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Maxillary premolar root and canal morphology in a Nigerian population: An in-vitro study

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Abstract

Aim: To describe the external and internal root anatomy of maxillary first and second premolars in a Nigerian population using decalcification, clearing and staining technique.

Materials and Methods: Ninety-six maxillary first premolars and one hundred and sixteen maxillary second premolars from 212 consenting adults indicated for extraction were studied. They were then decalcified, cleared and stained *in vitro*. The number of roots, tooth length, direction of root curvature, number of canals, canal configuration and number of apical foramina were noted.

Results: The maxillary first premolars were mostly two rooted (70.8%) while maxillary second premolars predominantly had one root (82.8%) (p=0.001) and two canals. The mean tooth length for the maxillary first (21.87mm) and second (21.56mm) premolars was determined. There was no statistically significant difference between tooth length and gender in the teeth studied.

The majority of single rooted teeth studied were curved distally, with more variable canal configurations than two rooted specimens. Overall, type IV configuration was the most prevalent in both maxillary first (81.2%) and second premolars (58.6%).

Lateral canals were present in 29.2% of maxillary first and in 34.4% of second premolars studied. Inter- canal communications were observed in 20.8% of maxillary first premolars and 6.8% of maxillary second premolars. Root canals exited with multiple foramina in both maxillary first (83.3%) and second (62.1%) premolars.

Conclusion: Maxillary first premolars were mostly two rooted while maxillary second premolars predominantly had a single root in the studied population. Also, the majority of the teeth studied had two canals and type IV canal configuration. Anatomic variations in these teeth should be borne in mind when carrying out endodontic treatment.

Keywords: Maxillary premolars, root canal, morphology, Nigerian

INTRODUCTION

An Increase in dental awareness which requires the need to maintain oral health, [1] coupled with population expansion and ageing have increased the demand for root canal treatment. [2] In emerging economies like Nigeria, the trend is similar, with more patients being desirous of keeping their teeth. However, there is a limited number of endodontists to meet this growing need. [3] Therefore, more trained clinicians are required in this specialised area of dentistry.

Maxillary premolar teeth are very important in the dental arch and are often root treated. Complex variations in their anatomy often lead to high rates of treatment failure following poor, under or no canal filling.[4] Therefore, a comprehensive knowledge and understanding of their root canal anatomy and morphology with their frequent variations is needed for endodontic success. This knowledge will facilitate proper cleaning, shaping and obturation of all canals, leading to better treatment outcomes. [5]

It is suggested that variations in root and canal anatomy may be influenced by factors including age, race, sex and study design. A previous study among a Saudi population [6] reported significant difference in root canal morphology in both genders however, a similar study in Ghana[7] had contrasting findings and showed no gender influence with regards root form and canal morphology. Similarly, a previous *in vivo* study in a Nigerian population[8] using digital radiography showed no significant gender differences in maxillary premolar teeth and only described internal root canal anatomy in the teeth studied.

Therefore, this present study aimed at describing the external and internal root anatomy of maxillary first and second premolars in a Nigerian population using decalcification, clearing and staining technique; as well as identify any possible racial and gender influence in root form and canal morphology.

MATERIALS AND METHODS:

This *in vitro* study was conducted at the Endodontic unit of the Department of Restorative Dentistry, University of Benin Teaching Hospital (UBTH), Benin City, Nigeria between November 2018 and November 2019; in compliance with the Helsinki declaration by the World Medical Association.

Approval was gotten from the Ethics and Research Committee in a protocol number ADM/E/22/A/VOL.VII/11205.

Extracted maxillary premolars that met the selection criteria were collected over the course of the study period. Teeth collected were stored in appropriately labelled 500ml plastic specimen bottles containing 10% formalin (Sigma-Aldrich Chemical Company, Germany) for one week. Collection and processing of teeth used in the *in vitro* study were done in batches. In each batch, hard and soft deposits were carefully removed from the tooth surfaces using a periodontal hoe and washed under a running tap. The length of the teeth was measured using a digital vernier caliper (Tool Zone®, USA) from the buccal cusp tip to the root apex.[9] In teeth with two roots, the measurements were taken from buccal cusp tip to the apex of the buccal root and from the palatal cusp tip to the apex of the palatal root. [9] The tooth length, number of roots, direction of root curvature were carefully observed and recorded in a data collection sheet (Appendix III).

The study of the internal anatomy was done following preparation of surgical access cavity to the pulp chamber using surgical length diamond round burs and canal orifice(s) located and identified using sharp endodontic explorer. The specimens were then placed in a 5.25% sodium hypochlorite solution (Hacros Chemicals Inc, USA), for 24 hours to remove organic tissue from the root surface and root canal system and thereafter flushed thoroughly with normal saline using a hypodermic syringe. They were then washed under running water for 2 hours and dried on a wire mesh. Decalcification of the specimens was done using 10% nitric acid solution (Ricca Chemical Company, USA) for 4 days at room temperature. The nitric acid solution was changed daily with the decalcification process aided by careful agitation. Subsequently, the teeth were rinsed under running water for 4 hours and dried, followed by dehydration in successive solutions of 80%, 90% and 100% alcohol (Sigma-Aldrich Chemical Company, Germany) in ascending sequence.

Diaphanization was induced by placing the specimens in 99% methyl salicylate (Shanghai Innojade Chemical Company) for 30 minutes. Following this, Indian ink (Rayudu Laboratories Limited, India) was injected coronally into the pulp chamber using a 2ml disposable syringe with a gauge 25 needle. The ink was aspirated through the canals' apices using small bore, low volume suction apparatus attached to the apex.

Observations regarding the external anatomy of teeth studied were carefully recorded in a data collection sheet (Appendix III). Although there is no universally accepted classification for root morphology, [10] roots were considered fused if union occurs in the apical, middle or cervical third of the roots.[11] The direction of root curvature was determined by visual examination of the tooth from the buccal, lingual, mesial and distal aspects and also by aligning a reamer perpendicular to the long axis of the premolar from the cusp tip towards the root apex.[12]

Observations regarding the internal anatomy; the number of root canals and their configuration based on Vertucci classification, lateral canals, inter-canal communications and apical foramina were recorded in a data collection sheet (Appendix III)

Data collected was analysed using Statistical Package for Social Sciences (SPSS) version 23.0 for Windows, Illinois, USA. Two examiners were calibrated on the Vertucci classification of root canal anatomy. Examiner's calibration was also based on the review of previously decalcified and cleared teeth, prior to carrying out the evaluations in this study. Data reliability was achieved by assessing the inter examiner reliability of both examiners. The inter examiner agreement of both examiners was evaluated by the Cohen's Kappa test. 30 images of decalcified and cleared teeth were examined by both examiners twice with an interval of 1 week between evaluations. The inter examiner agreement was strong with a Cohen's Kappa coefficient of 0.87 for number of roots, 0.89 for number of canals and canal configuration.

Analysis was presented in frequencies and percentages. Measures of central tendency and dispersion such as means and standard deviations were determined for the tooth length in maxillary first and second premolars. Independent *t*-test was used to determine any significant difference in mean working length and tooth length based on gender. Chi-Square and Fisher's exact test was used to test any gender differences in root and canal morphology in the studied teeth. Statistically significant level was taken at $p<0.05$

RESULTS

Table 1: Morphologic characteristics of roots of maxillary premolar teeth in the study participants

Root and canal morphology	Tooth Type		*p*-value
	First premolar (n = 96) n (%)	Second premolar (n = 116) n (%)	
Mean tooth length ± SD (mm) (Range)	21.87 ± 2.33 (16.52 - 28.20)	21.56 ± 1.39 (18.44 - 27.20)	
Number of roots			
Single root	28 (29.2)	96 (82.8)	0.001†
Two separate roots	40 (41.6)	8 (6.9)	
Two fused roots	28 (29.2)	12 (10.3)	
Number of canals			
One canal	4 (4.2)	36 (31.0)	0.112†
Two canals	90 (93.7)	80 (69.0)	
Three canals	2 (2.1)	0 (0.0)	
Canal configuration			
Type I	4 (4.2)	24 (20.7)	0.578†
Type II	12 (12.5)	16 (13.8)	
Type III	0 (0.0)	4 (3.4)	
Type IV	78 (81.2)	68 (58.6)	
Type V	0 (0.0)	4 (3.4)	
Type VIII	2 (2.1)	0 (0.0)	
Lateral canals			
Present	28 (29.2)	40 (34.5)	0.680‡
Absent	68 (70.8)	76 (65.5)	
Inter-canal communication			
Present	20 (20.8)	8 (6.9)	0.224†
Absent	76 (79.2)	108 (93.1)	
Number of apical foramina			
1	64 (16.7)	44 (37.9)	0.338†
2	78 (81.2)	72 (62.1)	
3	2 (2.1)	0 (0.0)	

‡ χ^2 test † Fisher's exact test *SD=Standard deviation

The mean tooth length ± SD of maxillary first premolars was 21.87 ± 2.33mm while that of the maxillary second premolars was 21.56 ± 1.39mm (Table 1).

The majority of maxillary first premolars had two roots. These roots were observed to either be separate (41.6%) or fused (29.2%). Whereas, most maxillary second premolars were observed to have a single root (82.8%) in the *in vitro* study (p=0.001) (Table 1).

The majority of maxillary first (93.7%) and second (69.0%) premolars had two canals. Two maxillary first premolars (2.1%) were recorded to have three canals (Table 1). Vertucci type IV was the most prevalent canal configuration in both maxillary first (81.2%) and second premolars (58.6%) (Table 1).

Table 2: Gender variation in the tooth length of maxillary premolar teeth in the study participants

Tooth type	Gender	Number of teeth	Minimum Length (mm)	Maximum Length (mm)	Mean±SD	t-value independent t-test	*p*-value
First Premolar							
One root							
	Male	16	17.50	24.30	21.61±2.90	0.109	0.918
	Female	12	16.52	24.30	21.32±4.20		
Two roots							
Buccal							0.579
	Male	36	20.00	28.20	22.85±2.61	0.567	
	Female	32	21.58	23.40	22.31±0.77		
Palatal							
	Male	36	19.10	27.30	21.86±2.60	0.672	0.512
	Female	32	20.20	22.50	21.20±0.93		
Second Premolar							
One root							
	Male	48	18.44	27.20	22.37±2.70	0.313	0.758
	Female	48	18.65	24.30	22.06±2.00		
Two roots							
Buccal							0.388
	Male	12	20.10	22.45	21.02±1.26	-1.008	
	Female	8	21.62	22.39	22.01±0.54		
Palatal							
	Male	12	19.70	21.96	20.48±1.28	-1.501	0.230
	Female	8	21.60	22.35	21.96±0.53		

*SD=Standard deviation

The mean tooth lengths of maxillary first premolars in were lower in females. In maxillary second premolars, the mean tooth length of single-rooted teeth was higher in males and vice versa for teeth with two roots. An independent *t*- test conducted to determine if a difference existed between the mean tooth lengths of male and female participants showed that the difference was not statistically significant (Table 2).

Table 3: Direction of root curvature in maxillary premolar teeth in the study participants

Tooth/ Number of roots	Straight n (%)	Direction of Root Curvature			
		Towards buccal n (%)	Towards palatal n (%)	Towards mesial n (%)	Towards distal n (%)
First premolar					
One root	4 (14.3)	0 (0.0)	0 (0.0)	4 (14.3)	20 (71.4)
Two roots					
Buccal	24 (35.3)	8 (11.8)	8 (11.8)	4 (5.9)	24 (35.3)
Palatal	24 (35.3)	12 (17.6)	8 (11.8)	4 (5.9)	20 (29.4)
Second Premolar					
One root	4 (4.2)	12 (12.5)	0 (0.0)	16 (16.7)	64 (66.7)
Two roots					
Buccal	16 (80.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (20.0)
Palatal	8 (40.0)	4 (20.0)	0 (0.0)	0 (0.0)	8 (40.0)

Maxillary first premolars with single roots were curved distally when viewed from the labial aspect in majority (71.4%) of the teeth studied (Table 3).

A total of 64 (66.7%) maxillary second premolars with single roots had their roots curved distally from the labial aspect. Two rooted specimens had straight buccal roots in 16 (80%) teeth while palatal roots were either straight or curved distally in 40% of the specimens studied (Table 3).

Table 4: Gender variation of morphologic characteristics in maxillary premolar teeth in the study participants

Root and canal morphology	First premolar		*p*-value	Second premolar		*p*-value
	Male (n = 52) n (%)	Female (n = 44) n (%)		Male (n = 60) n (%)	Female (n = 56) n (%)	
Number of roots						
One root	16 (30.8)	12 (27.3)	1.000ǂ	48 (80.0)	48 (85.7)	1.000ǂ
Two roots	36 (69.2)	32 (72.7)		12 (20.0)	8 (14.3)	
Number of canals						
One canal	0 (0.0)	4 (9.1)	0.717†	20 (33.3)	16 (28.6)	1.000†
Two canals	50 (96.2)	40 (90.9)		40 (66.7)	40 (71.4)	
Three canals	2 (3.8)	0 (0.0)		0 (0.0)	0 (0.0)	
Canal configuration						
Type I	0 (0.0)	4 (9.1)	0.556†	12 (20.0)	12 (21.4)	0.608†
Type II	4 (7.7)	8 (18.2)		8 (13.3)	8 (14.3)	
Type III	0 (0.0)	0 (0.0)		4 (6.7)	0 (0.0)	
Type IV	46 (88.5)	32 (72.7)		32 (53.3)	36 (64.3)	
Type V	0 (0.0)	0 (0.0)		4 (6.7)	0 (0.0)	
Type VIII	2 (3.8)	0 (0.0)		0 (0.0)	0 (0.0)	

ǂ χ^2 test with Yates correction † Fisher's exact test

The majority of maxillary first premolars had two canals in both males (96.2%) and females (90.9%) in the studied population. Three-canal variants were observed in 3.8% of teeth extracted from male participants in this study. Maxillary second premolars were observed to have a high prevalence of two canals in teeth extracted from both male (66.7%) and female (71.4%) study participants with a higher tendency in females (Table 4).

A high prevalence of Vertucci type IV configuration was recorded in both genders (88.5% and 72.7% respectively) in maxillary first premolars. However, a greater tendency to have type IV root canal configuration was observed in the first premolars of males compared to females. Vertucci type VIII configuration was recorded in teeth extracted from male participants in this study (Table 4). In maxillary second premolars, a greater variation in root canal configuration was observed in male participants compared to females. Overall, type IV configuration was predominant in both genders.

Table 5: Root canal configuration by number of roots in maxillary premolar teeth in the *in vitro* study participants

Tooth type	Number of roots	N	Canal configuration					
			I	II	III	IV	V	VIII
First premolars	1	28	4 (14.3)	12 (42.9)	0 (0.0)	10 (35.7)	0 (0.0)	2 (7.1)
	2	68	0 (0.0)	0 (0.0)	0 (0.0)	68 (100.0)	0 (0.0)	0 (0.0)
Second premolars	1	96	24 (25.0)	16 (16.6)	4 (4.2)	48 (50.0)	4 (4.2)	0 (0.0)
	2	20	0 (0.0)	0 (0.0)	0 (0.0)	20 (100.0)	0 (0.0)	0 (0.0)

Single rooted maxillary first and second premolar teeth had a more variable canal configuration than teeth with two roots. (Table 5). Two rooted teeth had only type IV configuration in maxillary first and second premolars in this study (Table 5).

Table 6: Lateral canals in maxillary premolar teeth in *in-vitro* study participants

Tooth type	Number of roots	Location of lateral canals			
		Cervical third	Middle third	Apical third	None
First premolar	1	0 (0.0)	8 (28.6)	4 (14.3)	16 (57.1)
	2	4 (5.9)	0 (0.0)	12 (17.6)	52 (76.5)
Second premolar	1	4 (4.2)	0 (0.0)	24 (25.0)	68 (70.8)
	2	0 (0.0)	8 (40.0)	4 (20.0)	8 (40.0)

Maxillary first premolars with single roots were observed to have lateral canals in either the middle (28.6%) or apical third (14.3%). The majority (17.6%) of two rooted maxillary first premolars with lateral canals were recorded in the apical third in the teeth studied (Table 6).

In the maxillary second premolars, lateral canals were more frequently observed in the apical (25%) and middle (40%) third of single rooted and two-rooted specimens respectively, in this study. (Table 6).

Table 7: Inter-canal communication in maxillary premolar teeth in *in-vitro* study participants

Tooth type	Number of roots	Inter-canal communication		
		Middle third	Apical third	None
First premolar	1	12 (42.9)	0 (0.0)	16 (57.1)
	2	4 (5.9)	4 (5.9)	60 (88.2)
Second premolar	1	4 (4.2)	4 (4.2)	88 (91.6)
	2	0 (0.0)	0 (0.0)	20 (100.0)

Inter canal communications were recorded only in the middle third in 42.9% of single rooted teeth. In two rooted first premolars, they were observed in either the middle or apical third in 5.9% of teeth studied (Table 7).

Maxillary second premolars showed a low prevalence of inter canal communication in this study. They were observed in either the middle (4.2%) or apical (4.2%) third of single rooted specimens (Table 7).

Table 8: Position of apical foramina of maxillary premolar teeth relative to the root apex in the study participants

Tooth type/ Number of roots	Position of apical foramen				
	Central n (%)	Buccal n (%)	Lingual n (%)	Mesial n (%)	Distal n (%)
First premolar					
One root	12 (36.4)	8 (18.2)	0 (0.0)	8 (18.2)	12 (27.2)
Two roots					
Buccal	44 (64.7)	4 (5.9)	4 (5.9)	0 (0.0)	16 (23.5)
Palatal	52 (76.4)	0 (0.0)	4 (5.9)	4 (5.9)	8 (11.8)
Second premolar					
One root	56 (37.8)	20 (13.5)	12 (8.1)	8 (5.4)	52 (35.1)
Two roots					
Buccal	8 (40.0)	8 (40.0)	0 (0.0)	0 (0.0)	4 (20.0)
Palatal	4 (20.0)	4 (20.0)	0 (0.0)	4 (20.0)	8 (40.0)

Single rooted maxillary first premolar teeth were observed to have multiple foramina in 42.8% of the teeth studied. The location of the apical foramen deviated from the centre of the anatomic apex in 63.6% of single rooted maxillary first premolars in this study. In contrast, the majority of apical foramina in two rooted maxillary first premolars in the study sample exited centrally in both buccal (64.7%) and palatal roots (76.4%) (Table 8).

In maxillary second premolars with the majority of apical foramina were also observed to deviate from the root vertex in teeth with single and two roots (Table 8).

DISCUSSION

An in depth knowledge and understanding of variations that exist in root and canal anatomy is required for successful endodontic treatment.[5] Several studies,[8,13-15] employing different methodologies, have been done to identify the variations possible in root anatomy and canal morphology.

In this *in vitro* study, 96 maxillary first premolars and 116 maxillary second premolars were evaluated using decalcification and clearing technique. This technique is widely used in anatomic investigations because it provides detailed information such as a three-dimensional view of the pulp space in relation to the external tooth surface. [16]

Findings form this study showed that the majority of maxillary first premolar specimens had two roots while maxillary second premolars were predominantly single-rooted (p=0.001). This is similar to findings in a previous study by Agholor and Sede[8]. Two-rooted maxillary first premolars were seen to be either separate or fused; with fused roots accounting for 41.2 % of the specimens in this study. This value was higher compared to that recorded in Singaporeans, [17] Polish [18] and Saudi populations.[19] This may be suggestive of racial differences in the morphology of maxillary first premolar teeth in these populations. Maxillary first premolars with three roots are rare but have been reported in several studies amongst Caucasian and Asian populations with percentages ranging from 0 to 9.2%.[9,15,17-20] In this *in vitro* study however, none of the maxillary first or second premolars had three roots.

The mean length of the maxillary first premolar in this study was 21.87mm with the buccal mean tooth length slightly longer than the palatal mean tooth length by about 1mm. This is in agreement with previous studies [9,20,]. This was, however, at variance with a Kenyan study where the palatal mean tooth length was longer than the buccal.[21] This difference may be due to the reference points used for measurements taken in the Kenyan study. Maina and Wagaiyu [21] in their study used the buccal cusp tip as the reference point for both buccal and palatal measurements. In this study, the measurements were taken from buccal cusp tip to the apex of the buccal root and from the palatal cusp tip to the apex of the palatal root for teeth with two roots. The mean length of the maxillary second premolar was 21.56 mm and was higher in single rooted teeth extracted from male participants and vice versa for teeth with two roots. There was however no statistically significant gender difference in mean tooth lengths in both maxillary first and second premolars.

Maxillary premolar teeth may curve quite sharply buccally, palatally, mesially or distally.[22] In this study, maxillary first and second premolars with a single root were found to curve distally in majority of maxillary first and second premolars studied . This is similar to findings by Pecora et al., [9,23] in a Brazilian population. In two rooted teeth, buccal roots of maxillary first premolars were either straight or curved distally in 35.3% while those of second premolars were predominantly straight. Palatal roots in maxillary premolars were either straight or distally curved in both first and second premolars with two roots.

The incidence of a single canal in this study was 4.2% in maxillary first premolars and 31% in second premolars. The prevalence of maxillary second premolars with a single canal in this study was lower than that previously reported in Caucasian and Asian populations.[15,24] This may be suggestive of racial influence on the number of canals in these teeth. Two canals were recorded in 93.7% of first premolars and 69% in maxillary second premolars. The prevalence of two canals in maxillary second premolars was lower than that recorded in previous studies in Nigerians by Oginni[14] and Chima. [25.] This may be attributed to difference in methodology used in these studies.

The influence of gender on the number of root canals showed that females had a higher prevalence of single canals in maxillary first premolar while the reverse was true in maxillary second premolars. This finding is similar to that

observed in a previous study in Nigerians[8]. Also, three-canal variants were found in maxillary first premolar teeth extracted from male participants in this study. The finding of three-canal variants amongst the maxillary first premolars studied is at variance with the results of previous studies by Oginni [14] as well as Agholor and Sede [8] in Nigerian populations where no three-canal variants were recorded.

In relating the number of roots to canal configuration, maxillary first premolars with single roots had more variable canal configurations than those with two roots which had only the type IV configuration. This is similar to findings by Abella et al.,[26] in a Spanish population where more variable canal configurations were reported in single-rooted maxillary first premolars. It was also observed that type IV configuration was the predominant canal configuration in both single and two-rooted maxillary first premolars in this study. This is in agreement with the findings of previous studies.[20,29] Maxillary second premolars with a single root had predominantly type IV canal configuration. This is at variance with findings in a study by Abella et al.,[26] where type I configuration was more frequently observed in single-rooted maxillary second premolars. This difference may be attributed to the possible racial influence on canal morphology.

The possible influence of gender on root canal configuration formed part of this study. This study showed that females were more likely to have type I configuration in maxillary first premolars. Generally, type IV configuration was predominant in both males (84.6%) and females (72.7 %) in the maxillary first premolars studied. This is similar to the findings of Al-Nazhan et al.,[5] in a Saudi population. In the maxillary second premolars, five different variations of root canal configuration were recorded in males while three were seen in females. Overall, type IV was the prevalent configuration recorded in the maxillary second premolars of both genders in this study. Celikten et al., [27] and Raj and Mylswamy [24] reported type I and type II canal configurations as the most prevalent in their studies of Turkish-Cypriot and Indian populations respectively. This may be due to difference in the racial background of the various study populations.

Lateral canals were observed in 29.2% of maxillary first premolars and 34.5% of second premolars studied. The incidence of lateral canals in maxillary first premolars in this study is lower than that recorded in previous studies by Pineda and Kuttler,[15] Vertucci and Gegauff [20] and Wu et al.[28]

Lateral canals were mostly found in the middle and apical third of the root in both maxillary first and second premolars in this present study. This is similar to what was reported in a study by Gupta et al.,[29] in a North Indian population.

Also, the frequency of inter-canal communications observed was similar to that reported by Weng et al.[30] The incidence of inter-canal communications in maxillary first premolars was higher in the middle third of single-rooted specimens and seen only in the middle and apical thirds of single-rooted maxillary second premolars.

In this study, maxillary premolar teeth were observed to predominantly have two separate apical foramina in maxillary first (81.2%) and second premolars (62.1%). This is similar to findings by Awawdeh and Al-Qudah [31] in a Jordanian population. Oginni [14] reported a lower incidence of two apical foramina in maxillary first premolars (55.7%) and maxillary second premolars (46.3%) in a Nigerian population. This may be attributed to the study method used by Oginni [14] in which radiographic evaluation was done.

A close relationship between the location of the apical foramen and the root apex exists. However, they frequently do not coincide.[31] In this study, root canals frequently exited away from the root vertex (63.6%) in single-rooted maxillary first premolar teeth in buccal, lingual, mesial or distal positions. In contrast, maxillary first premolars with two roots were observed to have apical foramina that predominantly exited centrally in both buccal (64.7%) and palatal roots (76.4%). In the maxillary second premolars, the majority of apical foramina were observed to deviate from the root vertex in both single and two-rooted teeth in the study sample. Burch and Hulen [32] reported that the apical foramina deviated from the root apex in 94.7% of single-rooted maxillary premolars and 97.8% of maxillary premolars with two roots. In their study there was no distinction between the first and second premolars. Other studies involving all tooth groups demonstrated that the apical foramen coincides with the apical root vertex 17 - 46% of the time.[33,34] This variation is more marked in older teeth through cementum apposition.[35] It is important to consider the morphology of the apical region during nonsurgical and surgical root canal treatment.[36] The deviation of the foramen is not easy to detect by conventional radiography, particularly when the opening occurs on the buccal or lingual root surfaces.[15] This makes the use of electronic apex locators, operating microscopes or more contemporary imaging methods (CBCT) crucial in dealing with the possible variations in apical morphology.[31]

CONCLUSION:

Maxillary first premolars were mostly two rooted while maxillary second premolars predominantly had a single root in the studied population. Also, the majority of the teeth studied had two canals and type IV canal configuration. It was observed that the influence of gender on tooth length, number of roots or canal configuration in the studied population was not statistically significant; however, the possible influence of race and gender on anatomic variations in these teeth should be borne in mind when carrying out endodontic treatment.

Conflict of Interest: None Declared

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