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Prevalence of three-rooted mandibular permanent first and second molars in the Saudi population

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KEYWORDS

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Saudi population

Abstract *Introduction:* This study aims to explore the frequency and factors affecting the prevalence of an extra root in the lower first and second permanent molars in the Saudi population.

Methods: Images of 379 Saudi patients who underwent CBCT for routine dental treatment were assessed. The CBCT images were evaluated on a 34-inch LED screen in a dark room and assessed by two examiners to count the prevalence of an additional root in the lower molars. Laterality and the gender factors were used to analyze that prevalence. Percentages represent categorical variables; Fisher's exact test and Chi square test were also used for the categorical variables.

Results: In the lower first molars, the prevalence of extra root in female patients was 5.7%, 3% in male patients and the overall prevalence was 3.05%; in lower second molars, the prevalence was 1.81% in female patients and 3.04% in male patients with an overall prevalence of 1.48%. A statistically significant difference was fond in the existence of an additional root with regard to laterality, to be more common on the right compared to the left side for both mandibular molars. The extra root prevalence was statistically significant in female patients at the first molar compared to male patients ($p < 0.05$).

Conclusion: The overall of extra roots prevalence in the lower first and second molars in the Saudi population are 3.05% and 1.48%, respectively. Consideration and identification of this variation is essential to ensure successful endodontic treatment.

1. Introduction

For performing effective dental treatment, detailed knowledge of the anatomy and morphology of the root canal is important (Tu et al., 2009). In endodontic treatment, three-dimensional obturation is the main objective after performing thorough canal cleaning and shaping (Schilder, 1974). However,

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anatomic variation in a root canal system presents clinical challenges in terms of its influence on the final treatment outcome (De Moor et al., 2004; Gulabivala et al., 2001; Gulabivala et al., 2002; Siqueira et al., 2013; Tu et al., 2007; Versiani et al., 2011; 2013). Failure of endodontic treatment may occur in cases of missed canals or incomplete removal of microorganisms and necrotic pulp remnants throughout canal preparation, which result in persistent infection (Berman et al., 2010).

Most first and second lower molars have two roots, with one root located mesially and the other located distally (Vertucci, 1984). However, anatomic variations in these teeth have been described in the literature; the first report was of an additional root in the lower molars (Carabelli, 1844). Racial variations in dental anatomy have been recognized, one of which is an extra root in the lower molar, which might be present on the buccal side (radix paramolaris) or on the lingual side (radix entomolaris). The cause of formation of a radix entomolaris is as yet unclear. Formation of an additional root can occur as a result of extrinsic factors during formation of the tooth or due to inclusion of an atavistic gene in the genetic makeup of the individual (Calberson et al., 2007; Carlsen and Alexandersen, 1990). However, this is considered to be a major anatomic variant in various populations, knowledge on the prevalence is essential to insure better outcome of the endodontic treatment.

Given that the frequency of an additional root in the lower molars in the Saudi population has not yet been evaluated, a study on the prevalence of this anatomic variation in this population is warranted to help endodontists and general dentists improve treatment outcomes in these patients.

Conventional and digital radiographic techniques depict three-dimensional objects in two-dimensional images, and thus, they are limited for accurate assessment of the root morphology or for detection of an extra root. Therefore, cone-beam computed tomography (CBCT) would be a more reliable technique for identifying the presence of such anatomic variations since it allows the three-dimensional evaluation (Shemesh et al., 2015).

Success rates of endodontic treatment of the lower first molars are reportedly lower than those for other teeth. The causes of treatment failure include failure to eliminate all bacteria and the pulp tissue remnants in the root canal system and missed canals. Thus, knowledge of the root canal anatomy of the lower first molars can be useful for improving the treatment success rates (Vertucci, 2005). Moreover, since root canal treatment of the teeth with extra root can be complex (affSinha et al., 2016; Hitij et al., 2017; Thomas et al., 2016), detection and proper management (including referral to an endodontist) would also help to improve treatment outcomes.

No detailed study has evaluated the frequency of an extra root in lower permanent molars in the Saudi population; therefore, the present study aimed to investigate the frequency and factors affecting the prevalence of an additional root in the lower first and second permanent molars in the Saudi population.

2. Materials and methods

This research was performed at King Saud University Dental Hospital. The Institutional Ethics Committee has approved the study. More than 2500 CBCT images obtained between January 1, 2014 and January 31, 2018 were reviewed, and images of 379 Saudi patients who underwent CBCT for routine dental treatment were assessed. All CBCT images were acquired using a ProMax 3D Max machine (Planmeca, Helsinki, Finland) with an isotropic voxel size of 0.2–0.6 mm and submillimeter resolution. The inclusion criteria were as follows: Saudi nationality; availability of radiographs confirming the presence of at least one permanent lower first or second molar; and complete apex formation. The patients whose radiographs were unclear or did not show the entire tooth were excluded. The details of patient sex and nationality were registered.

Inter-examiner calibration was performed before the reading to ensure reliability of the data by choosing 30 subjects and asking each examiner to read their data individually and compare the results. The CBCT images were evaluated on a 34-inch LED screen in a dark room and assessed twice by two examiners to check for the existence of an additional root. Images were examined in an axial section using Romexis software (Planmeca). Data on the total prevalence and location (buccal or lingual) were recorded.

Data analysis was carried out using SPSS version 22 (IBM Corp., New York, NY, USA). The categorical variables obtained were expressed as percentages. We performed Fisher's exact test and Chi square test for categorical variables. We considered a $p < 0.05$ as statistically significant.

3. Results

Three hundred and seventy-nine patients (204 male, 175 female) underwent scanning between January 1, 2014 and January 31, 2018. In total, 655 first lower molars and 672 s mandibular molars were evaluated, which comprised 320 left first molars, 335 right first molars, 336 left second molars, and 336 right second molars. Sixteen patients (6 male, 10 female) were found to have a lower first molar with a third root (Table 1). Prevalence of additional roots in the lower first molar was 3% in men, 5.7% in women, and an overall prevalence of 3.05%. Nine patients (6 male, 3 female) were found to have a lower second molar with a third root with a prevalence of 3.04% in men, 1.81% in women, and an overall prevalence of 1.48%.

Furthermore, there was a statistically significant sex-related difference in the frequency of an extra root: the extra root was more in female patients at the first molar.

Table 2 shows a significant difference in laterality ($p < 0.05$), with a predilection for the right side in both the first and second molars (first molar, $p = 0.003$; second molar, $p = 0.035$).

4. Discussion

Different population studies reported variable prevalence of the extra root in lower molars. In a study conducted in a Malaysian subpopulation, (Pan et al., 2019) radix entomolaris prevalence in the first molar was 21.4%. Another study in North India found the prevalence of radix entomolaris to be 8.3% in all teeth examined. (Gupta et al., 2017) According to another study in an Indian population, the prevalence of lower first molars with three roots was 4.55% (Garg et al.,

Table 1 Prevalence of three-rooted mandibular first and second molars in accordance to gender.

Patients/teeth, n		Right		Left		Bilateral		Total	
		n	%	n	%	n	%	n	%
Female patient, first molar	174	7	4.02	1	0.57	2	1.6	10	5.7
Male patient, first molar	199	4	2	0	0	2	1	6	3
P value		0.201		0.466		0.636		0.003*	
Female patient, second molar	166	3	1.8	0	0	0	0	3	1.81
Male patient, second molar	197	4	2	1	0.5	1	0.5	6	3.04
P value		0.593		0.543		0.543		0.343	

* Significant $p < 0.05$.

Table 2 Prevalence of three-rooted mandibular first and second molars in accordance to side.

Patients/teeth, n		Right		Left		P value
		n	%	n	%	
All first molars examined, n	655	11	1.67	1	0.15	0.003*
All second molars examined, n	672	7	1.04	1	0.15	0.035*

* Significant $p < 0.05$.

Table 3 Prevalence of three-rooted mandibular first molars in different ethnic groups.

Reference	Year	Population	Teeth, n	Three-rooted teeth	
				n	%
Chandra et al. (2011)	2011	South Indian	1000	133	13.3
Schafer et al. (2009)	2009	German	1024	7	0.7
Yang et al. (2010)	2010	Shanghai Chinese	1020	276	27.06
Gupta et al. (2017)	2017	North Indian	1000	83	8.3
Garg et al. (2010)	2010	Indian	1054	48	4.55

2010). A different study (Souza-Flamini et al., 2014) showed that the extra root occurred more frequently in the distolingual location.

There is lack of anatomical studies in Saudi population in regards to the radix root of lower permanent molars. In this study, using three-dimensional CBCT, the prevalence of extra root in the lower permanent first and second molars was determined to be 3.05% and 1.48%, respectively. An extra root in the lower first and second molars was present more often on the right side. This finding is consistent with that of Jayasinghe and Li (2007), who reported that an extra root was observed more frequently on the right side of the lower first molars. Other studies found that there was no significant difference in the sides or in the sex distribution (Chandra et al., 2011; Schafer et al., 2009)

The prevalence of first lower molars with an extra root was 3.05% in this study, which is higher than the prevalence of 0.7% reported in a study by Schäfer et al. in the German population (Schafer et al., 2009) and lower than the prevalence of 27.06% reported in a study by Yang et al. in the Chinese population of Shanghai (Yang et al., 2010). A recent study in Brazilian population (Rodrigues et al., 2016) showed that the prevalence of the first lower molar with three roots was 2.58%, which is slightly lower than the prevalence reported this study. Table 3 shows the prevalence of radix entomolaris or paramolaris in the lower first molar in different ethnic groups.

We found an extra root on the right side in 2.0% of male patients and 4.02% of female patients; these percentages are lower than the respective figures reported in the Chinese population of Shanghai representing 6.59% and 5.56% (Yang et al., 2010). Further, the current study found that the prevalence of an extra-root was 3.05% in the first lower molar and 1.48% in the second lower molar; these figures were lower than the corresponding values (24.5% and 0.7%, respectively) reported in a study performed in the Korean population by Song et al. (2010). This variation in prevalence varies according to the type of population and possibly there genetic predisposition.

This study was performed in the city of Riyadh; future multicenter studies with a larger sample size would provide a better estimation of the frequency of such anomaly in the Saudi population.

5. Conclusion

The overall prevalence of the extra roots is 3.05 and 1.48% in the mandibular first and second molars in the Saudi population, respectively. Consideration and identification of this

variation is essential to ensure successful endodontic treatment. Careful study of radiographs obtained at different angles is needed before initiating endodontic treatment to increase the chance of detection of such anatomical variations and reduce the risk of missing a canal; further, CBCT is recommended in patients suspected to have an additional root. If an extra root is found, the patient should be referred to an endodontist to avoid possible complications.

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Conflict of Interest

The authors deny any conflicts of interest related to this study.

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