Prevalence of three-rooted primary mandibular first and second molars: clinical and radiographic findings in a Mexican population

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ABSTRACT

The aim of this study was to determine prevalence and describe the clinical and radiographic findings of three-rooted primary mandibular first and second molars in a Mexican population. Intraoral periapical radiograph, orthopantomogram or cone beam computed tomography (CBCT) were obtained. A total 2284 children from the state of Puebla, Mexico were examined, of whom 20 presented an anatomic variant in tooth crown shape. Of the total teeth with crown alterations, 10 first and 5 second primary mandibular molars were found to have supernumerary roots. In one case, it was possible to obtain micro-CT images.

The study recorded prevalence, unilateral or bilateral occurrence, and ratio between sexes. Data were analyzed using descriptive statistics.

Clinical findings were presence of an anatomical variation (tuberculum paramolare / right and/or left cervical convexity) in primary mandibular first molars. Second molars presented conventional crown morphology. Prevalence of three-rooted primary mandibular first and second molars was 0.44% and 0.22%, respectively. Male: female ratio for presence of three-rooted primary mandibular first molars was 4:1, showing genetic predisposition in males, and for second molars it was 1.5:1, with no predisposition according to sex. The clinical and radiographic anatomical variants in primary molars should be considered by pediatric dentists during routine care because they may cause difficulties in restorations.

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Keywords: *deciduous tooth - tooth root - anomalies - diagnostic imaging.*

Prevalencia de primeros y segundos molares primarios mandibulares con tres raíces: hallazgos clínicos y radiográficos en una población mexicana

RESUMEN

El objetivo de este estudio fue determinar la prevalencia, así como los hallazgos clínicos y radiográficos de los primeros y segundos molares primarios mandibulares con tres raíces en una población mexicana. Se obtuvieron radiografías periapicales intraorales, ortopantomografía o tomografía computarizada de haz cónico (TCHC). Fueron revisados en total 2284 niños originarios del estado de Puebla, México, de los cuales 20 sujetos presentaron una variante anatómica en la forma de la corona dental. En el total de dientes con alteraciones coronarias, se encontraron 10 primeros y 5 segundos molares primarios mandibulares con raíces supernumerarias. En un caso fue posible la obtención de imágenes de micro tomografía computarizada (micro-CT).

Fueron registradas la prevalencia, la ocurrencia uni o bilateral y la relación entre sexos. Los datos se analizaron mediante estadística descriptiva.

Los hallazgos clínicos fueron: presencia de una variación anatómica (tuberculum paramolare / convexidad cervical derecha y/o izquierda) en los primeros molares primarios mandibulares. Los segundos molares presentaron una morfología coronal convencional. Entre los hallazgos radiográficos, fue común encontrar un conducto en cada raíz. La prevalencia fue de 0,44% y 0,22% para los primeros y segundos molares primarios mandibulares con tres raíces, respectivamente. La relación por sexo en los primeros molares primarios mandibulares con tres raíces fue de 4:1, indicando una predisposición genética para el sexo masculino, mientras que, en los segundos molares, la razón fue de 1,5:1 sin predisposición por sexo. Las variantes anatómicas clínicas y radiográficas presentes en los molares primarios deben ser tomadas en cuenta por los odontopediatras durante su rutina de atención, ya que pueden ocasionar dificultades para la restauración.

Palabras clave: *dientes primarios - raíz dentaria - anomalías - diagnóstico por imágenes.*

INTRODUCTION

The main aim of pulp therapy in primary teeth is to preserve the integrity of the affected tooth. Pulpectomy usually resolves the fistula problem in pediatric dentistry. However, treatment may be difficult in specific cases when there is a supernumerary root. This anatomical variation usually presents in primary first and second molars. It is an unusual finding, also considered to be a racial characteristic in Asian and Asian-derived populations[1].

Turner described similarities in the frequency of this anomaly among American Indians and contemporary southeastern Asian peoples[2]. These findings enabled inference of genetic relationships that are consistent with theories on important migratory events over the past 20,000 years.

Other studies suggest that the development of a supernumerary root may be due to external factors during odontogenesis, the expression of an atavistic gene with recurrence of a trait that has been absent for several generations, or a polygenic or multifactorial inheritance system[3].

There are few reports of clinical cases of supernumerary roots in primary teeth, and little is known about the characteristics of their crowns[4-6]. The aim of this study was to determine the prevalence of three-rooted primary mandibular first and second molars, and describe their clinical and radiographic characteristics in a Mexican population.

MATERIALS AND METHODS

This was a cross-sectional study that followed the guidelines for reporting observational studies set forth in Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)[7]. It was approved by the Research Ethics Committee of the School of Stomatology at Puebla University, Mexico (Res. 003-11032014).

A total 2284 patients who visited the Pediatric Dentistry Clinic from January 2014 to December 2019 were examined. The children visited the clinic for a routine procedure. Twenty of these children presented some anatomical variation in the dental crown. They all came from Puebla State. Their clinical history was taken and parents signed informed consent for their inclusion in the study. Intraoral periapical radiographs, orthopantomography, or cone beam computed tomography (CBCT) were taken, as applicable to each particular case. As diagnostic aids, periapical radiographs were taken of 19 children, orthopantomography of one child who needed orthopedic treatment, and cone beam computed tomography of one child who had a dentigerous cyst. The 3D CBCT images were taken using Orthophos XG, Sirona Dental Systems GmbH, version 2.5x SIDEXIS XG. Images were viewed using Galaxis Galileos 1.9 with a section window according to region of interest in volumetric mode, with bone contour, with threshold 1764 and transparency 78.8%, soft tissue range 961 and transparency 94.5%. Analysis was performed in two views (panoramic and 3D) and three axial sections: apical (A1), middle (A2) and cervical (A3) levels of the roots.

Extraction of a molar was necessary in one case due to an extensive carious lesion. This enabled the molar to be studied by micro-CT. The tooth was dried slightly, mounted on an *ad hoc* device and scanned in a micro-CT scanner (Nikon Metrology Dual-Source 225kV-450kV) at isotropic resolution 16.7 lm. The X-ray tube was operated at 93 Kv and 102 uA, and the scan was performed with 360° rotations. Different sections were obtained along the Z axis (upper z) for viewing the 3D model and quantitative evaluation of root canal shape.

The images were reconstructed using the software VGSTUDIO MAX 3.3.0. All images were evaluated by two previously standardized pediatric dentists. Prevalence of three roots in both sexes, and unilaterality or bilaterality were determined, and clinical and radiographic findings were described.

RESULTS

The most frequent crown anomaly (10 of the 20 cases studied) was a triangular-shaped mandibular first molar, characterized by the presence of a distolingual lobe in combination with a cervical prominence (Figs. 1a, b). Other crown variations were paramolar cusp (tuberculum paramolare), in a mandibular first molar (1 case) and mandibular second molars (2 cases, Figs. 1c, d, e). In addition, one case exhibited a root canal emerging from the paramolar cusp in the vestibular zone (Fig. 1f).

Figure 2 shows different radiographic images of three-rooted primary molars. We found one case with radix entomolaris in a permanent molar and three roots in the primary mandibular second molar. Supernumerary root canals are usually divergent, wide and well delimited, and may be associated to

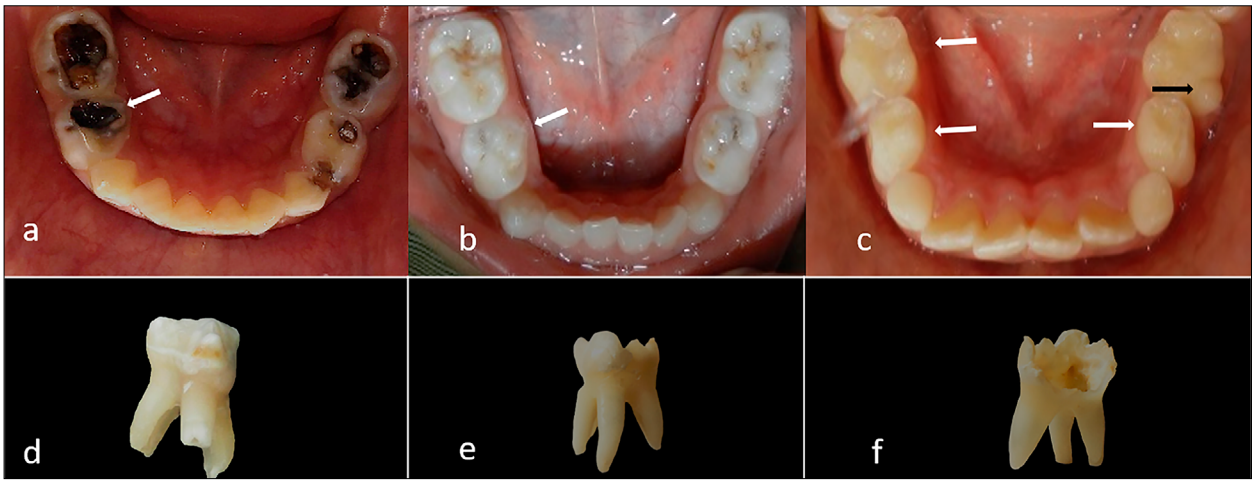

Fig. 1: Occlusal photographs showing crown morphology of three-rooted primary mandibular molars. a) and b) Triangular-shaped primary mandibular first molar (arrows). c) Primary mandibular first and second molars with normal anatomy (white arrows) and primary mandibular second molar with paramolar cusp (black arrow). d) Primary mandibular first molar with paramolar cusp. e) Vestibular view of primary mandibular second molar with paramolar cusp. f) Lingual view of primary mandibular second molar with the canal entrance of the radix paramolaris.

a cervical prominence in the crown (Figs. 2d and 2e). In 3 of the 15 cases studied, the anomaly was bilateral (Fig. 2f).

The CBCT images showed root canal morphology in detail. Fig. 3 is an example of a case in which mesial and distal canals were ribbon-shaped, while the canal in the accessory root was circular. 3D reconstructions clearly show the size relationship and position of roots and their root canals (Fig. 3b). The micro-CT showed early physiological root resorption, as well as a ribbon-shaped mesial canal, an oval-shaped distal canal, presence of a robust, well-defined accessory root with round-shaped vestibular canal which, according to its position, corresponds to a radix paramolaris (RP). There was also a small diverticulum located in the vestibular zone between the RP and the mesial root (Fig. 4).

Prevalence of three roots was 0.44% and 0.22% for first and second molars, respectively. Male:female ratio for three-rooted primary mandibular first molars was 4:1, indicating a genetic predisposition in males. For second molars, the ratio was 1.5:1, without predisposition according to sex.

The frequency of three-rooted primary mandibular first and second molars was higher on the right side than on the left side, with a 5:1 ratio. Results are shown in Tables 1 and 2.

DISCUSSION

Dental pattern is defined as a set of discrete, independent morphological features which may be present or absent in the crown and in the root, and/or may present variation in shape, which may be small, moderate, large or very large[8].

In normal conditions, the primary mandibular first molar has four cusps (two buccal and two lingual) and the primary mandibular second molar has five cusps; both molars have two divergent roots and three root canals[9]. In the current study, the most common clinical finding was the triangular shape of the crown of the primary mandibular first molar, with presence of a distal lingual lobe in combination with the cervical prominence.

Crowns may also have other structural variations such as accessory crests, tubercules or cusps expressed on the lingual, occlusal or buccal surfaces[10]. Crown alterations may also be accompanied by root alterations. Thus, the paramolar cusp is a feature that is frequently associated with a rudimentary root formation in permanent dentition, specifically in second and third molars. The occurrence of this tubercle has been reported in 2 to 65 out of every 1000 individuals. This frequency is lower than that of the Carabelli's tubercle (10 to 380 of every 1000 individuals in Europe)[11].

An interesting finding in the current study was the presence of a paramolar cusp in three different cases. Its occurrence is considered atypical in deciduous

Fig. 2: Radiographs of 3-rooted molars. a) Periapical radiograph showing a primary mandibular first molar with pulpectomy treatment (arrow). b) Primary mandibular second molar (arrow). c) Permanent mandibular first molar and primary mandibular second molar (arrows). d) and e) Bilateral primary mandibular first molar (arrow s). f) Orthopantomographic image showing a case of primary bilateral second molars (arrows).

teeth, more specifically, in the second molar[12,13]. Crown morphological variations (triangular shape and paramolar cusp) may cause clinical difficulties for restoration with preformed stainless steel crowns. In the three cases mentioned, the crown anatomical aberration continued towards the root as a radix paramolarisis (RP) or diverticulum.

Normal primary mandibular first and second molars usually have two roots: one mesial with two canals and another distal with one canal[14], although some studies have reported one or two canals per root[15,16]. The current study found one primary mandibular first molar with no clinical evidence of caries which only presented pain on percussion. This made clinical diagnosis difficult until the presence of a third root was found in the periapical radiograph. The CBCT revealed that the primary second molar had one canal in each root. The mesial and distal canals were ribbon-shaped, while the accessory root canal was round-shaped, narrower and shorter in comparison to the adjacent roots. In cases such as this, the pulp may not be fully formed in the

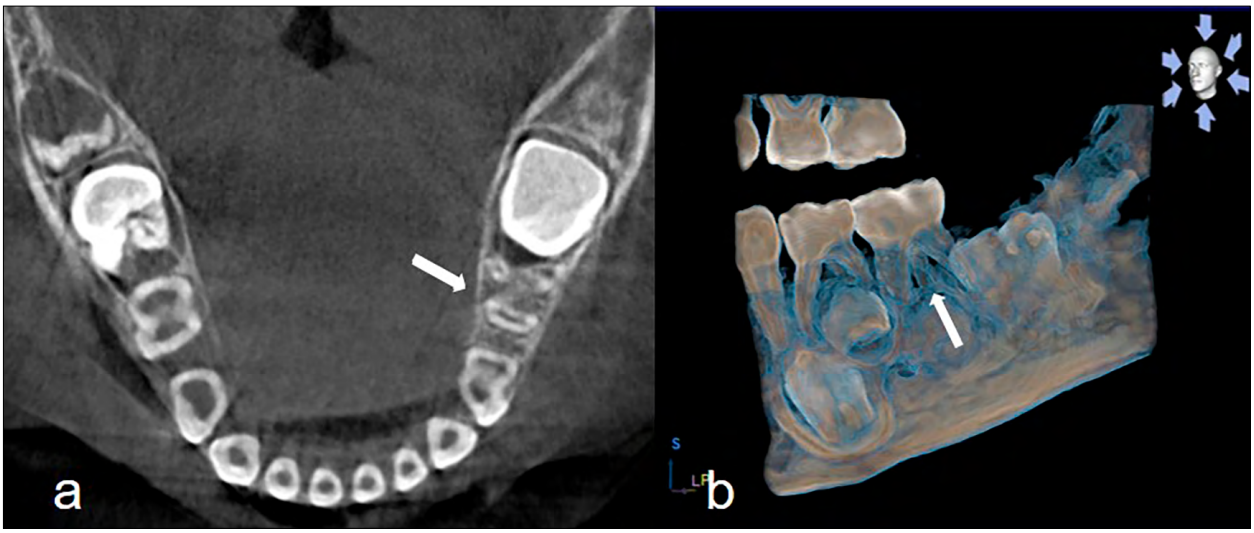

Fig. 3: Cone beam computed tomography. a) Image of cross section corresponding to horizontal lines at the mid-level of primary mandibular molar roots; left primary mandibular first molar with three roots and one canal per root (arrow). b) Three-dimensional view of 3-rooted primary mandibular second molar (arrow).

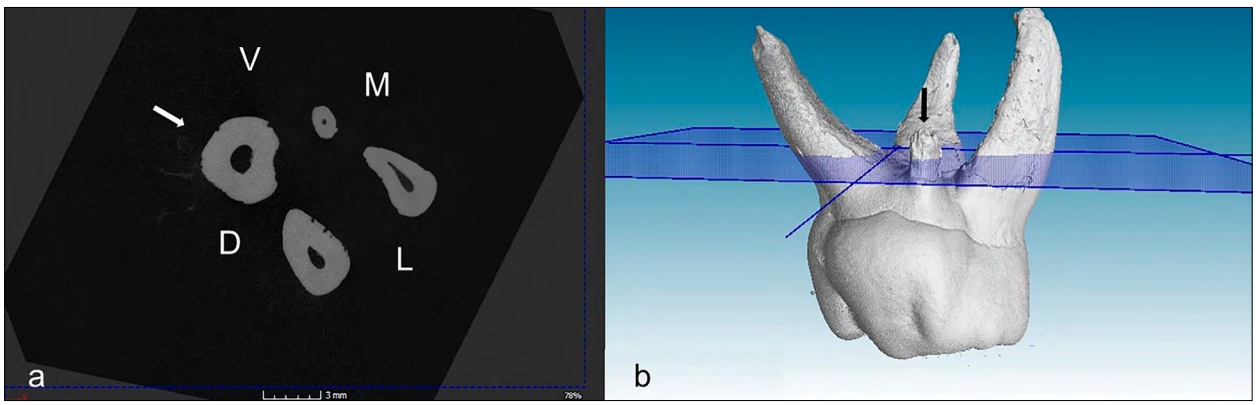

Fig. 4: Micro-TC images. Three-rooted primary mandibular second molar with one canal in each root. a) Cross section. M: mesial, D: distal, V: vestibular and L: lingual. b) Three-dimensional model of a 3-rooted primary mandibular second molar and diverticulum located in vestibular (arrow).

accessory root[17], which might cause pulp problems such as septic necrosis without presence of a fistula. Yang *et al.*[18] report that primary mandibular second molars may present seven variations in root morphology. In this regard, we found a small diverticulum located in vestibular of a second molar between the RP and the mesial root. If we consider this diverticulum to be a root, the case could be classified as variant type 7: four separate roots with a root canal in each[18].

Clinically, it is important to know about the anatomic variations of the root. Previous studies have discussed the implications of supernumerary roots in permanent first molars for endodontics and exodontia[3,19]. The same precaution must be taken for primary teeth, and pediatric dentists should have specific information on root canal morphology in children[20,21]. Knowledge of root canal shapes could help overcome problems related to root canal cleaning procedures[22].

The presence of supernumerary roots has been reported in several populations[5,6,13,23] but to date there is no information on the Mexican population. The study population for this research consists of children from the State of Puebla. General prevalence of supernumerary roots was 0.44% and 0.22% for primary mandibular first and second molars, respectively, which is somewhat lower than values reported for other populations[19,24-27].

Reports are not consistent regarding the unilateral

Table 1. Prevalence of three-rooted primary mandibular first and second molars.

Mandibular first molar No. of subjects	Unilateral		Bilateral	Total
	Right	Left		
Male (n=943)	5 (0.53)	1 (0.11)	2 (0.21)	8 (0.85)
Female (n=1341)	0 (0.00)	2 (0.15)	0 (0.00)	2 (0.15)
Total (n=2284)	5 (0.22)	3 (0.13)	2 (0.09)	10 (0.44)
Total no. of teeth examined (n=4568)	5 (0.11)	3 (0.07)	2 (0.04)	10 (0.22)
Mandibular second molar No. of subjects	**Unilateral**		**Bilateral**	**Total**
	Right	**Left**		
Male (n=943)	1 (0.11)	1 (0.11)	1 (0.11)	3 (0.32)
Female (n=1341)	0 (0.00)	2 (0.15)	0 (0.00)	2 (0.15)
Total (n=2284)	1 (0.04)	3 (0.13)	1 (0.04)	5 (0.22)
Total no. of teeth examined (n=4568)	1 (0.02)	3 (0.07)	1 (0.02)	5 (0.11)

**Data presented as n (%).*

Table 2. Distribution and odds ratio of unilateral and bilateral occurrence among fifteen subjects with three-rooted primary mandibular molars.

Additional root	No. of subjects		Odds ratio
	Primary first molars	Primary second molars	
Unilateral			
Right	5 (50)	1 (20)	5:1
Left	3 (30)	3 (60)	1:1
Subtotal	8 (80)	4 (80)	2:1
Bilateral	2 (20)	1 (20)	2:1
Total	10 (100)	5 (100)	2:1

**Data presented as n (%).*

or bilateral presence of this anomaly. In our study, most of the three-rooted primary mandibular first molars were unilateral (80%), predominantly on the right side (50%), in agreement with Mathew *et al.*[24] and Tu *et al.*[25]. Other studies report that this variation predominates on the left side[28,29]. Reports of bilateral occurrence range from 50% to 67%[4], whereas in our series it was only 20%.

Most studies have reported predominance of supernumerary roots in males[28], in agreement with our study. Some authors suggest that it is a sex-linked dominant trait, while others have found similar prevalence in both sexes[5,27].

It has been reported that supernumerary roots are less frequent in primary dentition than in permanent dentition[13,29]. Cases have also been described in which the anomaly is present in both dentitions, especially in the primary second molar and permanent first molar[30]. In the current study, we found one girl with this characteristic.

Supernumerary roots play a role as a genetic marker with forensic importance in terms of identification of persons of a certain race. Further studies are needed on prevalence in Mexican subjects, covering larger samples and different regions of the country, in order to be able to define its anthropological importance.

CONCLUSIONS

Pediatric dentists should consider the variations in dental morphology in temporary molars. A dysmorphic crown in the primary first mandibular molar may be related to the presence of an additional root; moreover, it could cause difficulties in restorations using commercially available steel-chrome crowns.

The temporary second molar was found to have more stable crown morphology. The additional root may have anatomic variations and is most often located distal-lingually with a round canal.

Prevalence of three-rooted primary mandibular molars in Mexican subjects was 0.44% for first molars and 0.22% for second molars.

Further studies are needed on very large samples to establish exact prevalence in the Mexican population.

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DECLARATION OF CONFLICTING INTERESTS
The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article

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