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MAXILLARY SECOND MOLAR;

VARIATIONS IN ROOT CANAL MORPHOLOGY IN MAXILLARY SECOND MOLAR IN PATIENTS UNDERGOING ROOT CANAL TREATMENT.

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ABSTRACT… Introduction: It is important for a dental practitioner to have a clear understanding of the root canal morphology and its variations to perform successful root canal treatment. The inability to identify and adequately treat all canals of root canal system may contribute to the failure of root canal treatment. **Objectives:** Clinically determine the frequency or numbers of root canals per tooth in the maxillary second molar teeth in the local population. **Setting:** Department of Operative Dentistry in Punjab Dental Hospital / de`Montmorency College of Dentistry, Lahore. **Study Design:** Randomized Control Trial. **Study Period:** 25th May 2013 to 24th November 2013 (6 months). **Results:** This was a Cross sectional survey of 80 patients with symptomatic irreversible pulpitis in maxillary second molar teeth in patients undergoing root canal treatment. The results showed that five (6.25%) patients had single root canal, seventeen (21.25%) patients had 2 root canals, forty (50%) patients had 3 root canals, seventeen (21.25%) patients had 4 root canals and one (1.25 %) patient had 5 root canals per tooth. In patient with five canals, single root canal was present in distobuccal and palatal root each while three root canals were present in mesiobuccal root as MB-1, MB-2 and MB-3 canal. **Conclusion:** Local population have a lot of variations in root canal anatomy in second molar. So preclinical knowledge can increase the success rate of root canal treatment.

Key words: Root Canal Morphology/Anatomy, Root Canal Treatment, Maxillary Second Molar Tooth.

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INTRODUCTION

It is of great importance for a dental practitioner to be familiar with the variations in the anatomy of root canal system, which decides the result of dental treatment to some extent.[1,2] The ultimate goal for patients and practitioners is to relieve pain and retain natural teeth in natural form and function for a lifetime, root canal treatment is mostly the treatment of choice for teeth with pulpal and periradicular pathology.[3] The objective of successful root canal treatment is thorough mechanical and chemical cleaning, shaping of entire root canal system and its complete and compact obturation with an inert filling material under aseptic conditions.[3,4] The main reason for endodontic failure is the presence of untreated canals. Other reasons include apical percolation, presence of microorganisms due to incomplete instrumentation, inadequate cleaning and insufficient canal obturation. Therefore it is of great importance to have a complete knowledge of root canal anatomy and its variations prior to initiation of treatment.[5,6,7]

Studies related to maxillary second molars for anatomical variations and abnormalities are not so numerous.[8,9] The root canal system of maxillary second molar is complex and its treatment is difficult. A maxillary second molar typically contains three roots (mesiobuccal, distobuccal, and palatal) each with one root canal. It can have as many as three mesial canals, two distal canals and two palatal root canals.[10,11]

Most of maxillary second molars have three root canals in 57% of the teeth whereas four root canals are found in 31.7% of the teeth. The fourth canal was mainly found in mesiobuccal root of the teeth. There are some case reports showing two distinct canals in distobuccal (DB)

and palatal (P) roots in maxillary second molar teeth. The presence of fourth canal (MB) ranges from 22.7% to 50.7% for maxillary second molar in-vivo. The presence of only two canals reported in 8.1% while only one root canal reported in 3.2% of the maxillary second molar teeth. Several other studies also show variations in number of root canals and their frequency in the maxillary second molar teeth.[12,13]

The ideal method for precise determination of root canal morphology of a tooth is serial sectioning of the tooth, which is not practical in clinical situations. This makes illumination, careful interpretation of angled radiographs, proper access preparation, detailed exploration of dental map, uncovering chamber floor, floor countersinking, looking for bleeding spots, using ultrasonic instruments, lubricating and chelating agents, using pre-curved hand files and magnification by dental loupes and operating microscope and more recent CBCT, micro CT and spiral computed tomographs even more important. However the most important factor is the clinician awareness that these canal variations exist. These variations may result from many factors including ethnic origin.[7,8,11,12,13,14]

There is a lack of studies on local population regarding information on root canal morphology of maxillary second molar.

The rationale of this study is to investigate the number of root canals per tooth and their frequency in maxillary second molar teeth so we would know their magnitude in local population and be able to guide dentists whether it is same or different from other populations. This will result in reducing the number of dentists ignoring any canal and cases with unsuccessful root canal treatments.

The objective of this study is "To determine the frequency or various numbers of root canals per tooth in the maxillary second molar teeth in patients undergoing root canal treatment."

MATERIAL AND METHOD

The study was conducted in department of operative dentistry, de'Montmorency College of Dentistry / Punjab Dental Hospital and completed in duration of six months from 25th May 2009 to 24th November 2009. The calculated sample size was 80 cases with 95% confidence level, 6 % margin of error and tacking expected percentage of two root canals i.e. 8.1% in patients of irreversible pulpitis in maxillary second molar teeth.

Sampling was non-probability purposive sampling and the study design was randomized clinical trial. Patients of both genders from 15-45 years of age were included in the study having symptomatic irreversible pulpitis in maxillary second molar teeth confirmed by history, examination and percussion/ thermal testing and radiographs. Teeth also had restorable remaining structure, assessed clinically. All patients presenting at the out-patient department at Punjab Dental Hospital, Lahore meeting the inclusion criteria were included in this study. The informed consent was obtained. The demographic information like name, age, gender and address was obtained. Intra oral examination was performed clinically by using dental units' headlight. Standard protocol for root canal treatment cases include history taking, preoperative periapical radiograph, local anesthesia and isolation was performed by the researcher herself.

Initial access preparation was performed with the help of taper fissure bur in a high speed contra angle hand piece then a safe – tipped fissure bur 0142 012 was used to remove enough roof to facilitate straight line access for exploration of the pulp chamber and root canals. Also all carious tooth structure was removed to reduce chances for reinfection from this source. After proper illumination, careful observation, exploration of dentinal map, looking for bleeding spots and uncovering calcification from the chamber floor root canal orifices (including MB, DB and palatal canals) were located with endodontic explorer. The number of canals were confirmed by taking straight on and distal shifted radiographs and the observations were recorded in a pre-designed proformas.

Working length of all canals were determined

by using K files and exposing radiographs. K files were used for mechanical debridement done by hand. All the canals were prepared by step back technique using hand K-files and Gates Glidden drills. 2.5 % sodium hypochlorite used for irrigation and paper points for drying root canals, inter- appointment dressing was placed with cresophene on cotton ball and the access cavity was sealed with cavit. In the next appointment obturation was done after the canal was found dry using standardized Guttapercha points along with Apexit sealer using lateral condensation technique and the access cavity was filled with zinc phosphate and checked for occlusal interferences with articulating paper.

The collected information was entered into SPSS version 10.00 and analyzed through statistical package. The study variables were age, gender and number of canals. The qualitative variables like gender and patients having different number of root canals per tooth (1, 2, 3 4 or 5) were presented as frequency and percentage in maxillary second molars.

RESULTS

Table-I shows most frequently found root canal morphology was three canals (50%), followed by an equal frequency of four canals (21.25%) and two canals (21.25%) followed by single canal (6.25%) and five canals (1.25%). In the patient having five canals, single root canal was present each in distobuccal and palatal roots while three canals were present in mesiobuccal root as MB-1, MB-2 and MB-3 canal.

Table-II shows the gender distribution among the root canal treated cases.

According to Table-III frequency of three canals were found to be same in males and females. In males extra canals (four & five) were more frequently found (26.97% & 2.94%) compared to those of females (17.39% & 0%). In females frequency of lesser canals (one & two) were slightly more (8.69% & 23.91) compared to that of males (2.94% & 17.64%).

Table-IV shows that frequency of extra canals (fourth canal, MB-2) were more in younger age group (15~24 years = 35.71%) as compared to that of two older age groups (25~34 years = 20.69%) (35~45 years = 16.22%). But single case of five canals (MB-3) was found only in age group 35~45 years.

No. of Canals/ Tooth	Frequency	Percentage
1 canal	5	6.25%
2 canals	17	21.25%
3 canals	40	50%
4 canals	17	21.25%
5 canals	1	1.25%
Total cases	80	100%

Table-I. Frequency and percentage of numbers of root canals in maxillary second molars

	Frequency	Percentage
Male	34	42.5%
Female	46	57.5%
Total	80	100%

Table-II. Frequency and percentage of gender in Root canal treated cases of maxillary second molar

	Males		Females	
Number of Canals	Frequency	Percentage	Frequency	Percentage
1 canal	1	2.94%	4	8.69%
2 canals	6	17.64%	11	23.91%
3 canals	17	50%	23	50%
4 canals	9	26.47%	8	17.39%
5 canals	1	2.94%	0	0
Total cases	34	100%	46	100%

Table-III. Frequency and percentage of number of root canals in maxillary second molars in males and females

No. of Canals/ Tooth	Age 15~24		Age 25~34		Age 35~45		Cumulative Frequency	Cumulative percentage %
	Frequency	%	Frequency	%	Frequency	%		
1	0	0	4	13.79	1	2.70	5	6.25
2	3	21.43	4	13.79	10	27.03	17	21.25
3	6	42.86	15	51.72	19	51.35	40	50.00
4	5	35.71	6	20.69	6	16.22	17	21.25
5	0	0	0	0.00	1	2.70	1	1.25
Total	14	100	29	100	37	100	80	100

Table-IV. Frequency & percentage of number of root canals in different age groups

DISCUSSION

Several studies show variation in the number of root canals and their frequency per tooth in maxillary second molar teeth. These findings usually vary according to method and the number of teeth used for investigation. The methods include sectioning of extracted teeth, injection of dye, microscopic, study of radiographs, study using magnification and clinical study.[3,4,10]

Some authors like Omer Gorduysus et al reported that operating microscope (OM) improves negotiation(80%) of second mesiobuccal canals in maxillary molars than without use of OM (69%).[15] Similarly Buhrly LJ et al reported that use of Operating Microscope or dental loupes increases location of more extra canals compared to those using no magnification.[4] Some authors found that in maxillary molars negotiation of the MB-2 canal was more challenging than their location due to dentine ledge covering its orifice, tortuous pathway with one or more abrupt curves in the coronal portion and mesial-buccal emergence of MB-2 canal. File pre curved in mesial buccal direction, chamber floor countersinking lingual and mesial to major mesiobuccal canal orifice can be effective in locating missed minor canals in mesiobuccal root.[15]

Rwenyonyi et al investigated root and canal morphology of maxillary permanent teeth in a Ugandan population and concluded that Ugandan Population have different root and canal morphology from Asian and Caucasian population.[16]

More recent methods include spiral computed tomographic imaging, cone-beam computed tomographic imaging but micro–computed tomographic (micro-CT) imaging has been applied to evaluate root and root canal anatomy in a 3-dimensional (3D) manner because of its high resolution and nondestruction of the specimen.[17,18]

SemihSert and Gunduz S. Bayirli believed that root canal morphology exhibit variations as a result of many factors including ethnic origin and investigated root canal morphology of permanent teeth by in the Turkish population and found additional root canal morphologies in the teeth other than those classified by Vertucci classification.[14]

The present study results showed 50% of the teeth had three root canals per tooth which is similar to the study of Emel Olga that is 57% of the teeth.[12] But study results of Xi-Li and Shishir Singh had higher percentage of three canals (86%, 82%) with study on extracted teeth with dye penetration.[1,19]

In present study four root canals were present in 21.25% of the teeth which is in line to the study result of Mian Iqbal and Shishir Singh that is 21.99% and18% of second molars had four canals (MB-2)[17,19] but the study of Emel Olga and Emmanuel J N L Silva had higher percentage of fourth canal that is 30.23% and 34.32% respectively and study by Xi-Li had less percentage that is 12%.[12,20]

In present study second MB canal was found to be fourth canal but in literature there are several case reports in which fourth canal was an additional palatal or distobuccal canal (second palatal canal or second distobuccal canal).[21,23]

In present study only one case presented with

five root canals (1.25%) that is similar to the study result of Mian Iqbal with 0.19% and Xi-Li with 2.1% of the teeth with five root canals. In present study the fifth root canal was present as third MB canal in MB root. In literature there are some case reports of third mesiobuccal canal in maxillary second molar tooth.[17]

In present study 21.25% of the teeth had two canal with one buccal and one palatal which are similar to the result of Carlsen and Alexandersen which showed 11% of the teeth had two root canals at mid root level and 19% at apical level. Shishir Singh et al reported 13%of the study cases with two root canals.[19] But the results are in contrast to the study of Mian Iqbal (6.8% two root canals) and Emel Olga (8.1% with two root canals per tooth.)[12,17] Zhang Q. et al investigated maxillary second molar with fused root and reported Root fusion type 1 (n = 24, 11.8%) had the highest occurrence because most (21/24 = 87.5% of root fusion type 1) of the specimens had 3 or 4 canal orifices. The remaining 3 (12.5% of root fusion type 1)had only 2 orifices with 1 in the middle of the buccal side and the other in the palatal side, which urge the clinician to distinguish the specific canal orifices carefully, paying attention not to damage the pulp floor in an attempt to try to find a nonexistent root canal.[18]

In present study 6.25% of the tooth had single root canal which is near to the study results by Shishir Singh, Emel Olga and Mian Iqbal (5%, 3.2% and 1.56% respectively).[19,12,17] Ajeti N, et al reported a case of bilateral maxillary second molar with single root and single canal. They recommended for taking a radiograph of the contralateral tooth if the initial radiograph showed unusual anatomy. Even though the occurrence of single rooted maxillary second molar and a single canal is not high, diagnosing these unusual cases is of tremendous importance for successful endodontic treatment of these teeth. [22]

There are some limitations of this study. This was an in-vivo study with only a small sample size which may not show all root canal anatomy variations in the local population. No magnification or advanced radiographic technique was used during the study that may help in determination of more accurate internal root canal morphology.

CONCLUSION

Maxillary second molar teeth have a complex root canal morphology with a lot of variation regarding number of root canals in local population. It may have one to five root canals. All practitioners should make every effort to locate and treat all extra canals but also distinguish the specific canal orifices carefully, paying attention not to damage the pulp floor in an attempt to find a nonexistent root canal during the root canal treatment. So preclinical knowledge can increase the success rate of root canal treatment.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Amira Shafqat	Performed all the procedure and made the results and conclusion.	Amira
2	Bader Munir	Supervised all the procedure and make an impact on discussion part.	Bader
3	Mustafa Sajid	Literature review and introduction writing.	Mustafa