EVALUATION OF ROOT CANAL CONFIGURATION OF MAXILLARY SECOND PREMOLAR IN ARMED FORCES INSTITUTE OF DENTISTRY RAWALPINDI

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ABSTRACT

Objective: To investigate and compare the root canal morphology of maxillary second premolar in relation to quadrant and gender distribution in Pakistani population presenting to Armed Forces Institute of Dentistry Rawalpindi.

Study Design: Cross-sectional comparative study.

Place and Duration of Study: Department of Operative Dentistry, Armed Forces Institute of Dentistry Rawalpindi, from Jul 2018 to Dec 2018.

Methodology: Patients of either gender ranging from 21 to 70 years, seeking root canal treatment of maxillary second premolars of either quadrant presenting to out-patient department were studied. Two periapical radiographs were taken through paralleling technique and same lingual opposite buccal (SLOB) rule during the canal negotiation step with endodontic files inserted in the canals. The canal configuration and classification was noted. Chi square statistics were used to compare groups and results noted.

Results: Of the total 200 patients, 56.5% were males and 43.5% were females. Two canals system was found in 75% of the patients with type II classification accounting to 37.5%, followed by type IV (32%), type I (25%) and type V (5.5%).

Conclusion: In conclusion, maxillary second premolar canal morphology is complex and highly variable for different populations.

Keywords: Maxillary second premolar, Root canal morphology, Root canal treatment, Vertucci classification.

INTRODUCTION

The dental pulp canal shows a variety of shapes and configurations in dentition. There fore, a thorough knowledge of dental morphology, evaluation and interpretation of radiographs, sufficient access cavity preparation and location of root canal orifices are the basic requirements for all surgical and non surgical root canal therapy procedures. Success of these procedures depends on efficiently enlarged, properly cleaned and shaped, effectively disinfected and obturated root canal space[1]. Good results of the root canal therapy are difficult to achieve in case of under prepared access cavity of the tooth as it will result in difficulty in location and preparation of canal. Root canal system is complex. Its complexity can be best understood by ample knowledge of the anatomic considerations of tooth and its root/roots and thorough study of the radiographs. A single peri apical radiograph may not provide sufficient knowledge about root canal morphology. Multiple radiographs taken at different angulations of x-ray cone along with cone beam computed tomography (CBCT) scans can provide sound information of root canal configuration[2].

Root canal morphology is highly variable among different populations and even in individuals in same population. The clinician should be aware of these variation and anomalies in root canal systems for successful outcome. The missed canal may result in peri apical infection due to the persistence of the microorganisms and necrotic remnants inside the root canal. Lack of knowledge of root canal anatomy is the main reason for unfavourable outcome[3].

The clinical and radiographic examination is required to determine the number, location and shape of the root canal system[4]. Maxillary second

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premolar is among the most commonly endodontically treated teeth. Its root canal morphology is highly variable[5]. Root canal system may show numerous branches. It may divide and reunites in its course to the apical foramen[6]. Root canals in this tooth may range from one to three in number. Number of roots may be one or two. When two canals are present access cavity is prepared wider buccolingually to achieve better and straight access. The root of maxillary second premolars is wider buccolingually than mesiodistally. The occurrence of one canal configuration in the western world has been found to be more (75%) than two canals (24%) and three canals (1%)[7]. Studies conducted in the East show discrepancies among different countries[8,9].

Different techniques have been used to asses root anatomy such as tooth sectioning, radiographs, post treatment clinical observation, direct observation under microscope, tooth clearing, three dimensional (3D) reconstruction, and computed tomography[6]. Recently CBCT is increasingly being used to study the canal morphology in vivo due to better results. It provides extra information about complexity of the root canal system[10]. Due to constraints like availability, affordability and radiation exposure in developing countries like Pakistan, periapical radiographs using same lingual opposite buccal (SLOB) rule are widely used with comparable results.

This study was conducted to see the relative frequency of different morphological canal systems in maxillary second premolar using periapical radiography and its correlation with gender for our population. Extensive western research regarding this topic is available but local data is lacking.

METHODOLOGY

This analytic cross-sectional study was carried out in the Department of Operative Dentistry, Armed Forces Institute of Dentistry, Rawalpindi Pakistan over a period of six months i.e. July 2018 to December 2018. Sample size was calculated using the soft ware G-Power. By considering the values of effect size as 0.2, α Error probability as 0.05 and power of the test as 0.8, a sample size of 197 was calculated. However in the current study we used a sample size of 200. Non probability convenience sampling technique was used to collect sample. Study included patients with both gender, ranging from age 21 to 70 years who presented to the out-patient department with clinical symptoms of irreversible pulpitis, pulp necrosis, periapical periodontitis or abscess associated with maxillary second premolars requiring root canal treatment (RCT). All those patients who had teeth with guarded prognosis, inadequate coronal structure and root caries, age less than 21 years and more than 70 years, internal resorption, incomplete root formation and fractured teeth were excluded. Written informed consent from all the participants and ethical committee approval under IERB no 905/Trg-ABP1K2 was sought before the start of the study.

All patients fulfilling the inclusion criteria were examined clinically and radiographically. Local anaesthesia was administered and rubber dam was applied to the teeth for adequate isolation. An oval access opening was created bucco-lingually to negotiate the orifices of the canals. The canals were located with the root canal explorer. The endodontic files were inserted in the canals and two radiographs were taken according to the SLOB rule using paralleling technique for better identification of the canal system[11,12]. The number of canals and their configurations were recorded in a proforma. The canal configurations were categorized according to the Vertucci's Classification as follow[13]. Type I: A single canal is present from the pulp chamber to the apex. Type II: Two separate canals leave the pulp chamber and join short of the apex to form one canal. Type III: One canal leaves the pulp chamber, divides into two within the root, and then merges to exit in one canal. Type IV: Two separate and distinct canals are present from the pulp chamber to the apex.

Type V: Single canal leaves the pulp chamber but divides into two separate canals

with two separate apical foramina. Type VI: Two separate canals leave the pulp chamber but join at the midpoint and divides again into two separate canals with two separate apical foramina. Type VII: One canal leaves the pulp chamber, divides and rejoins within the canal, and finally redivides into two distinct canals short of the apex. Type VIII: The pulp chamber near the coronal portion divides into three separate root canals extending till the apex of the root.

Table-I: Frequency and percentage of root canals number in maxillary second premolars.

No. of Canals	n (%)	*p*-value
One canal	50 (25)	<0.001
Two canals	150 (75)	

Table-II: Correlation of gender and root canal morphology.

Gender	One canal system	Two canal system	*p*-value
Male	31 (62)	82 (55)	0.297
Female	19 (38)	68 (45)	

Table-III: Quadrant wise distribution of two canals system.

Quadrant with two canals	n (%)	*p*-value
Right quadrant	70 (47)	<0.001
Left quadrant	80 (53)	

Table-IV: Distribution of morphological configuration of the root canal system of maxillary second premolars.

Canal type (Vertucci Classification)	Canal Pattern	n (%)
I	1-1	50 (25)
II	2-1	75 (37.5)
III	1-2-1	-
IV	2-2	64 (32)
V	1-2	11 (5.5)
VI	2-1-2	-
VII	1-2-1-2	-
VIII	3-3	-

Data were analysed by using SPSS version 25. Categorical variables were presented as frequency and percentages. Comparison between the categories of binary variable was done using binomial test. Association of gender with number of canals was measured by using Chi-Square test. A $p \leq 0.05$ was considered significant.

RESULTS

Out of 200 patients, 113 (56.5%) were males and 87 (43.5%) females. Majority of the patients 150 (75%) had two canals system as compared to one canal 50 (25%), with a statistically significant result (*p*-value <0.001) table-I. Of the 150 patients with two canals 82 (55%) were males and 68 (45%) were females whereas, among the one canal system 31 (62%) were males and 19 (38%) were females table-II. The gender distribution had no significance in relation to canal configuration (*p*-value 0.297). For the two canals system, right maxillary second premolars accounted to 70 (47%) of the total and left maxillary premolars accounted to 80 (53%) with a significance of <0.001 table-III.

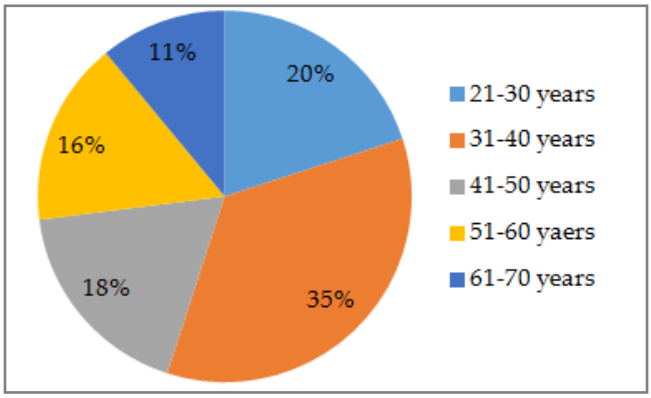

Figure: Age stratification of the study population.

The morphological configurations of the root canal systems of maxillary second premolars according to the Vertucci classification showed that type II was in abundance e.g. 75 (37.5%) whereas type V was in the minority 11 (5.5%). Type I and IV classification were found to be 50 (25%) and 64(32%) of the total maxillary second premolars respectively table-IV.

Mean age of the population was 38.9 ± 12.2 years. The age stratification for the study population showed that the age group of 31-40 years accounted to the majority of the population (35%), followed by age groups 21-30 (20%), 41-50 (18%), 51-60 (16%) and 61-70 years (11%) respectively figure.

DISCUSSION

The number of roots and root canal system of the maxillary premolars is variable. Root canal may divide and rejoin and have configurations that are considerably complex than thought previously[14]. An adequate knowledge regarding root and canal morphology for endodontic procedures is of paramount importance[15]. Root canal morphology has been studied using various techniques with clearing technique and CBCT as very reliable methods but some studies have questioned the reliability of these methods. They found micro-CT imaging system with better results[16].

Many classifications of the root canal morphology have been proposed including Weine, Vertucci and Gulabivala on different populations. Gulabivala *et al*, proposed classification i.e. three canals leave the pulp chamber and join to form one at the apex (type I), three canals leave the pulp chamber and form two canals short of apex (type II), two canals leave the pulp chamber and divide to form three separate canals (type III), two canals from pulp chamber join to form one and then redivide before joining to form one canal short of apex (type IV), four canals leave the pulp chamber and join to form two canals at apex (type V), the pulp chamber near the coronal portion divides into four separate root canals extending till the apex of the root (type VI), five canals leave the pulp chamber and rejoin to form four canals near apex (type VII)[7].

A single periapical radiograph is inadequate to identify the canal morphology of a three dimensional structure hence our study employed two radiographs at mesial angles to each other with paralleling technique for satisfactory details[17]. Significant difference in canal morphology of contra lateral maxillar premolars was found in present study table-III, whereas study conducted by Johnsen GF and others concluded no significance between right and left teeth[18].

Our study showed that two canals system was much more prevalent as compared to one canal system in the ratio 3 : 1. One study of two hundred maxillary premolar teeth from the Indian population reported incidence of 33.6% type II, 31.1% type IV and 29.2% type I canal morphology[19]. Saini and associates observed root canal morphology in decalcified sample of eighty second premolar in Rajasthani population. They found type II canal pattern in 35%, type IV in 28.7% and type I in 27.5% of the sample[9]. Reports from Chinese, Turkish, Spanish and Saudi Arabian populations showed a higher incidence of two canal system in maxillary second premolar teeth[8]. Pecora and associates in a Brazilian study of maxillary second premolar teeth found single canal in 67.3% and two canals in 32.4 % of the cases[20]. Albella F and others in a study of 374 maxillary premolars concluded that majority of single rooted had type I canal system and type III pattern was present in three rooted teeth[15].

In our study type II canal classification was observed in majority of the patients (37.5%), followed by type IV, type I and type V. Type III, VI, VII and VIII were not seen in our test population. In contrast another study from Pakistan reported 53.4% type I followed by 13.5% type II canal morphology in a sample of 115 maxillary second premolar teeth[21]. Similarly American and Turkish population reported a higher incidence of Type I canal classification followed by Type II[5].

The variation in root canal morphology is affected by various factors like race, gender, age and in vivo versus ex vivo study of the teeth[19]. Our study did not show any statistical significance between number of canals and gender which is in contrast to a similar study that reported a higher incidence of one canal system in females as compared to males[5]. Yet other studies showed no significant correlation between the number of canals and the gender[15].

CONCLUSION

In conclusion, maxillary second premolar canal morphology is complex and highly variable for different populations.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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