), which was previously used to assess the retromolar canal, has certain limitations when compared to more modern imaging technologies, such as CBCT, because of the superimposition and the two-dimensional perspectives seen in panoramic pictures.12

Therefore, using CBCT images, this study assessed the incidence and anatomical characteristics of the retromolar canal and their corresponding foramina and gave a thorough classification of the retromolar canal types by analysing the prior researches. The retromolar canal can be defined as a canal that leads to one or more foramina in the retromolar area. The retromolar canal's other end may be joined to the mandibular foramen, mandibular canal, lower wisdom tooth's root, or a different foramen in the mandibular ramus.

The retromolar canal, which arises from the mandibular neurovascular bundle and courses towards the retromolar fossa, has been described in certain studies as a form of bifid mandibular canal. This definition is not always accurate since it excludes the canals that open in the third molar's root part that were discovered in this study and some other investigations. 6,10,12,13

The retromolar canals and retromolar foramina of 0.6 diameter or greater were evaluated in this study and detected using the CBCT images of 0.3 mm voxel size, allowing us to precisely and accurately determine the course and location of these canals and foramina. The Newtom Giano HR CBCT system produced higher resolution scans with 0.125 mm voxel sizes, but they were not used because they had a tight field of view, which would have limited the height of the scan and prevented evaluation of the mandibular ramus and mandibular foramen regions.

The linear measurements precision made using the abovementioned software, the NNT dental software utilized in our investigation is a dependable and accurate measuring software.14

According to our study results, even though there was a higher number of RMCs in males than in females, there was no discernible gender statistical difference, which is in accordance with the findings of Patil et al., Sawyer and Kiely, and Pyle et al.10, 15,16

A finding that concurs with those of Patil et al., von Arx et al., and Sagne et al. is that there are more unilateral canals than bilateral canals.10,17,18

With incidence rates ranging from 25.4 to 75.4% and 8.5 to 17.4%, respectively, in numerous studies employing CBCT on the Japanese and Korean populations, there are a number of genomic, environmental and racial explanations responsible for this vast incidence rate range difference.19

This variation in results might also be attributable to the differences in sample sizes across studies as well as inclusion and exclusion criteria. For instance, a study on the population of Brazil using a large sample size of 300 CBCT scans found a mere 5% incidence rate.1

While a study limited to 84 CBCT scans of the Chilean population revealed a 23.8% incidence rate.20

Others have discovered an incidence rate that is noticeably higher than what was discovered in the present investigation. An incidence of 75.4% was naked by Patil et al.10

In the Japanese population, for insistence, Kawai et al. also determined an incidence rate of 52%.21

This might be explained by the fact that these studies' voxel sizes, which were 0.08 mm, and 0.1 mm respectively, were actually smaller than voxel size used in our investigation. While employing a 0.38-mm voxel size, Han and Hwang discovered an incidence rate of 8.5% which was in accordance with our results as they used almost the same voxel size. As a result, the quality of the image is influenced by the voxel size of the CBCT scans analyzed; a smaller voxel size enables the visualization of much narrower canals, which impacts the incidence rate in each research.22

In a procedure similar to ours, Freitas et al. used a voxel size of 0.25 mm with an i-CAT CBCT Scanner and obtained a comparable result of 7.33% incidence rate in the Brazilian population.1Also, a recent study done on the Turkish population, Tuncer et al. showed an analogous result.23

For the classification of RMCs in this study, we used Patil et al.'s system.It was the most practical categorization, in our opinion; the classifications made by Ossenberg, Park and Jamalpour et al. did not include the canal type that originates from the retromolar foramen and ends in the radicular region of the third molar.8,24,25

According to the course of the canals, the most common type in our study was type A (35/43), followed by type B (12/43), and type C was the rarest type with only (3/43). These findings differ from those of Patil et al.'s investigation, which determined that type B was the most prevalent. This can be explained by the fact that the voxel size utilised in their research (0.08 mm) allowed them to examine significantly smaller canals, where the majority of the type B canals have a very small diameters.10

With respect to the linear measures, this investigation who correlated between mandibular foramen and and retromolar foramen in the Egyptian population has the merit of being the second of its kind to do so, following the study of Badry et al. It also highlights the incidence rate and the significance of being aware of such relationship. Additionally, these measurements may help the physician to more accurately localise the the retromolar foramina during various clinical trials.26

Where our investigation found the distance between the mandibular foramen and retromolar foramen in the anteroposterior and mediolateral direction to be 15.17± 2.39 mm and 3.04±0.53 mm respectively which were in accordance with the only previous study who investigated for, on the Egyptian population.26

However, the current study discovered that the retromolar foramen's distance from the wisdom tooth's distal surface was to be 9.34±1.36 mm which was not much of a change with the results of Badry et al, Park et al. and Ogawa et al who discovered that the retromolar foramen and wisdom were separated by 4.26±4.21 mm, 5.8±3.6 mm and 5.5±2.1 mm, correspondingly.8,26,27

Moreover, the present study determined that the distance between the retromolar foramen and the second molar's distal surface is 16.96±2.12 mm which was analogous to the findings of Elbadry et al who determined the distance to be 14.7±5.07 mm, Han et al. who determined the distance to be 14.08±3.85 mm, von Arx et al. who determined the distance to be 15.16±2.39 mm, and Park et al. who determined the distance to be 12.1±3.3 mm.8,17,26,28

Conclusion

The prevalence of retromolar canals was 17.0%, more common unilaterally and in males, according to the study's findings. The high frequency of surgical procedures in the posterior region of the mandible serves as a reminder of the significance of having a thorough understanding of the anatomy of the retromolar region. This knowledge could optimise predictability of treatment planning and anaesthetic and surgical outcomes, thereby reducing anaesthetic failures and surgical mishaps.

REFERENCES

1. Freitas, George Borja de, Alessandra de FREITAS E SILVA, and Luiz Roberto Coutinho MANHÃES. "The prevalence of mandibular retromolar canals on cone beam computed tomography and its clinical repercussions." Revista de Odontologia da UNESP 46 (2017): 158-163.
2. M. E. Chávez-Lomelí, J. Mansilla Lory, J. A. Pompa, and I. Kjær, “The human mandibular canal arises from three separate canals innervating different tooth groups,” Journal of Dental Research, vol. 75, no. 8, pp. 1540–1544, 1996.
3. J. R. Allison and A. Carr, “A prevalence study of bifid mandibular canals using cone beam computed tomography,” Oral Surgery, vol. 10, no. 4, pp. e55–e61, 2017.
4. Ö. Okumuş and A. Dumlu, “Prevalence of bifid mandibular canal according to gender, type and side,” Journal of Dental Sciences, vol. 14, no. 2, pp. 126–133, 2019.
5. Nikkerdar, N., et al. "Incidence and anatomical properties of retromolar canal in an Iranian population: a cone-beam computed tomography study." International journal of dentistry 2020 (2020).
6. N. Alves and N. F. Deana, “Anatomical and radiographical study of the retromolar canal and retromolar foramen in macerated mandibles,” International Journal of Clinical and Experimental Medicine, vol. 8, no. 3, pp. 4292–4296, 2015.
7. Cennet E, Levent C (2015) Case report: aberrant buccal nerve in the retromolar canal. Indian J Basic Appl Med Res 4:239–241
8. M.-K. Park, W. Jung, J.-H. Bae, and H.-H. Kwak, “Anatomical and radiographic study of the mandibular retromolar canal,” Journal of Dental Sciences, vol. 11, no. 4, pp. 370–376, 2016.
9. T. Y. Noorani, F. Shahid, N. R. N. A Ghani, N. Rashidah Saad, and S. A. Nowrin, “Effective use of cone beam computed tomography to detect a lateral root perforation: a case report,” Journal of International Dental and Medical Research, vol. 11, no. 2, pp. 520–526, 2018.
10. S. Patil, Y. Matsuda, K. Nakajima, K. Araki, and T. Okano, “Retromolar canals as observed on cone- beam computed tomography: their incidence, course, and characteristics,” Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology, vol. 115, no. 5, pp. 692–699, 2013.
11. Valenzuela-Fuenzalida JJ, Cariseo C, Gold M, Díaz D, Orellana M, Iwanaga J. Anatomical variations of the mandibular canal and their clinical implications in dental practice: a literature review. Surg Radiol Anat. 2021;43(8):1259–1272. doi:10.1007/s00276-021-02708-7
12. Y. Sisman, A. Ercan-Sekerci, M. Payveren-Arikan, and H. Sahman, “Diagnostic accuracy of cone- beam CT compared with panoramic images in predicting retromolar canal during extraction of impacted mandibular third molars,” Medicina Oral Patología Oral y Cirugia Bucal, vol. 20, no. 1, pp. e74–e81, 2015.
13. A. C. Rossi, A. R. Freire, G. B. Prado, F. B. Prado, P. R. Botacin, and P. H. F. Caria, “Incidence of retromolar foramen in human mandibles: ethnic and clinical aspects,” International Journal of Morphology, vol. 30, no. 3, pp. 1074–1078, 2012.
14. Wessam et al. " Influence of Two Software Programs on The Accuracy of Linear Measurements of Cone-Beam Computed Tomography. In Vitro Study. "European chemical bulletin, Volume No. 12, special issue 8 at 2023.
15. Sawyer DR, Kiely ML (1991) Retromolar foramen: a mandibular variant important to dentistry. Ann Dent 50:16–18.
16. Pyle MA, Jasinevicius TR, Lalumandier JA, Kohrs KJ, Sawyer DR (1999) Prevalence and implications of accessory retromolar foramina in clinical dentistry. Gen Dent 47:500–503 quiz 504–5
17. Von Arx T, Hänni A, Sendi P, Buser D, Bornstein MM (2011) Radiographic study of the mandibular retromolar canal: an anatomic structure with clinical importance. J Endod 37:1630–1635
18. Sagne S, Olsson G, Hollender L (1977) Retromolar foramina and canals in the human mandible. Dentomaxillofacial Radiol 6:41–45
19. Haas LF, Dutra K, Porporatti AL, Mezzomo LA, De Luca CG, Flores-Mir C (2015) Anatomical variations of mandibular canal detected by panoramic radiography and CT: a systematic review and meta-analysis. Dentomaxillofacial Radiol 45:1–12
20. López-Videla Montaño J, Vergara Miranda M, Rudolph Rojas M, Guzmán Zuluaga CL (2010) Prevalencia de variables anatómicas en el recorrido de los conductos mandibulares: Estudio mediante tecnología Cone Beam. Rev Fac Odontol Univ Antioquia 22:23–32
21. O. Rashsuren, J.-W. Choi, W.-J. Han, and E.-K. Kim, “Assessment of bifid and trifid mandibular canals using cone-beam computed tomography,” Imaging Science in Dentistry, vol. 44, no. 3, pp. 229–236, 2014.
22. Y.-Q. Zhang, Y.-N. Zhao, D.-G. Liu, Y. Meng, and X.-C. Ma, “Bifid variations of the mandibular canal: cone beam computed tomography evaluation of 1000 Northern Chinese patients,” Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology, vol. 126, no. 5, pp. e271–e278, 2018.
23. B. Bilecenoglu and N. Tuncer, “Clinical and anatomical study of retromolar foramen and canal,” Journal of Oral and Maxillofacial Surgery, vol. 64, no. 10, pp. 1493–1497, 2006.
24. N. S. Ossenberg, “Retromolar foramen of the human mandible,” American Journal of Physical Anthropology, vol. 73, no. 1, pp. 119–128, 1987.
25. Jamalpour M, Shokri A, Falah-koshki S, Zavareian A (2016) Evaluation of retromolar canals with cone beam-computed tomography in an Iranian adult population: a retrospective study. Int J Clin Dent 9:59–66
26. Badry, Mahmoud Sayed Mahmoud, Fatma Mostafa El-Badawy, and Walaa Mohamed Hamed. "Incidence of retromolar canal in Egyptian population using CBCT: a retrospective study." Egyptian Journal of Radiology and Nuclear Medicine 51 (2020): 1-8.
27. Ogawa A, Fukuta Y, Nakasato H, Nakasato S (2016) Evaluation by dental cone-beam computed tomography of the incidence and sites of branches of the inferior dental canal that supply mandibular third molars. Br J Oral Maxillofac Surg 54:1116–1120

28. Han SS, Hwang YS (2014) Cone beam CT findings of retromolar canals in a Korean population. Surg Radiol Anat 36:871–876

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