ORIGINAL RESEARCH

Root Canal Morphology and Variations of Mandibular Premolars by Clearing Technique: An *in vitro* Study

Vaishali Parekh, Nimisha Shah, Hardik Joshi

ABSTRACT

Background and objectives: The aim of this study was to compare internal anatomy between first and second mandibular premolars and to study different percentage variations of root canal morphology of mandibular premolars in Gujarat population based on Vertucci's classification by clearing technique.

Methodology: A total of 80 extracted intact permanent mandibular premolars (40 each mandibular first premolar and mandibular second premolar) with fully formed apices were collected. Access cavity was prepared with endo access kit, all samples were placed in 2.5% sodium hypochlorite for 48 hours, after that all samples were washed in running water for 2 hours. After washing, all samples were transferred to 5% nitric acid, for decalcification, for 72 hours, with the acid being changed every 24 hours and stirred once every 8 hours. All samples were washed in running water and dehydrated using ascending grades (70%, 80%, 90% and 100%) of isopropyl alcohol for 2 days. Finally, they were rendered transparent by immersion in methyl salicylate for 15 minutes and then India ink dye was injected into the access cavity. The anatomy of the root canal was observed and classified based on the Vertucci's classification.

Statistical analysis: Parametric Z-test was used to compare the variation between mandibular first and second premolars.

Results: In mandibular first premolar, type 1 was found in 20%, type 2 was 5%, type 3 was 5%, type 4 was 25%, type 5 was 12.5% and type 6 was 2.5% of total samples. Whereas, in mandibular second premolar, type 1 was found in 80% out of all samples, type 4 was 2.5%, type 5 was 17.5%. Type 2, type 3, type 6, type 7 and type 8 were not found in this study.

Conclusion: Mandibular first premolar showed higher variation (75%) compared to mandibular second premolar (37.5%).

Clinical significance: The knowledge of variations in the root canal morphology of the mandibular premolars can enhance the level of endodontic treatment of mandibular premolars.

Keywords: Root canal morphology, Vertucci's classification, Clearing technique.

How to cite this article: Parekh V, Shah N, Joshi H. Root Canal Morphology and Variations of Mandibular Premolars by Clearing Technique: An *in vitro* Study. J Contemp Dent Pract 2011;12(4):318-321.

INTRODUCTION

A clear understanding of the root canal anatomy of the human dentition is a prerequisite for conventional endodontic procedures. A consistent, high level of success in endodontic treatment depends on root canal anatomy and morphology and that the entire root canal system must be debrided, disinfected and filled.[1] The mandibular premolars from endodontic perspective exhibits higher failure rates, which to a large extent can be attributed to the highly variable root canal morphology and the inability to access extra canals.[2]

There are different methods to study the morphology of human permanent teeth. These include the use of radiography, placing instrument in the canals to determine canal configuration, cutting the teeth in different levels, polyester resin cast replicas of the pulp space, and clearing and injection of dye.[3] Canal staining and tooth clearing is generally considered the gold standard in these studies.[4] A CT scan allows 3D reconstruction of root canal systems.[5]

MATERIALS AND METHODS

The present *in vitro* research study was conducted in the Department of Conservative and Endodontics, KM Shah Dental College and Hospital, Vadodara after obtaining the ethical approval. A total of 80 extracted intact permanent mandibular premolars (40 each mandibular first premolar and mandibular second premolar) with fully formed apices from patients belonging to Gujarat population undergoing extractions for orthodontic reasons were collected from Vadodara, Nadiad, Bharuch and Ahmedabad cities of Gujarat.

All the 80 teeth samples were cleaned of any attached soft tissues or calculus and periodontal tissues by means of a periodontal ultrasonic scaler (Satelec, France). Teeth were then stored in 10% formalin until analysis. Access cavity was prepared using Endo access kit (Dentsply) and the shape of the canal orifice was observed with the naked eye. After that all samples were placed in 2.5% sodium hypochlorite for 48 hours, all samples were washed in running water for 2 hours.

After washing, all samples were transferred to 5% nitric acid for decalcification for 72 hours, with the acid being changed every 24 hours and stirred once every 8 hours. All samples were then washed in running water and dehydrated using ascending grades (70%, 80%, 90% and 100%) of isopropyl alcohol for 2 days. Finally, they were rendered transparent by immersion in methyl salicylate for 15 minutes and then India ink dye was injected into the access cavity.

The anatomy of the root canal was observed with the naked eye and all the samples were classified based on the Vertucci's classification.

OBSERVATIONS AND RESULTS

In this study, morphology of mandibular first and second premolars was determined by clearing technique based on Vertucci's classification.

In mandibular first premolar, 50% of samples show type 1 (Fig. 1), type 2 was 5%, type 3 was 5% (Fig. 2), type 4 was 25% (Fig. 3), type 5 was 12.5% and type 6 (Fig. 4) was 2.5% and type 7 and type 8 were not found in this study (Graph 1).

In mandibular second premolar, 80% of samples show type 1 (Fig. 5), type 4 was 2.5% (Fig. 6), type 5 was 17.5% (Fig. 7). Type 2, type 3, type 6, type 7 and type 8 were not found in this study (Table 1).
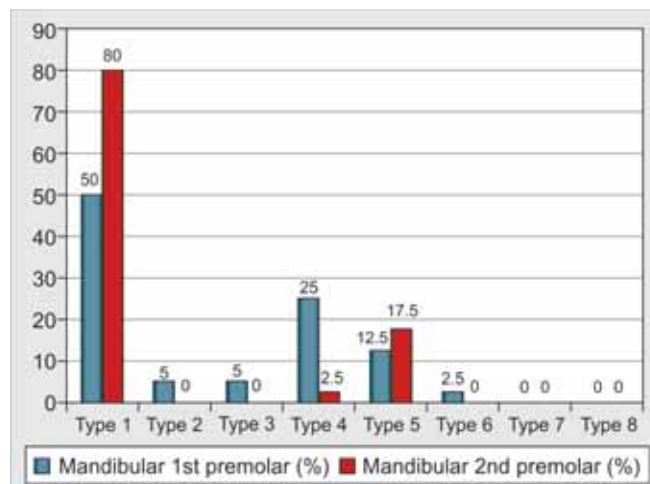
Graph 1: Graphical representation of percentages of various types of mandibular first and second premolars

Table 1: Morphology determined by clearing technique based on Vertucci's classification

	Mandibular first premolar		Mandibular second premolar	
	Total out of 40	percentage	Total out of 40	percentage
Type 1	20	50	32	80
Type 2	2	5	0	0
Type 3	2	5	0	0
Type 4	10	25	1	2.5
Type 5	5	12.5	7	17.5
Type 6	1	2.5	0	0
Type 7	0	0	0	0
Type 8	0	0	0	0
	40	100	40	100

Parametric Z-test of mandibular first and second premolars show the variation was high in mandibular first premolar (75%) than mandibular second premolar (37.5%) with a p-value of 0.103.

Fig. 1: Mandibular first premolar type 1

Fig. 2: Mandibular first premolar type 3

Fig. 3: Mandibular first premolar type 4

Fig. 4: Mandibular first premolar type 6

Fig. 5: Mandibular second premolar type 1
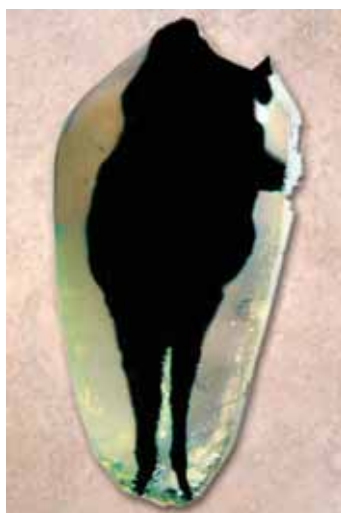
Fig. 6: Mandibular second premolar type 4

Fig. 7: Mandibular second premolar type 5

DISCUSSION

The mandibular premolars from endodontic perspective exhibit higher failure rates, which to a large extent can be attributed to the highly variable root canal morphology and the inability to access extra canals. There are studies with an incidence of 5.5% for two root canals in the Caucasian and 16.2 and 4.8% in second premolars in the African American group of patients. Three-rooted mandibular first premolars are rare but are occasionally found in case reports. It is a well-known fact that the root canal system varies with race and gender.[1]

There are different methods to study the morphology of human permanent teeth like (a) Placing the instrument in the canal to determine the canal configuration, (b) cutting the teeth in different levels, (c) polyester resin cast replicas of the pulp space, (d) clearing and injection of dye. In this study, clearing technique was used because of its advantages, like clearing technique helps to maintain the original form of the root canal system, produces a three-dimensional view of the pulp cavity and instrument is not required.[4]

The clearing technique has considerable value in the study of root canal anatomy, for it gives a three-dimensional view of the pulp cavity in relation to the exterior of the tooth. In addition, it is not necessary to enter the specimens with instruments; thus, the original form and relationship of the canals are maintained. Clearing techniques that render the teeth transparent provide a reliable method for viewing the entire root canal system. These techniques have revealed lateral canals, transverse anastomoses, apical deltas and other canal complexities. In this present study, clearing technique was used because of its advantages like clearing technique helps to maintain the original form of the root

canal system, produce a three-dimensional view of the pulp cavity and instrument is not required.[6]

This study revealed that the variation in mandibular first premolar was 75%. According to Vertucci's classification, type 1 was found in 50% from all samples, type 2 was 5%, type 3 was 5%, type 4 was 25%, type 5 was 12.5% and type 6 was 2.5%, and type 7 and type 8 were not found in this study.

All of the mandibular second premolar in this study were single rooted and variations was 37.5%. Type 1 was found in 80% out of all samples, type 4 was 2.5%, type 5 was 17.5%. Type 2, type 3, type 6, type 7 and type 8 were not found. According to result of this study, mandibular first premolars show marked difference in variation than the mandibular second premolars.

The result of this study reveals that both mandibular first and second premolars show many variations in the root canal morphology. Therefore, clinician should consider thorough assessment of radiograph before the treatment of mandibular premolars and have a true concept of number of root canals.

CONCLUSION

Within the limitation of this study it can be concluded that the maximum variation in the morphology was observed in mandibular first premolar compared with mandibular second premolar. Further researches are required for evaluation of larger population. Although most mandibular first premolars have a single root, two-, three- and even four-rooted forms have been reported. The majority of mandibular first and second premolar teeth have a single canal but there is a relatively high incidence or one-quarter of mandibular premolars that have two or more canals.

CLINICAL SIGNIFICANCE

The result of this study reveals that both mandibular first and second premolar show many variations in the root canal morphology. Therefore, clinician should consider thorough assessment of radiograph before the treatment of mandibular premolars and have a true concept of number of root canal. Special attention must be given to correct access cavity preparation that is the key to locate all orifice and successful endodontic treatment.

Present study awares the clinician to pay attention during the endodontic treatment of mandibular premolars due to its variations in canal patterns which is challenging task for any endodontist.

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ABOUT THE AUTHORS

Vaishali Parekh (Corresponding Author)

Professor and Head, Department of Conservative and Endodontics KM Shah Dental College and Hospital, Sumandeep Vidyapeeth Waghodia Road, Piparia, Vadodara-391760, Gujarat, India, Phone: 9825055042, e-mail: drchiragtaluja@yahoo.com

Nimisha Shah

Reader, Department of Conservative and Endodontics, KM Shah Dental College and Hospital, Sumandeep Vidyapeeth, Vadodara Gujarat, India

Hardik Joshi

Postgraduate Student, Department of Conservative and Endodontics KM Shah Dental College and Hospital, Sumandeep Vidyapeeth Vadodara, Gujarat, India