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Radiological Study of the Root Form and Canal Configuration of the Maxillary First Premolar among Sudanese Population

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Abstract: *The aim of this research was to determine the most common anatomical form of roots and canals configuration of the maxillary first premolar among Sudanese population. The study was an observational descriptive in nature. Diagnostic periapical radiographs were used along with clinical findings. Data was collected from departments of restorative dentistry in some Khartoum state's clinics and hospitals. The study included a total of 80 patients, of which (30) were males and (50) were females with a minimum age of 15 years and a majority ranging between 26 and 36 years. It revealed that 30 (37.5 %) of the maxillary first premolars under study had a single root, while 49 (61.25%) had two roots and only one tooth (1.25%) had three roots. The majority of teeth had straight roots ; 28 (93.3%) of the single rooted MFPs were straight, while 2 (6.7%) were curved. 43 (87.8%) of the MFPs which had two roots were straight, while 6 (12.2%) were curved and regarding the single tooth which was found to have three roots all of them were straight. With regard to number of canals 8 (10%) of cases had a single canal, while 71 (88.75%) had two canals and only one (1.25%) had three canals. Of the single rooted MFPs, 22 (73.3%) had a single canal with a mean length of 20.6 mm, while 8 (26.6%) had two canals with a mean length of 20.1 mm for the buccal canal and 20.4 mm for the palatal one. All of the MFPs which had two roots also had two canals; their buccal canal had a mean length of 19.5 mm while the palatal canal had a mean of 19.8 mm. 40 (81.6%) of their roots were separate while 9 (18.4%) were fused and with regard to the single MFP which had three roots, they were found to be separated from each other.*

Keywords: *Buccal canal, First premolar, Maxillary, Palatal canal, Periapical.*

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I. Introduction

The maxillary first premolar (MFP) is one of two teeth located in the upper jaw. Premolars are so named because they are anterior to the molars in the permanent dentition. [1/2] Crowns of the maxillary premolars are shorter than those of the maxillary canines, and their roots are also shorter. The root lengths equal those of the molars, while the crowns are little longer. Because the cusp develops buccally and lingually, the marginal ridges are in a more horizontal plane and are considered part of the occlusal surface of the crown rather than part of the lingual surface, as in the case of incisors and canines. The internal anatomy of the first maxillary premolar is particularly complex due to their variations in number of roots and canal configuration. [2/3]

Normally the MFP has two roots and two root canals. Occasionally only one root is present, but even then two canals are still often found. The root tips are very fine, which may result in perforation even in a straight canal if a large apical open size is attempted. The roots are often equal in length, but 1-2 mm differences may occur. The root tips and apical canals may curve in the mesio-distal or bucco-palatal dimensions. Rarely, the upper first premolar has three roots and three root canals (molarization) as with the upper molars, although the roots are much finer and smaller. [4,5]Conventional root canal treatment has an overall success rate of 65-95%. The outcome is influenced by the quality of treatment, the design and quality of subsequent restoration; poor endodontic treatment therefore increases the risk of tooth loss, thus a rational approach to the treatment of disease requires an understanding of the pathological process which in turn demands knowledge of the normal anatomy and physiology of the tissues involved. [5]

II. Methods

It is an observational descriptive study in which diagnostic periapical radiographs are used along with clinical findings. The study contains a mixture of pro and retrospective approaches. The study was held in Sudan, Khartoum state, at Dental clinics of Khartoum University and Khartoum educational dental hospital during the period from (Jul – Dec 2015). The study included only patients with a fully completed root development. Patients with uncompleted root development were excluded along with those whose records were

not clear. Background variables included; age, gender and geographic area. Quantitative variables were the number of roots, canals and their lengths, while the root form was included as a qualitative variable. Simple random sampling was applied. Non probability sampling technique was used and the data of 80 study subjects was collected. Interviewing method of data collection was applied and held through a check list along with dental X-rays. All of the collected data were analyzed by using the Statistical package for Social Studies computer program, version 16 and presented as texts, tables, charts and figures.

III. Results

Among the 80 study cases 30 (62.5%) were females and 50 (37.5%) were males. The age of the patients underwent the study ranges between (15-47) and was divided into four groups. Regarding the number of roots, 30 (37.5%) of cases had a single root, while 49 (62.25%) had two roots and only one case (1.25%) had three roots. Generally 72 (90%) of the MFPs had straight roots, while 8 (10%) of them had curved roots, as shown in tables (4.1) and (4.2).

Table (4.1): Shows the number of roots

No. of roots	Frequency	Percentage
Single	30	37.5
Two	49	61.25
Three	1	1.25
Total	80	100

Table (4.2): Shows the overall root form

Root Form	Frequency	Percentage
Straight	72	90
Curved	8	10
Total	80	100

28 (93.3%) of the single rooted maxillary first premolars were straight and only 2 (6.7%) were curved as shown in table (4.3).

Table (4.3): Shows Single Root Form

Single root form	Frequency	Percentage
Straight	28	93.3
Curved	2	6.7
Total	30	100

Of the 49 maxillary first premolars which had two roots, 43 (87.8%) of them were straight and 6 (12.2%) were curved, as shown in table (4.4).

Table (4.4): Shows the status of the two roots curvature

Root form	Frequency	Percentage
Straight	43	87.8
Curved	6	12.2
Total	49	100

With regard to the root separation, 40 (81.6%) of the MFPs had separate roots, while 9 (18.4%) had fused roots, as shown in table (4.5).

Table (4.5): Shows the status of the two roots separation

Root form	Frequency	Percentage
fused	9	18.4
separate	40	81.6
Total	49	100

When comparing the straightness with the separation of the roots, in the 43 MFPs which had two straight roots, it had been found that 36 (83.7%) of them presented with straight and separate roots, while 7 (16.3%) had straight and fused roots, as shown in table (4.6).

Table (4.6): Shows straightness vs separation in the maxillary first premolars with two roots

Root form	Frequency	Percentage
Straight and fused	7	16.3
Straight and separate	36	83.7
Total	43	100

When comparing the curvature with the separation of the root, in the 6 MFPs which had two curved roots, it had been found that 4 (66.7%) of them presented with curved and separate roots, while 2 (33.3%) had curved and fused roots, as shown in fig (4.1).

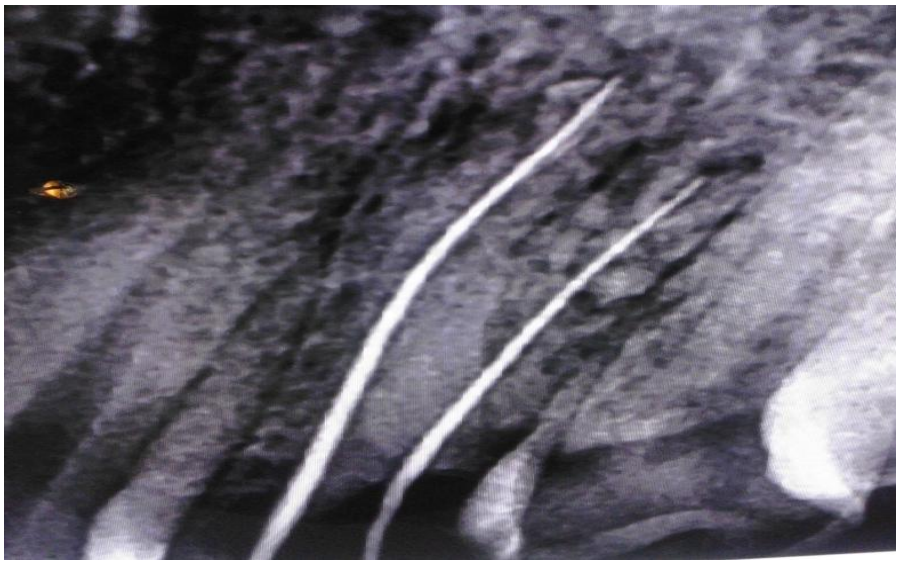

Fig (4.1): Shows maxillary first premolar with two curved separate roots

Regarding the single tooth which had three roots, they were straight and separate and distributed as a single palatal and two buccal roots (mesiobuccal and distobuccal roots), their lengths were 21, 19 and 17 mms respectively. Generally a single canal was found in only 8 (10%) of the cases, while just two canals were seen in 71 (88.75%) of them and three canals were found in 1 case, representing (1.25%). Regarding the single rooted maxillary first premolars, 8 (26.7 %) of them had a single canal which terminated in either a single foramen or two foramina and 22 (73.3 %) had two canals, as shown in table (4.9).

Table (4.9): Shows the number of canals in the single rooted maxillary first premolars

Number of canals	**Frequency**	**Percentage**
Single	8	26.7 %
Two	22	73.3 %
Total	30	100 %

The mean length of the single central canal was 20.6 mm with a minimum length of 19 mm and a maximum length of 23mm, while in the case of two canals; the buccal canal had a mean value of 20.1 mm with a minimum length of 15 mm and a maximum of 24 mm. The palatal canal had a mean value of 20.4 mm with a minimum length of 18 mm and a maximum length of 24 mm. All of the maxillary first premolars which had two roots also had two canals. Their buccal canal had a mean length of 19.5 mm with a minimum length of 16 mm and a maximum of 17 mm, while the palatal canal had a mean length of 19.8 mm with a minimum of 22 mm and a maximum length of 23 mm, as shown in table (4.10).

Table (4.10): Shows root canal length of the maxillary first premolars with two roots

Length **Canal**	**Minimum** **(mm)**	**Maximum** **(mm)**	**Mean** **(mm)**	**±SD**
Buccal	16	17	19.5	1.7
Palatal	22	23	19.8	1.6

IV. Discussion

The present study revealed that 49 (61.25%) of the study subjects had two roots, while 30 (37.5%) had a single root and only one (1.25%) had three roots, which coincides with that mentioned in the literature; in the Brazilian study done by Jesus D and the Saudi Arabian study done by Atieh MA, **[10,13,14]** The majority of MFPs under this study had two canals 71 (88.75%), which agree with the (Brazilian, Nigerian & Isfahan's studies). **[6,7,8]** In the present study 8 (10%) of cases had a single canal and only one tooth (1.25%) had three canals coinciding with the Brazilian, Nigerian, Isfahan's and Saudi Arabian studies in which the majority of MFPs had two canals, a minimum number of them had a single canal, while the least had three canals. **[9,10]** Table (4.11).

Table (4.11): Shows A Comparison Between The Results Of The Present Study And The Previous Ones With Regard To Number Of Roots And Canals

Results / Studies	Canals			Roots		
	Single	Two	Three	Single	Two	Three
Present study	10%	88.75%	1.25%	37.5%	61.25%	1.25%
Brazilian	17.1%	80.4%	2.5%	55.8%	41.7%	2.5%
Nigerian	23%	77%	0%	-	-	-
Isfahan's	32.5%	67.5%		-	-	-
KSA	8.94%	89.84%	1.22%	17.9%	80.9%	1.2%

Of the single rooted MFPs found in the present study, 8 (26.6%) had a single canal with a mean length of 20.6 mm, while 22 (73.3%) had two canals with a mean length of 20.1 mm for the buccal canal and 20.4 mm for the palatal one. The buccal canal was found to be slightly shorter than the palatal canal in those single rooted MFPs (The minimum length of the buccal canal was 15 mm while the palatal one had a minimum of 18 mm). The fact that the majority of single rooted MFPs in the present study had two canals coincides with what was found in the Brazilian study done by Jesus D, et al, which revealed that in the teeth with only one root (55.8%), a single canal was found in (17.1%) of them, while the majority (38.7%) had two canals. [10]Regarding the MFPs with two roots in the present study, all of them had two canals; their buccal canal with a mean length of 19.5 mm while the palatal canal had a mean of 19.8 mm. The buccal canal was slightly shorter than the palatal one (with a minimum length of 16 mm, while the palatal had a minimum of 17 mm). These results are in disagreement with those revealed by the Brazilian study done by Jesus D, et al; they stated that the buccal canal was the longest (The average buccal root length was 21 mm, while the palatal had an average length of 20mm). [10] In the present study 28 (93.3%) of the single rooted MFPs were straight, while 2 (6.3%) were curved which disagree with the Brazilian study, in which the majority (91.1%) of the single rooted MFPs had curved roots, also in the present study the majority of the MFPs with two roots had straight roots; 43 (87.8%) were straight and 6 (12.2%) were curved which disagree with the results reported for buccal and palatal roots of MFPs with two roots in the same Brazilian study; (23%) of the buccal and (24%) of the palatal roots were straight, the rest were curved. Regarding the single tooth which was found to have three roots all of them were straight, unlike the (16.7 %) and (33.3%) of straightness reported for the mesiobuccal and palatal roots of the MFPs with three roots in that Brazilian study. [10]It is worth to note that the previous studies didn't mention the fusion nor the separation of roots when more than one root are present. The present study has shown that of the 49 MFPs which had two roots, 40 (81.6%) of them had separate roots, while 9 (18.4%) had fused roots. In comparison of straightness with the separation of those roots, it had been found that 36 (72%) of cases presented with straight and separate roots, while just 7 (14 %) had straight and fused roots, and when comparing the curvature with the separation, 5 (10%) of cases presented with curved and separate roots, while 2 (4 %) had curved and fused roots. The previous studies also didn't mention the length of roots in cases of MFPs with three roots, our study found a single MFP with three roots which were distributed as a single palatal and two buccal roots (mesiobuccal and distobuccal), their lengths were 21, 19 and 17 mms respectively.

V. Conclusion

The suitable instrumentation technique according to the morphology of each tooth. In the study of 80 MFPs, 30 (37.5%) had a single root while 49 (41.25%) had two roots and only one (1.25%) tooth had three roots. The majority of teeth had straight roots (93.3% of the single roots and 87.8% of the two roots and in the one which had three roots all of them were straight). Considering the MFPs with two roots, 81.6% were separate, while only 18.4% were fused and the majority had straight and separate roots. The roots of the one tooth which was found to have three roots were straight and separate. The majority (88.75%) of the MFPs under the study had two canals; (73.3%) of single rooted MFPs had a single canal, with a mean length of 20.6

mm, while 26.6% had two canals with a mean length of 20.1 mm for the buccal canal and 20.4 mm for the palatal one. All of the MFPs which had two roots also had two canals; their buccal canal had a mean length of 19.5 mm while the palatal canal had a mean of 19.8 mm. Maxillary first premolars are among the most difficult teeth to be treated endodontically for various reasons; the number of roots and canals, the various pulp cavity configurations and also the difficulties of visualizing the apical limit by radiographs, so they should be treated with caution by choosing

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