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Research article

Prevalence of *radix accesoria dentis* in a northern Peruvian population evaluated by cone-beam tomography

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A R T I C L E I N F O

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A B S T R A C T

Radix accessoria dentis are anatomical variations of the mandibular molars and identifying them radiographically can be challenging for the clinician, especially in specific areas such as endodontics. The objective this study was to determine the prevalence of *radix accessoria dentis* evaluated in cone-beam computed tomography in a northern Peruvian population. The study design was descriptive and cross-sectional. The sample consisted of 2640 permanent mandibular first and second molar teeth evaluated by cone beam tomography. Non-probabilistic convenience sampling was used. For the analysis of *radix accesoria dentis*, the axial and coronal views of the tomography were evaluated. Prevalence was evaluated according to sex and according to type of tooth and average length. The statistical analyses used were the chi-square test and Kruskal-Wallis H test to find the correlation of the variables. A prevalence of 2.5 % of *radix accesoria dentis* was determined. According to sex, *radix accesoria dentis* was present in 1.36 % in females and 1.14 % in males ($p > 0.05$). The tooth 4.6 obtained the highest prevalence with 1.33 % ($p > 0.05$) and the average length of *radix accesoria dentis* found was 9.27 mm ($p > 0.05$). The prevalence of the *radix accesoria dentis* evaluated in cone beam tomography in a northern Peruvian population is low. Sex does not influence its presentation. Mandibular first molars are the ones that present the greatest amount of this anatomical variation and the average length of the *radix accesoria dentis* is less than 10 mm.

1. Introduction

The morphology of dental roots is important in dentistry because of its influence on various clinical procedures. The specific details of the roots have been the subject of extensive research, focusing on root canal variations and root number anomalies. These variations are relevant as they directly affect the success of endodontic treatments. The presence of accessory canals, pronounced curvatures or complex ramifications can make endodontic cleaning and obturation difficult, impacting the long-term health of the tooth organ [1]. Abnormalities in the number of roots, such as supernumerary roots, can complicate both exodontic and endodontic treatment. The study of root morphology is important to identify, because although there is scientific evidence that addresses dental macroscopic anatomy and orofacial structures in general, there is a lack of specific evidence that focuses on root variants [2,3]. This gap in knowledge highlights the importance of research that focuses exclusively on the morphology and characteristics of the root anatomy of teeth. A detailed understanding of the anatomy and possible variations in tooth roots is essential in order to improve clinical

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procedures [4]. Mandibular permanent molars usually have two roots; however, they may present anatomical variations in the number of roots. Additional roots may be located lingual or buccal to the tooth [5,6]. They usually have shorter lengths and a spiral arrangement, allowing for their possible connection or separation from the roots [7]. Although the term *radix accessoria dentis* is used in several studies, the anatomical terms may vary from one country to another. It is important to consider an exclusive reference source for official terminology for the scientific community worldwide. The adoption of a unified and standardized international anatomical terminology facilitates international understanding and acceptance. The term *"radix entomolaris"* has been a useful term in dental practice and in the scientific literature. The transition to "*radix accesoria dentis*" represents a step toward greater precision and standardization [8,9].

Identifying *radix accessoria dentis* through periapical radiographs is often difficult due to the vestibule-lingual overlap of the roots. These may remain undiagnosed despite direct examination of the floor of the pulp chamber, and their omission allows inflamed or infected pulp tissue to remain, which may result in the appearance or persistence of apical periodontitis and poor-quality treatment [10].

Their formation could be related to external factors during odontogenesis, or to the genetic penetrance of an atavistic gene or polygenetic system [11]. They are also related to ethnic inheritance, especially in East Asian societies, and to a lesser extent in other populations such as in Europe. Research in populations showing Mongolian characteristics, including Chinese, Eskimo and American Indians, has documented the occurrence of *radix accesoria dentis* with varying prevalence rates, ranging from 5 % to 30 %. In individuals of Caucasian ancestry, they are considered unusual at 3.4 % [12].

Several studies determined the presence of *radix accesoria dentis*: In Iran a prevalence of 0.74 % was found [12], in India with 24 % [13], in Slovenia with 1.6 % in the first molar and 1.9 % in the second mandibular molar [14]. In a Chinese population 25.04 % of *radix accesoria dentis* was found [15]. A multinational study in 15 countries found a prevalence of 3 % [16].

One of the tools to properly assess the *radix entomolaris dentis* is cone beam computed tomography, which is specially designed to produce high-resolution images and provide three-dimensional information for the observation of these variations, improving their detection and accuracy for diagnosis [17]. Cone beam computed tomography is a valuable radiographic method to evaluate such anatomical variations in vivo [18]. Several studies suggest that cone-beam computed tomography is an appropriate tool for evaluating anatomic variations and visualizing root canal morphology [19]. The objective of the research was to determine the prevalence of *radix accesoria dentis* of evaluated on cone beam tomography in a population of northern Peru.

2. Materials and methods

The research had a descriptive and cross-sectional design. Tomographies corresponding to the years 2022 and 2023 were evaluated from the database of a radiographic center in the city of Piura, Peru. The following selection criteria were met: tomographies presenting at least one of the lower first or second molars or both and tomographies of molars with root resorptions, images where dispersion was interfered by artifacts such as intra-radicular posts, endodontic treatment, teeth with crowns, orthodontic appliances; open apex, and inadequate image quality were excluded. A total of 1350 tomographies were examined and by consensus of two of the investigators (KLA and AJN), 1024 tomographies were selected. The sampling was non-probabilistic by convenience. For the analysis of *radix accessoria dentis*, the prevalence was evaluated according to sex and according to type of tooth and average length.

All tomographies were performed by the same radiologist and tomographic equipment. The following parameters were used: 90 kV, 5 mA, exposure time 5.2 s and pixel size of 0.30 mm, thickness and axial pitch: 0.300 mm. The tomographic equipment used was a 3D cone beam, Newton Giano HR model, 13x10 field with a resolution of 200 μm and manufactured in 2020. To evaluate the tomographic images the tomographies were evaluated in 2 planes (axial and coronal), a computer with a 13th generation Intel® Core™ I5 processor was used for image analysis. The length of the *radix accessoria dentis* for the present study was measured from its beginning in the pulp chamber to the root apex.

The observation consisted of the 20, 20, 20 technique, established by Christopher Starr. It consists in that for every 20 min that one remains in front of a computer or mobile device, the gaze is dissipated towards an object that is at a distance of 20 feet, that is, 6 m away for a period of 20 s or more [20]. The ethical principles established in the declaration of Helsinki [21] were taken into account, maintaining the confidentiality of the participants' data and the study did not involve any risk. The study was approved by the Ethics Committee of the School of Stomatology of the César Vallejo University with Official Letter No. 017–2023/UCV.

Stata Statistical Software: Release 18 was used. College Station, TX: Stata Corp LLC; For the reliability of the measurements, the researchers (KLA and AJN) were calibrated with a specialist in oral and maxillofacial radiology, through the Cohen kappa coefficient to identify the *radix accessory dentis* and the interclass coefficient to evaluate the length of the *radix accessory dentis*. For statistical analysis, the chi-square test and H Kruskal-Wallis were used to determine the correlation of the variables. Statistical significance was considered $p < 0.05$.

Table 1
Prevalence of *radix accesoria dentis* evaluated in cone beam tomography in a northern Peruvian population.

	n	%
Presence	66	2,5
Absence	2574	97,5
Total	2640	100

3. Results

A total of 2640 lower first and second molars were analyzed in cone-beam computed tomographies, and it was determined that 2.5 % of the teeth had *radix accessoria dentis* (Table 1).

When evaluating the prevalence of *radix accessoria dentis* according to sex, 1.36 % was determined in females and 1.14 % in males; no statistically significant difference was found ($p > 0.05$) (Table 2).

When analyzing the *radix accesoria dentis* according to the type of teeth, it is the 4.6 that presented the highest prevalence with 1.33 % ($p > 0.05$). (Table 3).

The averages of the length of *radix accessoria dentis* were obtained, finding that it was the piece 3.6 with the highest average of 9.55 mm ($p > 0.05$). (Table 4).

Figs. 1 and 2 shows the axial view of the cone beam tomography, where the presence of *radix accesoria dentis* is identified.

Fig. 3 shows the coronal view the presence of the *radix accesoria dentis* oriented towards the lingual bone table.

Fig. 4 shows the coronal view the presence of the *radix accesoria dentis* to determine its length.

4. Discussion

Radix accesoria dentis are anatomical variations and can be found in the lower molars, but more frequently in the mandibular first molar. It is important to understand dental morphology and its anatomical variations to ensure the success of endodontic treatments [22]. In the present investigation the prevalence of *radix accesoria dentis* was low, being found to be 2.5 %, as well as in the studies carried out by Duman et al. [23] and Alazemi et al. [24] who found prevalences of 1.2 % and 1.4 % respectively. These data could be related to the fact that they evaluated Turkish and Asian populations, where prevalence is low. Betancourt et al. [25] found a prevalence of 5.7 % in a Chilean population. Although their sample was smaller than the present study, it is important to point out that the racial and ethnic characteristics in Latin American countries vary due to the diverse origins of their population.

Vilas et al. [26] in Brazil evaluated the prevalence of *radix accesoria dentis* in panoramic radiographs and determined no observed cases, however, when evaluating with cone beam tomographies in the same sample they found 0.7 %. Tomography provides a more accurate visualization of these anatomical variants compared to other tools such as panoramic radiographs; due to the distortion they present.

On the other hand, Chankradhar et al. [27] found 11.38 % of *radix accesoria dentis* in Nepal, despite having a smaller sample than the present study. Likewise, a study conducted in China found a prevalence of 25.04 %. This could be explained by the fact that in studies carried out in Asian populations, this variant is common and relatively high, where one in four people could have an *radix accesoria dentis* [15].

The present study determined that it is the mandibular first molars that present a greater amount of RE than the second molars. Several investigations have found similar results, such as Duman et al. [23] who found a higher prevalence in the first molars with 1.9 % as opposed to the second molars with 0.6 %. Likewise, Rafieri et al. [28] determined a prevalence of 10.3 %, while in the lower second molars no *radix accesoria dentis* were found.

When evaluating the prevalence according to sex, Talabani et al. [29], found that *radix accesoria dentis* was significantly higher in men. In contrast, Al-Alawi et al. [30] found no difference. In the present study, *radix accesoria dentis*, no significant difference was found according to sex ($p > 0.05$). Emphasizing the need for the detection of additional canals and roots in both sexes. This finding is consistent with most previous studies [31].

In the present investigation, the average length of the *radix accesoria dentis* was determined. The measurement was made from the origin of the canal in the pulp chamber to the apex observed in the tomography. The average length of the *radix accesoria dentis* found was 9.27 mm. As can be seen, its length is shorter than the other roots of the lower molars, so it may not be adequately identified in a conventional radiograph. Its lingual origin, small diameter of the canal and the average length of these anatomical variations are important characteristics for endodontic treatments [32].

One of the limitations of this study is the size of the sample. We recommend conducting similar studies of larger size and in other regions. On the other hand, as the sampling was non-probabilistic, it is not possible to generalize the results to the entire Peruvian population. Despite these limitations, we consider this research as a contribution to the literature on the prevalence of *radix accesoria dentis* in a population of northern Peru.

Root anatomical variations missed during endodontic diagnosis and treatment increase the likelihood of endodontic failures. The omission of this additional root can significantly compromise treatment outcomes, leading to complications such as persistent infections and the need for costly and painful retreatments for the patient. The implementation of advanced imaging techniques and a

Table 2
Prevalence of *radix accesoria dentis* evaluated in cone beam tomography in a northern Peruvian population, according to sex.

radix accesoria dentis	present		absent		total		p[a]
	n	%	n	%	n	%	
Male	30	1,14	1452	55,00	1482	56,14	0.283
Female	26	1,36	1122	42,5	1158	43,86	
Total	66	2,5	2574	97,5	2640	100	

[a] Chi-square test. $p < 0.05$.

Table 3
Prevalence of *radix accesoria dentis* evaluated in cone beam tomography in a northern Peruvian population, according to tooth type.

	presente		ausente		total		p[a]
	n	%	n	%	n	%	
3.6	24	0,91	601	22,77	625	23,67	
3.7	2	0,08	676	25,61	678	25,68	0.955
4.6	35	1,33	608	23,03	643	24,36	
4.7	5	0,19	689	26,10	694	26,29	
Total	66	2,50	2574	97,50	2640	100	

[a] Chi-square test. $p < 0.05$.

Table 4
Average length of *radix accesoria dentis* according to dental piece.

Dental piece	Mean (mm)	Standard Desviación (mm)	Median(mm)	[a]p
3.6	9,55	1,58	9,9	0,359
3.7	8,85	1,34	8,85	
4.6	9,21	1,89	8,8	
4.7	8,62	0,75	8,4	
Total	9,27	1,48	9,2	

[a] Kruskal-Wallis H-test: $p < 0.05$.

Fig. 1. Axial view, in this section we can see (blue arrow) the presence of *radix accesoria dentis* oriented towards the lingual bone table of the left mandibular first molar.

meticulous approach to anatomical examination of the teeth can improve diagnostic accuracy and treatment efficacy. This includes the use of high-resolution imaging technologies, such as cone-beam computed tomography, which can reveal anatomical details that conventional radiographs might miss. For dentists in Peru, where the prevalence of *radix accessoria dentis* can vary, detailed knowledge of this anatomical variation is essential. Although there are no studies on the prevalence of *radix accessoria dentis* in Peru, it was found that this anatomical variation is present in 2.5 % of cases. This figure, although apparently low, underscores the need for Peruvian dental professionals to adopt advanced diagnostic techniques and to be alert to the possibility of encountering this variation during endodontic procedures The study and understanding of *radix accesoria dentis* not only optimizes clinical outcomes, but also strengthens endodontic practice in the Peruvian context, highlighting the importance of continuing education and the adoption of advanced technologies in the practice of dentistry in Peru.

Declaration of data availability

Data will be available upon request.

Fig. 2. Axial view, in this section we can see (blue arrow) the presence of the *radix accesoria dentis* oriented towards the lingual bone table of the right mandibular first molar.

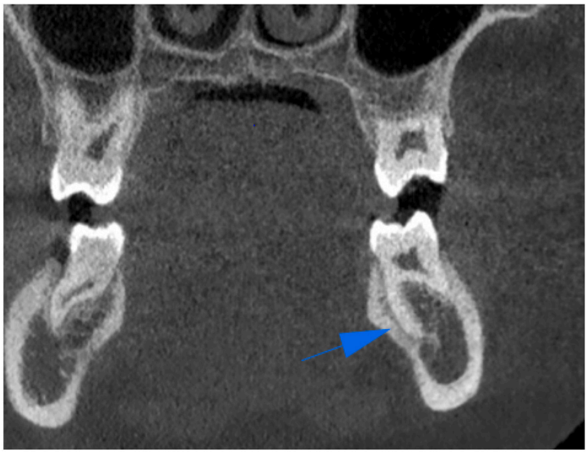

Fig. 3. Coronal view, in this section we can see (blue arrow) the presence of *radix accesoria dentis* oriented towards the lingual bone table of the right mandibular first molar.

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CRediT authorship contribution statement

Karla Renata León-Almanza: Writing – review & editing, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Conceptualization. **Anthony Adrián Jaramillo-Nuñez:** Writing – original draft, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Catherin Angélica Ruiz-Cisneros:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Formal analysis. **Paul Martín Herrera-Plasencia:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: No conflict of interest of the authors If there are other authors, they declare that they have no known competing financial

Fig. 4. Coronal view, this section shows the measurement of *radix accesoria dentis*, from the pulp chamber to the apex.

interests or personal relationships that could have appeared to influence the work reported in this paper.

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