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Frequency of Retromolar Canal in Cone Beam Computed Tomography in Rural Population of Western Maharashtra.

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KEYWORDS

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ABSTRACT:

Background: The retromolar canal (RMC), which branches off from the primary mandibular canal, contains neurovascular bundles that include arteries, small veins, and myelinated nerve fibers. Identifying the presence and location of RMC is crucial for dental surgeons prior to mandibular surgical procedures. This study aims to identify the prevalence, structure, and location of the retromolar canal in adults using cone beam computed tomography (CBCT).

Methods:CBCT scans from 200 patients were analyzed to assess age and gender distribution. Instances where a retromolar canal was detected in the CBCT images were then classified according to their path and shape.

Result: In the present study, we found that Retromolar canals appeared in 25% of CBCT images. Type A1 was the most common (12%), while other types like A2, B1, B2, and C had lower frequencies. The distribution of RMC types showed no significant differences between genders ($P > 0.05$). Unilateral occurrences were more frequent than bilateral cases. The mean incidence of Type A1 was the highest (4.04), and variability was noted across types. Overall, RMC presence was not significantly influenced by gender or side.

Discussion: These findings underscore the importance of recognizing the Retromolar canal as a common anatomical variant, present in 25% of cases within the rural population of Western Maharashtra.

Conclusion: This study highlights the necessity for clinicians to be aware of this variation to avoid potential complications during surgical interventions in the mandible.

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1. Introduction

The mandibular canal, which contains the neurovascular bundle, originates at the mandibular foramen on the inner surface of the ramus and extends to the mental foramen. During its course, the canal can have accessory canals, such as the retromolar canal (RMC) in the retromolar region which demandsimportant consideration during posterior mandibular surgeries[1-2].The retromolar region is delineated by the anterior margin of the ramus of the mandible, the temporal crest, and the distal aspect of the last lower molar. Within this area, a retromolar canal (RMC) may exist exiting through the retromolar foramen[3,4]. RMC too exhibits morphological and morphometric variations, which includes a posterior concavity and a straight configuration[5]. The occurrence of RMC has been noted by several authors across different populations, indicating a rising trend in its frequency[2-5]. It could include myelinated nerve fibers and blood vessels originating directly from branches of the inferior alveolar neurovascular bundle. These structures may supply the areas around the third molar, retromolar triangle mucosa, buccal mucosa, and lower molars[6]. Therefore, accessory canals in the retromolar region play a crucial role in delivering neural and/or vascular components to the mandible.

Although the clinical significance of RMC has not been extensively studied, its involvement in the innervation of the third molar poses a potential risk to successful endodontic treatment[7].The presence of RMC can also significantly contribute to the failure of mandibular nerve block injections as some branches of the mandibular nerve pass through this canal[8].Trauma to the contents of this canal during procedures such as tooth extraction, bone harvesting, and implant placement can lead to complications such as bleeding, hematoma formation, and sensory impairment in the third molar area and buccal mucosa[9-12].Furthermore, tumors and infections originating from the retromolar area can potentially spread to adjacent regions through the retromolar foramina([13,14].

In clinical practice, anatomical variants such as supplemental or accessory canals and foramina can only be detected through radiological methods. However, conventional two-dimensional (2D) radiographs, such as panoramic images, are often insufficient to identify all anatomical structures, including the presence of an RMC[14]. Cone-beam computed tomography (CBCT), widely used in dentistry, has proven significantly effective in confirming anatomical variations of the mandibular canal that panoramic radiographs may miss[15,16]. This study aims to evaluate the incidence and anatomical properties of RMC using CBCT images in a rural population of Western Maharashtra.

Methodology:

CBCT scans available in the department were collected and examined for the presence of RMCs. A total of 200 CBCT scans were analyzed using multiplanar reconstructions to optimize visualization of the retromolar region.

Inclusion Criteria: CBCT images of adult patients available in the department with optimum diagnostic quality showing retromolar regions were selected.

Exclusion Criteria: CBCT scans having posterior mandibular dental implants, those with clinical or radiographic signs of any jaw pathologies in the area of interest, or a history of trauma to the posterior mandibular region requiring surgical intervention were excluded.

Each CBCT image was assessed for the presence or absence of the mandibular retromolar canal and foramen and further evaluated for incidence, course, and morphology based on the classification system described by **Von Arx et al.** (2011), which categorizes RMCs into five types (**Fig. 1)**:

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Type A1: Vertical course of the retromolar canal.
Type A2: Vertical course of the retromolar canal with a horizontal branch.
Type B1: Curved course of the retromolar canal.
Type B2: Curved course of the retromolar canal with an additional horizontal branch.
Type C: Horizontal course of the retromolar canal.

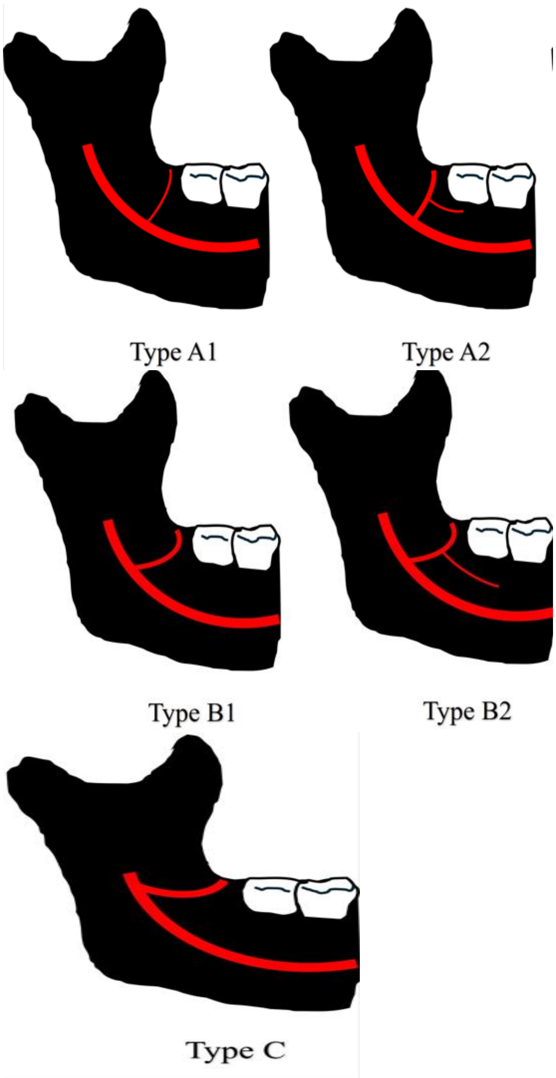

Fig.1: **Types of Retromolar canal and morphology**

Statistical Analysis: Data were recorded in a Microsoft Office Excel Sheet (version 2019) and analyzed using the Statistical Package for the Social Sciences (SPSS) software version 21 (SPSS Inc., Chicago, IL, USA). Kappa statistics were used to determine the reliability of measurements. Descriptive statistics, measures of central tendency, and distribution of data with frequencies and percentages were calculated to find the percentages of RMC in this study sample. Chi-square tests were calculated to identify significant incidences with P values < 0.05.

Results:

The study included 200 CBCT scans, comprising 133 males (66.5%) and 67 females (33.5%). The age range of participants was from 12 to 84 years, with a mean age of 42.32 years (±16.10). Among males, the age range was 15 to 84 years with a mean age of 43.79 years (±16.09), and among females, the age range was 12 to 80 years with a mean age of 39.40 years (±15.84). The average diameter of the retromolar canal was 0.36 mm (±0.34). The age distribution and gender ratio of the study population indicate a broad age range and a higher proportion of male participants. The mean diameter of the RMC was relatively smallwith mean diameter of 0.36 mm (± 0.34), consistent with its nature as a minor anatomical variant. **(Table 1)**

Table 2 shows the relative incidence and distribution of Retromolar Canal Types. Type A1 retromolar canal was the most common, followed by Type A2, B1, C, and B2. Unilateral canals were more prevalent than bilateral ones, with the right side being slightly more common for Types A1 and A2. For Type B1, males showed higher prevalence across all sides compared to females. For Type B2 and C, the prevalence was minimal and predominantly observed in males on the right side. **(Table 3)**

Table 4 shows the mean incidence and Standard Deviation of Different Retromolar Canal Types. The mean incidence of Type A1

was the highest, followed by Types B1, A2, C, and B2. The standard deviation indicates variability in the incidence rates, with Type A1 showing the highest variability. To summarise the results, this study found that 25% of the CBCT scans demonstrated the presence of retromolar canals, with Type A1 being the most prevalent. The findings indicate a higher occurrence of unilateral canals, particularly on the right side, and minimal gender differences in the prevalence of RMC types. On Chi-square test, no significant differences were observed among all the types. (Table 3)

Table 1: Descriptive Statistics and Retromolar Canal Incidence

Sex	N (%)	Minimum age (years)	Maximum age (years)	Mean age (years)
Male	133 (66.5%)	15	84	43.79±16.09
Female	67 (33.5%)	12	80	39.40±15.84
Total	200 (100%)	12	84	42.32±16.10

Table 2: Relative Incidence and Distribution of Retromolar Canal Types

Type	Frequency	Percentage (%)	Unilateral Left (%)	Unilateral Right (%)	Bilateral (%)	Total (%)
Type A1	24	12.0	4.5	6.0	1.5	12.0
Type A2	11	5.5	3.5	2.0	0.0	5.5
Type B1	9	4.5	2.5	1.0	1.0	4.5
Type B2	2	1.0	0.0	1.0	0.0	1.0
Type C	4	2.0	2.0	0.0	0.0	2.0

Table 3: Prevalence of Retromolar Canal Types by Gender and Side

Type	Gender	Absent (%)	Left (%)	Right (%)	Bilateral (%)	Total (%)	λ2	P-value
Type A1	Male	87.7	5.27	6.01	1.50	133	**0.23**	**0.88**
	Female	89.5	2.98	5.97	1.49	67		
	Total	88.0	4.50	6.00	1.50	200		
Type A2	Male	95.4	3.76	0.75	0.0	133	**3.21**	**0.20**
	Female	92.5	2.98	4.47	0.0	67		
	Total	94.5	3.50	2.00	0.0	200		
Type B1	Male	93.2	3.76	1.50	1.50	133	**4.74**	**0.09**
	Female	100	0.00	0.00	0.00	67		
	Total	95.5	2.50	1.00	1.00	200		
Type B2	Male	98.4	0.0	1.50	0.0	133	**1.01**	**0.31**
	Female	100	0.0	0.00	0.0	67		
	Total	99.0	0.0	1.00	0.0	200		
Type C	Male	98.4	1.50	0.0	0.0	133	**0.49**	**0.48**
	Female	97.0	2.98	0.0	0.0	67		
	Total	98.0	2.00	0.0	0.0	200		

Table 4: Mean Incidence and Standard Deviation of Different Retromolar Canal Types

Types of Retromolar Canals	Mean Incidence	Std. Deviation
Type A1	4.04	7.066
Type A2	3.08	0.332
Type B1	3.64	5.886
Type B2	3.04	0.199
Type C	3.02	0.281

Discussion

A comprehensive understanding of the mandibular canal anatomy and its variations, including bifid canals, foramina, and RMCs, is crucial for planning and performing surgical and anesthetic procedures. According to Chávez-Lomeli et al. [17] the mandibular canal originates from the fusion of three separate nerve branches during different stages of development. This fusion process is accompanied by the formation of bony canals around these nerves. Throughout prenatal growth, bone remodeling occurs through intramembranous ossification, which shapes the mandibular canal. This developmental process helps explain the occurrence of bifid mandibular canals and retromolar canals observed in some patients, often due to incomplete fusion of these three nerves[18].

In dental practice, orthopantomogram (OPG) is widely used as a diagnostic tool due to its ability to provide an overview of the maxillary

and mandibular dental structures at a relatively low cost. According to Kalantar Motamedi et al. [19], the prevalence of RMCs or type I bifid mandibular canals detected on panoramic radiographs is less than 1%. Because RMCs are typically very narrow, conventional radiography is not dependable for their detection[15]. Variations in the mandibular canal can lead to false-positive findings on panoramic radiographs due to the overlap of anatomical structures. Furthermore, ghost shadows produced by structures such as the opposite hemimandible, soft palate, pharyngeal airway, and uvula can result in false-negative images[20].Due to the limitations of three-dimensional visualization of the mandible, we opted to utilize CBCT images in this retrospective study. CBCT evaluation has been recommended as a cost-effective method with effective radiation dosage. Previous studies using dry mandibles and CBCT have reported a wide range in the prevalence of RMCs, varying from 1.7% to 72%[7,21]. The diversity in RMC prevalence has been attributed to ethnic variations, genetic factors, environmental influences such as nutrition and stress, as well as differences in study methodologies[22].

According to Park et al., the prevalence of RMC was found to be 33.6% based on macroscopic examination of cadaver mandibles, whereas it was 11.5% using CBCT. They concluded that CBCT has limitations in detecting RMCs compared to direct anatomical observation but remains the best method for clinical identification.[23] Patil et al. [24] utilized high-resolution CBCT images (0.08 mm voxel size) and reported a prevalence rate of 75.4% for RMCs, which is notably higher than other studies. They found that 75% of these canals were type II, many of which were too narrow to measure their diameter accurately. In our present study, the prevalence of RMCs is 25%, which is consistent with findings from studies by Bilecenoglu& Tuncer and Von Arx et al. [3,11]

Various classification systems for RMC have been proposed. Han and Hwang categorize RMCs into three groups: 1) vertical, 2) horizontal, and 3) originating from a separate foramen on the medial aspect of the mandibular ramus near the mandibular foramen[25].Von Arx et al. [11] categorized RMCs into three types: type A – vertical, type B – slightly curved, and type C – horizontal. They also distinguished two subtypes within types A and B: 1) without an additional mandibular canal, and 2) with an additional mandibular canal. Von Arx's classification is widely adopted among researchers for studying RMC variations.

According to the course of the canals, the most common type in our study was type A1 (12%), followed by type A2 (5.5%), and B1 (4.5%) and type C (2%) and B2 was the rarest type with only 1%. Our study results are consistent with those of Thomas Von Arx et al. [11], who also found that the majority of retromolar canals had a vertical course (type A1, 41.9%) or were slightly curved (type B1, 29.0%). They did not observe any canals with a horizontal course (type C). In contrast, Qureshi et al. [26] reported different findings. Among 9 CBCT scans showing a retromolar canal, they identified type B1 as the most common (55.56%), followed by type A2 (22.23%), with types A1 and B2 each at 11.12%. They did not encounter any type C patterns in their observations. Both Von Arx et al. [11] and Qureshi et al. [26] reported a higher prevalence of retromolar canals in women compared to men, which contrasts with our study where we observed a different gender distribution. Additionally, they noted a tendency for more retromolar canals on the left side compared to the right, which aligns with our findings.

In our study, we observed that the number of unilateral retromolar canals was higher than bilateral canals, with a predominance on the left side of the mandible. This finding is consistent with the results reported by Badry et al. [27]. However, similar to the findings of Patil et al. [28] and Von Arx et al. [11], we did not find a significant difference in the prevalence of unilateral versus bilateral canals. In our study, bilateral RMCs were found in 4.5% of cases, a figure similar to that reported by Tassoker and Sener[22], who noted a 5% incidence of bilateral RMCs. This contrasts with the findings of Patil et al. [28] who reported a higher occurrence of bilateral RMCs. These comparisons underscore the variability in RMC prevalence, types, and bilateral occurrence across different studies and populations, influenced by factors such as gender, laterality, and anatomical variations.

Regarding gender distribution, although we found more RMCs in males than females, this difference could be attributed to random enrollment of study subjects without consideration of gender. Our study did not identify a significant gender difference in RMC prevalence, which is consistent with the findings of previous studies[28-30].

This study offers significant insights into the prevalence and variations of retromolar canals (RMCs) using CBCT, contributing valuable data to the understanding of mandibular canal anatomy. One of the strengths of this study is the use of CBCT imaging, which allows for detailed three-dimensional visualization, providing a more accurate assessment of RMCs compared to traditional radiography. Additionally, the relatively large sample size and the detailed classification of RMC types enhance the reliability and specificity of the findings. However, the study is not without limitations. The retrospective nature of the study limits the control over variables such as the selection of participants and imaging parameters, which could introduce bias. Furthermore, while CBCT offers superior imaging capabilities, it still may not detect very fine anatomical details compared to direct anatomical examination, potentially leading to underreporting of smaller RMCs. The study's focus on a specific population may also limit the generalizability of the findings to other ethnic or demographic groups. Future research should aim to include a more diverse population and consider a prospective design to control for potential confounding factors. Moreover, the development of more advanced imaging techniques or the combination of imaging modalities could improve the detection and characterization of RMCs. Understanding the clinical implications of these anatomical variations will also be crucial, particularly in relation to surgical planning and anesthesia administration.

Conclusion

This study emphasizes the importance of recognizing the retromolar canal as a common anatomical variant in the rural population of Western Maharashtra. The presence of RMCs in 25% of CBCT images underscores the need for clinicians to be aware of this variation to avoid potential complications during mandibular surgical procedures. The use of CBCT for preoperative assessment can significantly enhance the identification of these anatomical variants, contributing to better surgical outcomes and patient safety.

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Conflict of Interest

No conflict of interest to declare.

References

1. Muinelo-Lorenzo J, Suárez-Quintanilla JA, Fernández-Alonso A, Marsillas-Rascado S, Suárez-Cunqueiro MM. Descriptive study of the bifid mandibular

canals and retromolar foramina: cone beam CT vs panoramic radiography. Dentomaxillofacial Radiology. 2014 Jul;43(5):20140090.
2. Claeys V, Wackens G. Bifid mandibular canal: literature review and case report. Dentomaxillofacial Radiology. 2005 Jan;34(1):55-8.
3. Bilecenoglu B, Tuncer N. Clinical and anatomical study of retromolar foramen and canal. Journal of Oral and Maxillofacial Surgery. 2006 Oct 1;64(10):1493-7.
4. Rossi AC, Freire AR, Prado GB, Prado FB, Botacin PR, Ferreira Caria PH. Incidence of retromolar foramen in human mandibles: ethnic and clinical aspects. International Journal of Morphology. 2012 Jan 1:1074-8.
5. De Freitas Gb, Silva Ad, Júnior Lr. The prevalence of mandibular retromolar canals on cone beam computed tomography and its clinical repercussions. Revista de Odontologia da UNESP. 2017 Jul 3;46(3):158-63.
6. Kodera HA, Hashimoto IW. A case of mandibular retromolar canal: elements of nerves and arteries in this canal. Kaibogakuzasshi. Journal of anatomy. 1995 Feb 1;70(1):23-30
7. Schejtman R, Devoto FC, Arias NH. The origin and distribution of the elements of the human mandibular retromolar canal. Archives of Oral Biology. 1967 Nov 1;12(11):1261-IN9.
8. Ikeda K, Ho KC, Nowicki BH, Haughton VM. Multiplanar MR and anatomic study of the mandibular canal. American journal of neuroradiology. 1996 Mar 1;17(3):579-84.
9. Singh S. Aberrant buccal nerve encountered at third molar surgery. Oral Surgery, Oral Medicine, Oral Pathology. 1981 Aug 1;52(2):142.
10. Jablonski NG, Cheng CM, Cheng LC, Cheung HM. Unusual origins of the buccal and mylohyoid nerves. Oral surgery, oral medicine, oral pathology. 1985 Nov 1;60(5):487-8.
11. Von Arx T, Hänni A, Sendi P, Buser D, Bornstein MM. Radiographic study of the mandibular retromolar canal: an anatomic structure with clinical importance. Journal of endodontics. 2011 Dec 1;37(12):1630-5.
12. Potu BK, Kumar V, Salem AH, Abu-Hijleh M. Occurrence of the retromolar foramen in dry mandibles of South-eastern part of India: a morphological study with review of the literature. Anatomy research international. 2014;2014.
13. Nikkerdar N, Golshah A, Norouzi M, Falah-Kooshki S. Incidence and anatomical properties of retromolar canal in an Iranian population: a cone-beam computed tomography study. International journal of dentistry. 2020 Mar 9;2020.
14. Fanibunda K, Matthews JN. Relationship between accessory foramina and tumour spread in the lateral mandibular surface. Journal of anatomy. 1999 Aug;195(2):185-90.
15. Han SS, Park CS. Cone beam CT findings of retromolar canals: Report of cases and literature review. Imaging science in dentistry. 2013 Dec 1;43(4):309-12.
16. Noorani TY, Shahid F, Ghani NR, Saad NR, Nowrin SA. Effective use of cone beam computed tomography to detect a lateral root perforation: a case report. Journal of International Dental and Medical Research. 2018 May 1;11(2):520-6.
17. Chávez-Lomeli ME, Mansilla Lory J, Pompa JA, Kjaer I. The human mandibular canal arises from three separate canals innervating different tooth groups. Journal of Dental Research. 1996 Aug;75(8):1540-4.

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18. Sanchis JM, Peñarrocha M, Soler F. Bifid mandibular canal. Journal of oral and maxillofacial surgery. 2003 Apr 1;61(4):422-4.
19. Motamedi MH, Navi F, Sarabi N. Bifid mandibular canals: prevalence and implications. Journal of Oral and Maxillofacial Surgery. 2015 Mar 1;73(3):387-90.
20. Capote TS, de Almeida Gonçalves M, Campos JÁ. Retromolar canal associated with age, side, sex, bifid mandibular canal, and accessory mental foramen in panoramic radiographs of Brazilians. Anatomy research international. 2015;2015.
21. Ossenberg NS. Temporal crest canal: case report and statistics on a rare mandibular variant. Oral Surgery, Oral Medicine, Oral Pathology. 1986 Jul 1;62(1):10-2.
22. Tassoker M, Sener S. Investigation of the Prevalence of Retromolar Canals: A Cone Beam CT Study. International Journal of Morphology. 2017 Dec 1;35(4).
23. Park MK, Jung W, Bae JH, Kwak HH. Anatomical and radiographic study of the mandibular retromolar canal. Journal of Dental Sciences. 2016 Dec 1;11(4):370-6.
24. Patil S, Matsuda Y, Nakajima K, Araki K, Okano T. Retromolar canals as observed on cone-beam computed tomography: their incidence, course, and characteristics. Oral surgery, oral medicine, oral pathology and oral radiology. 2013 May 1;115(5):692-9.
25. Han SS, Hwang YS. Cone beam CT findings of retromolar canals in a Korean population. Surgical and Radiologic Anatomy. 2014 Nov;36:871-6.
26. Qurishi AA, Bakri MM, Mustafa A, Altowarqi SA. Incidence And Evaluation Of Retromolar Canal With CBCT In The Population Of Jazan Saudi Arabia-Our Experience With Review. Journal of Pharmaceutical Negative Results. 2022 Dec 31:1747-50.
27. Badry MS, El-Badawy FM, Hamed WM. Incidence of retromolar canal in Egyptian population using CBCT: a retrospective study. Egyptian Journal of Radiology and Nuclear Medicine. 2020 Dec;51:1-8.
28. Patil K, Sanjay CJ, Devi KR, Nagabhushana D, Viveka S, Girish MS. Retromolar canal: a classic analysis with CBCT in South Indian population. Eur J Anat. 2022;26(6):703-8.
29. Sawyer DR, Kiely ML. Retromolar foramen: a mandibular variant important to dentistry. Annals of dentistry. 1991 Jan 1;50(1):16-8.
30. Pyle MA, Jasinevicius TR, Lalumandier JA, Kohrs KJ, Sawyer DR. Prevalence and implications of accessory retromolar foramina in clinical dentistry. General dentistry. 1999 Sep 1;47(5):500-3.