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Prevalence of radix entomolaris in mandibular first molars using cone-beam computed tomography in Egyptian population: a cross-sectional study

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Aim: By identifying the supernumerary root, the clinician can prevent the root's canal from being overlooked during root canal therapy. Therefore, this study used cone beam computed tomography (CBCT) images of a group of Egyptian population to determine the prevalence of radix entomolaris (REM) in mandibular first molars.
Materials and methods: After a total of 893 CBCT images of male and female Egyptian population were screened, the CBCT scans with unilateral or bilateral mandibular first molars were included in this research. A lone researcher with CBCT technology training conducted the examination. As part of the CBCT imaging screening process, axial sections from coronal to apical were assessed. It was determined and documented if REM was present or absent (yes/no) in the mandibular first molar.
Results: The prevalence results in mandibular first molars showed that, the overall prevalence of REM was 3.92% (35/893) in the sample population, however, the REM was present in 3.54% (16/452) of females and 4.31% (19/441) of males. The prevalence of REM did not significantly differ according to side or gender. Although the prevalence of REM was prevalent bilaterally, neither the unilateral nor bilateral positions showed any statistically significant differences.
Conclusion: In the Egyptian population, 3.92% of mandibular first molars had REM. Moreover, when treating the permanent first mandibular molar, clinicians should consider the probability of bilateral REM occurrences.

Key Words: CBCT, Egyptian, Mandibular First Molars, radix entomolaris

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Introduction

Frequently, root canals go untreated while the operator is unaware of their existence, particularly in teeth with auxiliary or aberrant root canals or anatomic abnormalities. [1] Teeth with missing canals had a greater frequency of posttreatment periodontitis (AP), according to several studies. [2-4] The formation or recurrence of AP may come from the insufficient removal of microorganisms and inflamed or infected pulp tissue caused by a failure to identify and treat anatomical and morphological abnormalities. [4, 5] Therefore, the results of endodontic treatment can be improved by anticipating potential issues with a full awareness of the proper anatomical features before and after root canal therapy. [5]

The first permanent posterior tooth that emerges is the permanent mandibular first molar, which is in charge of occlusion establishment and critical physiological processes including chewing. In most cases, it is the one that requires endodontic therapy. Therefore, it is crucial that the clinician understands the differences in the mandibular first molar roots and root canal architecture. [1, 6] Previous research showed that untreated canals were the main reason for molar treatment failure and the second most frequent cause for all tooth types. [7]

Although differences in the number of roots and the shape of the canals are common, permanent mandibular first molars typically have three root canals and two roots positioned mesially and distally. [1] The complicated architecture of mandibular first permanent molars, which can exhibit several anatomical variances, makes them challenging to clean and shape. [5, 8] An extra root called the radix "Entomolaris" when found "distolingually" or radix "paramolaris" when found "mesiobuccally" on mandibular molars. [1, 8] The mesial root typically has two root canals, which terminate in two separate apical foramina. Alternatively, they can occasionally combine at the root tip to form a single foramen. Although a second distal canal may exist if the opening is extremely round and small, the distal root normally has one kidney-shaped root canal. [8]

The form and morphology of molar roots and their canals can be influenced by genetic, racial, and ethnic variables, as several studies have shown. [9-11] Along with hereditary and biological factors, external stimuli during odontogenesis may also be the cause of extra roots. [12] Research has shown that there are notable differences in the shape of the root and root canals both within and across groups, as well as within the same individual. [13]

Basically, there are two classifications on radix entomolaris. One is a classification that has been classified by Ribeiro & Consolaro based on the curvature of the root, there are 3 types of radix entomolaris according to it's curvature: Type 1: A straight root / root canal, Type 2: Initially curved entrance of the root canal and the continuation as a straight root or root canals ,Type 3: Initial curve in the coronal third of the root canal and a second buccally orientated curve starting from the middle third (the radix entomolaris may also have a pronounced 90° buccal curve in the apical part of the root). [6]

Other classification has been reported by Wang et al based on radiographic appearance of overlapped degree between Distolingual (DL) and Distobuccal (DB) root. There are 3 types from this classification: Type 1: Slight overlapped image, Type 2: Moderate overlapped image ,Type 3: Severe overlapped image. [6]

Studies on morphology have shown a connection between particular ethnic groups and the presence of a unique REM in the first mandibular molar. [5, 10, 11] Given its importance in clinical dentistry, it is important to comprehend the incidence of any tooth anatomical variation. [12] There is, however, little information available on the prevalence of REM among the Egyptian populace. This study used CBCT images of group of adult male and female Egyptian population to ascertain the prevalence of REM in the mandibular first molar teeth across the Egyptian population.

Methods

Sample collection

The time frame for this retrospective cross-sectional study was February 2022 to October 2024. Archived CBCT pictures from 2019–2024 were used to gather data from the radiology departments of faculties of dental medicine at four Egyptian universities: Al-Azhar University, which represents the middle of Egypt; Bani-Sweif and Assiut Universities, which represent the upper Egypt; and Alexanderia University, which represents the northern Egypt.

Sample size calculation

According to the results of a previous study [13] in which the prevalence was (2.9%)- by adopting a confidence interval of (97%), a margin of error of (3%) with finite population correction; The predicted sample size (n) was a total of (147) cases. Sample size was calculated by using EPI INFO version 7.2.5.0.

Along with demographic data like gender and age, the study included diagnostic-quality CBCT images obtained in accordance with manufacturer-specified references for a variety of purposes, such as treatment planning in cases of implant-related surgery and dental impaction, orthodontic treatment, endodontic treatment or traumatic fractures. The CBCT images were not acquired with the intention of being used in this research. This study examined 893 CBCT pictures of 441 Egyptian male and 452 Egyptian female with age range between 9-56 years old.

Two examiners' experts in endodontics and oral and maxillofacial radiology double-checked each CBCT image for the presence of REM in the first mandibular molar. To provide the best possible visualization, the examiners were allowed to use the software's image processing function to change the pictures' brightness and contrast. [5]

The following standards were applied to ascertain if REM existed: obvious boundary of the third root, which starts in the top half of the distal root and is seen by the intersection of translucent lines that represent the pulp space and periodontal ligaments. After determining each mandibular first molar's long axis, the toolbar was moved from the pulp chamber to the tooth's apex to analyze pictures in cross-sections up to the apical third of the root. A REM was described as an extra small root that is often curled and located lingual to the primary distal root. The REM might be partially merged with one of the roots or detached from them. The CBCT image sections were examined in axial, sagittal, and coronal planes by using the romexis viewer (4.5.0.R) program from Digital Image Communication in Medicine (DICOM) [5, 12] showing REM appearing unilateral **(figure 1)** or bilateral **(figure 2)**.

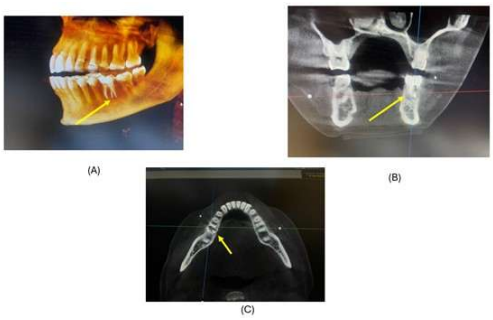

Figure (1): CBCT image: (A)Left sagittal, (B) Left coronal view (C) Axial section of CBCT image showing unilateral distribution of RE in lower first molar. (yellow arrow) denoting RE.

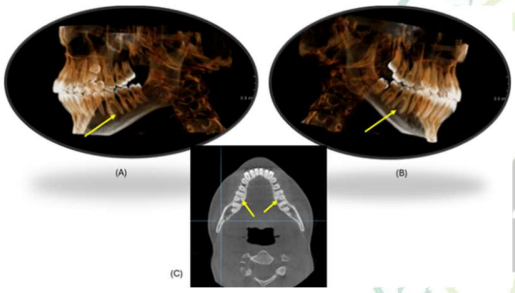

Figure (2): CBCT image: (A)Left, (B) Right sagittal view (C) Axial section of CBCT image showing bilateral distribution of RE in lower first molar. (yellow arrow) denoting RE.

Statistical analysis

After gathering data, Excel was used for data input, and SPSS 22.0 for Windows (SPSS Inc., Chicago, IL) was used for data analysis. In order to conduct an intraobserver reliability test (Cohen's kappa), 45 CBCT pictures were reviewed twice, separated by one month. The statistical analysis was conducted to compare the age difference within the gender using The Mann Whitney U test for non-parametric data. Descriptive statistics were employed to assess continuous data. The unilateral or bilateral categorical data in REM prevalence between males and females were evaluated using the chi-square (χ^2) test and Fisher Test. A significance criterion of $P < 0.05$ was established.

Results

A total of 893 CBCTs were included to the research. There were 452 (50.61%) female participants and 441 (49.39%) male participants **(Table 1)**. With ages ranging from 9 to 56, the participants' mean ages were 33.51±12.90 years for male and 30.67±9.92 years for female. The reliability (kappa correlation) and interobserver agreement of 82.7 were deemed almost perfect agreement for REM detection. The Mann Whitney U test for non-parametric data showed no significant difference (P=0.23) in age.

The prevalence results in mandibular first molars showed that, the overall prevalence of REM was 3.92% (35/893) in the sample population, however, the REM was present in 3.54% (16/452) of females and 4.31% (19/441) of males (Table 1). Regarding the position (unilateral or bilateral), the REM Prevalence result was not statistically significant (P=0.78) between male and female. The female recorded 37.50 percent (6/16) unilateral REM and bilateral REM of 62.5 percent (10/16), while the male recorded 36.85 percent (7/19) unilateral REM and bilateral REM of 63.16 percent (12/19) (Table 2).

Regarding the unilateral position (right or left), the REM Prevalence result was not statistically significant (P=0.78) between male and female. The female recorded REM of 25.00 percent (4/16) for right side and 12.5 percent (2/16) for left side, while the male recorded REM 21.05 percent (4/19) for right side and 15.79 percent (3/19) for left side **(Table 2)**. Additionally, the REM prevalence data show that there was no apparent disparity between the frequency of bilateral or unilateral in males and females (Table 2).

Table (1): The prevalence results of REM in mandibular first molars along the study

	Availability		Marginal Raw Total
	Yes	No	
Female; no (%)	16 (3.54)	436 (96.46)	452 (50.61)
Male; no (%)	19 (4.31)	422 (95.69)	441 (49.39)
Marginal Column Total	35 (3.92)	858 (96.08)	Grand total = 893

Table (2): Comparison in REM prevalence between males and females (unilateral vs. bilateral and right vs. left):

	Unilateral				Bilateral
	Right	Left	P-value	Total	
Female; no (%)	4 (25.00)	2 (12.50)	0.64 NS	6 (37.50)	10 (62.5)
Male; no (%)	4 (21.05)	3 (15.79)	1 NS	7 (36.85)	12 (63.16)
P-value	0.72 NS			0.96 NS	

Discussion

One of the most frequent issues influencing the results of endodontic therapy is variances in root canal shape. Every doctor should be knowledgeable with aberrant variation and its occurrence in the community as it raises the success rate. [5, 9, 12] Furthermore, it was discovered that, as several studies have demonstrated, genetic, racial, and ethnic factors can affect the shape and morphology of molar roots and their canals. [9-11] Therefore, the purpose of this study was to ascertain the prevalence of REM in Egyptian mandibular first molars because the distolingual root “radix entomolaris” has been regarded as one of the most prevalent ethnic and genetic characteristics in mandibular first teeth.

According to previous study, REM occurrence is not influenced by ethnicity. [9] However, other study has proposed that REM ought to be categorized as a hereditary characteristic as opposed to a developmental disorder. [14] Consequently, more prevalence research was required to determine the REM prevalence in a particular racial group.

Numerous imaging methods, including as 2-dimensional radiography, micro-computed tomography (m-CT), and CBCT, have been used to examine root shapes and canal morphology. [12, 13, 15, 16] The most used diagnostic method for assessing the morphology of mandibular roots is conventional radiography. The use of 2-dimensional (2D) photographs to study a 3-dimensional (3D) item can make it more difficult to perceive the intricacies and minutiae of the root canal anatomy, even while radiographs can show the tooth's primary morphological traits. [11] Compared to traditional and digital radiography, CBCT offers superior resolution and may show the internal and exterior morphologies of the tooth and its root canal system. [11] Therefore, this study utilizes the CBCT because the existence of the REM may be detected with great sensitivity using CBCT, which offers 3D reconstruction imaging.

Because they treat a wide range of patients from neighboring governorates, the sample population for this study was chosen from the faculties of dental medicine at three Egyptian universities: Al-Azhar University, which represents the middle of Egypt; Bani-Sweif and Assiut Universities, which represent the upper Egypt; and Alexanderia University, which represents the northern Egypt. Only the impact of gender on REM prevalence was examined in this study because roots are not anticipated to alter throughout time. [5] Numerous earlier studies [17, 18] on the prevalence of REM found that the prevalence of REM in the Middle Eastern population ranged between 0.5% and 4%,

which was regarded as considerably lower than that of populations from other racial areas, such as Asian populations, including Chinese (29%), Koreans (25.82%), and Taiwanese (25.3%), as reported in earlier studies. [19-21] The method employed to assess the extra canals and structure, as well as ethnic disparities across different groups, may be the cause of the disparity in results between these researches. [5]

The results of this study showed that the overall prevalence of REM was 3.92%, which is comparatively consistent with the results of earlier research on Arab populations in Asia or Africa. According to the most recent study on REM prevalence in Saudi Arabia, the overall prevalence was 4.3%; [11] however, in Yemen and Palestine (Asia), the prevalence was 3.2% and 3.73%, respectively. [22, 23] Furthermore, the Sudanese population has a very low prevalence of REM in Africa, at 3%. [24] A recent study on the prevalence of REM in 15 different nations revealed that, although there were notable variations among the countries, there were no notable variations within the subgroups of geographical regions. [5] This may be explained by the fact that differing ethnic backgrounds account for the majority of the diversity in REM prevalence between populations. [10-12] Nearly all studies employed CBCT imaging to identify REM; however, variations in results might be caused by a variety of variables, including sample size, CBCT technicalities, observer bias, and population ethnicity. [5]

Furthermore, the current study's findings showed that the overall prevalence of REM in the Egyptian population is 3.92 percent, which is comparatively higher than the findings of earlier research that looked at the prevalence of REM in the Egyptian population (3.12%). This could be explained by the fact that the current study used a larger sample population (893 CBCT), whereas a previous study only used 497 radiographs. [12] Additionally, the current study relies on a larger sample variation from the Egyptian population because it used samples from various regions that cover a larger area of the Egyptian population.

The prevalence of REM in this study was higher in males (4.3%) than in females (3.54%), but there was no significant difference, which is consistent with a previous study that found no gender-related differences. [5, 11, 25] This finding, however, is in accordance with other study that found males had a significant prevalence of REM when compared with female. [26] Other researches, however, has revealed that REM is more common in female. [9, 12]

In line with several previous research, this one also identified no discernible variations in the incidence of REM between the left and right dental sides. [5, 12, 14, 23] This conclusion is consistent with previous findings, which showed that molars' root canal structure and morphology resemble those of symmetrical teeth. [27] However, other research has also shown that either the left [28, 29] or right sides had a noticeably greater occurrence of REM. [30]

Although there was not a significant distinction, this study discovered that REM was bilateral in 62.5% of the female participants and 63.16% of the male participants. This is consistent with earlier research, which supports the robust bilateral link shown in those earlier investigations. [5, 11]

Conclusions

Based on the findings of this cross-sectional investigation, 3.92% of Egyptians were found to have REM. The prevalence of REM did not significantly

differ according to side or gender. Moreover, when treating the permanent first mandibular molar, clinicians should consider the probability of bilateral REM occurrences.

Ethical consideration

The Ethical Committee of the Faculty of Dental Medicine, Assiut University, Egypt, authorized the methodology for the investigation and gave its approval to this cross-sectional study with IRB local approval number 17-2025-0001. The Helsinki Declaration and the Guidelines for Good Clinical Practice were followed when conducting the study. The authors would declare that no funding was taken to establish this research.

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