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A Cone Beam Computed Tomographic Evaluation of Root Canal Morphology of Mandibular Premolars In Haryana Population – An In Vitro Study.

[1]Dr Chauhan Sushmita Rajesh Kumar, MDS, Conservative dentistry and Endodontics, Private Practioner

[2]Dr Shikha Gautam, MDS, Conservative dentistry and Endodontics, Private Practioner

[3]Dr Apurva Goyal, MDS, Conservative dentistry and Endodontics, Senior Resident at Deen Dayal Upadhyay Hospital, Delhi

Corresponding Author: Dr Chauhan Sushmita Rajesh Kumar, MDS, Conservative dentistry and Endodontics, Private Practioner

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Abstract

Aim: The aim of this in vitro study was to investigate root canal morphology of Mandibular Premolars in a Haryana population of North India using CBCT.

Materials and Methods: To study the variations 100 mandibular first premolar and 96 mandibular second premolars was collected from different colleges and hospitals from different cities of individuals who are natives of Haryana state. Teeth were then mounted and subjected to CBCT scanning. The number of roots, canals- Vertucci's classification of canals and position of bifurcation was evaluated and statistically analyzed.

Result and Conclusion: Of the total 100 mandibular premolars, 97 had one root (97%) and 3 had two roots (3%). The canal morphology of mandibular first premolars according to Vertucci's classification was as follows: Type I = 70%, Type V = 14%, Type III = 6%, Type II= 3%. Type VI and type VII showed similar incidence of 1% each. C-shaped canals were seen in 2% of the sample. The additional canals pattern were also observed. Two teeth exhibit Sert and Bariyli classification, Type IX and Type X each. One tooth had shown an aberrant canal pattern which was not identified in any of the classification (1-2-3-2-1). The average length of canal bifurcation from the crown tip in mandibular first premolar was 12.67mm. All 96 samples of mandibular second premolars studies in this study were single rooted. The canal morphology of mandibular first premolars according to Vertucci's classification was as follows: Type I = 86.45%, Type V = 9.37%, Type III = 3.12% and Type II = 0.04%. The average length of canal bifurcation from the crown tip in mandibular second premolar was

11.52mm. Result of present study highlight the influence of ethnic difference on morphological variations and increased incidence of two or more canals in mandibular premolars.

Keywords: Aberrant canal pattern CBCT, Mandibular premolars, Sert and Bariyli Classification, Vertucci's Classification.

Introduction

Modern endodontic is a blend of science and art that requires a high degree of specialized ability and intimate working knowledge of the morphology of root canals and its variations. The morphology of root canals, thus, dictates the parameters under which root canal therapy should be carried out as it can directly affect the degree of success, for this reason, endodontist must have knowledge of it before he can endeavor to undertake endodontic treatment.[1] From the early documented investigation by Hess and Zurcher (1925) till date, a fair amount literature reflects anatomical complexities of the root canal morphology and bespeaks single apical foramen is the exception rule rather than the rule.[2] Hoen and Pink reported 42%, Iqbal reported 17.7% of root canal failures due to unfilled and missed canals.[3,4]

The University of Washington (1955) reported 11.4% occurrence of a failure in mandibular premolars inferable from the varieties and inaccessibility of additional canals.[5] Several studies put an example on view of increasing level of endodontic failures and flare-ups in mandibular premolars.[4,5] Slowey (1979) has report the mandibular premolars are the most difficult teeth to treat endodontically thus, called mandibular premolar as an endodontic enigma.[6] Owing to this, many investigator aroused their interest to study detailed morphology of this teeth and investigate complex morphology of these teeth that often results in complex procedures and the increase need of retreatment.[7]

A number of variables contribute to the varieties found within the root canal morphology like ethnic background, age and sex of the populace examined.[8] There is a scarcity of information on the population of indigenous Indians regarding the morphology and pulp space configuration of mandibular premolar teeth and till date, there is no published data on root canal morphology of mandibular premolar in Haryana population of North India. The purpose of this in vitro study was to investigate root canal morphology of Mandibular Premolars in a Haryana population of North India using CBCT.

Materials and methods

The present study was conducted in Department of Conservative Dentistry and Endodontics, SGT Dental College and Research Institute, SGT University, Gurgaon. One hundred mandibular first premolars and ninety six mandibular second premolars extracted because of caries, periodontal diseases, and orthodontic reasons were collected from different dental hospitals. Teeth with carious defects, immature apex, fractures, cracks, calcifications, metallic restorations, resorptions or pervious root canal interference were excluded. The process of collection and aims of the study was explained to the clinicians to ensure that the teeth belonged to indigenous Haryana population in North India. The teeth were washed under tap water immediately after extraction and immersed in 5.25% sodium hypochlorite for 30 mins to remove organic debris. The residual soft tissues, bone fragments, and calculus were cleansed and removed by ultrasonic scalers.

All the teeth were dried and mounted longitudinally on a modelling wax sheet. Then, the teeth were scanned by CBCT scanner (Sirona Dental System) using SICAT Galileo Implant version 1.9.2 software. The scan setting was done at 85 kVp, 42 mAs with an exposure time of 14s and the slice thickness was 150µm. According to the

examination requirements, a field of view of 50 ×50 mm. All CBCT exposures were performed by an appropriately authorized radiologist. The reconstructed images obtained from the software were analyzed. Images were assessed on axial and cross-sectional planes. The pattern of the root canals and level of bifurcation were assessed and classified according to Vertucci's root canal classification system. Additional patterns have been classified based on the classification given by Sert and Bayirli's classification.

Results

Number of roots: Out of 100 mandibular first premolars, 97 teeth (97%) had one root and three teeth (3%) had two roots. Of 96 mandibular second premolar all were single rooted. (Table 1)

		Number and % of Occurrence	
Tooth	Sample Size	1 Root	2 Roots
Mandibular First Premolar	100	97 (97%)	3 (3%)
Mandibular Second Premolar	96	96 (100%)	--

Table 1: Showing number and percentage of roots in Mandibular Premolars

Variation in root canal morphology

Mandibular First Premolar: Out of 100 mandibular first premolar, 70% sample had a single canal and single foramen concluding 30% of the sample with different canal pattern than the standard Type

Additional Type: (Figure 1)

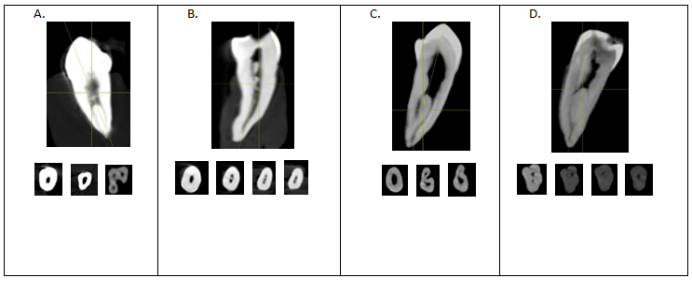

Figure 1: The Longitudinal And Axial Planes Of Cbct Scanning In The Coronal, Middle And The Apical Thirds Of The Root Displayed The Variation In The Canal Morphology Of Mandibular Premolar.

A. Type IX according to Sert and Bayirli Classification (Canal Pattern 1-3)
B. Type X according to Sert and Bayirli Classification (Canal Pattern 1-2-3-2)
C. C shaped Canal
D. Aberrant Type – Canal Pattern 1-2-3-2-1

Sample A

Type IX (1-3) Introduced by Sert and Bayirli: One tooth (1%) had this morphology where one canal leaves the pulp chamber and separates into 3 canals.

Type X (1-2-3-2) Introduced by Sert and Bayirli: Only one tooth (1%) showed this morphology where one canal leave the pulp chamber divides into two out of which one canal further divides into two and later exit as two canals.

Only 2 teeth (2%) showed C-shaped canal configuration.

Additional Type (1-2-3-2-1) One tooth (1%) showed this morphology where one canal leave the pulp chamber divides into two separate root canals, these root canals separates into three root canals further joins to two canals and ends as one foramina. (Table 2)

	Number and percentage of occurrence									
Vertucci Classification	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Type VIII	C-Shaped Canals	Other Types
Canal Pattern	1	2-1	1-2-1	2	1-2	2-1-2	1-2-1-2	3		
Mandibular First Premolar	70 (70%)	3 (3%)	6 (6%)	--	14 (14%)	1 (1%)	1 (1%)	--	2 (2%)	3 (3%)

Table 2: Showing pattern and percentage of canal system in Mandibular First Premolars.

Mandibular Second Premolar

Out of all the studied mandibular second premolars (96), the incidence of two canals was 13.54%. (Table 3)

	Number and percentage of occurrence									
Vertucci Classification	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Type VIII	Other Types	C-Shaped Canals
Canal Pattern	1	2-1	1-2-1	2	1-2	2-1-2	1-2-1-2	3		
Mandibular Second Premolar	83 (86.45%)	1 (1.04%)	3 (3.12%)	--	9 (9.37%)	--	--	--	--	--

Table 3: Showing pattern and percentage of canal system in Mandibular Second Premolars

Bifurcation of the root canal

The level at which the canal bifurcation occurred was measured from the crown tip. The average length from crown tip to point of canal bifurcation was found to be 12.67 mm in mandibular first premolars and 11.52 mm in mandibular second premolars. (Table 4)

Canal Pattern		Type III	Type V	Type VI	Type VII	Additional canal Patterns	Average
Level of Bifurcation	Mandibular first premolar	13.58 mm	14.60 mm	11.71 mm	12.01 mm	11.46 mm	12.67 mm
	Mandibular second premolar	9.81 mm	13.24 mm	—	—	—	11.52 mm

Table 4: Showing level of canal bifurcation in Mandibular First and Second Premolars

Discussion

Success in endodontic therapy depends upon the endodontic procedures, i.e. effective debridement of root canal system, proper disinfection followed by three dimensional obturation of the root canal(s).[8,9] There is an increasing incidence of root canal failure due to missed roots and canals. Understanding the internal and external root anatomy and having deep knowledge of root canals morphology and its variation reduces the risk of failures of root canal treatment.

Studies on root canal anatomy are usually done by radiography, clearing technique, longitudinal and transverse cross-sectioning, scanning electron microscopy, and stereomicroscope, direct observation with a microscope, and macroscopic sections. CBCT has gained the popularity in the field of imaging and its application in endodontics.[10] Cone beam computed tomography is better than all conventional methods. The generation of three-dimensional pictures permits a real image about tooth and canal morphology.

Mandibular premolar presents a wide range of morphological oddities and canal morphology to keep an endodontist continually speculating. The failure rate of mandibular premolar has been stated between 5.5-11.4%.[3,5] These aberrant variations of mandibular premolars are well put forward in literature both in terms of anatomic studies and clinically case reports.[1,4,11]

In the present study, most mandibular first premolars had one root (97%). Of the 100 mandibular first premolars studied, three teeth (3%) had bifurcated roots. The result of the present study are in agreement with other studies done on the Indian population, Jain and Bahuguna[12] (Gujarat) reported the incidence of two roots at 2.89%, Shah et al[7] (Gujarat) at 3%, and Iyer et al[13] (Tamil Nadu) at 3.9%. Singh and Pawar[14] (Maharashtra) reported a slightly higher incidence at 6.1%. In the present study, the incidence of single-rooted mandibular second premolars was 100% and significantly differs with other studies done on the Indian population where Singh and Pawar[14] reported 8% and Banga[15] reported 22.66% prevalence of two roots.

The incidence of the single canal in mandibular first premolar as reported in the literature varies from 50 to 94.5%, in the present study 70% of the mandibular first premolars had Type I configuration and our finding confined within the reported ranges. The result of the present study are similar to the other reports on the Indian population, Jain and Bahuguna[12] reported an incidence of (67.39%), Banga[15] (72.66%) and Sharma[16] (73.33%).

However, Ahmad[17] and Parekh[18] reported lower predilection of 50% in their respective studies, whereas Shah et al[7] (94.50%) and Shetty[19] (83.81%) reported the comparatively higher incidence in Indian population.

After Type, I, Type V and Type IV are the next more prevalent canal variation in the literature. In our study, the incidence of Type V canal pattern was 14%. This concurs with the previous studies in India by Jain and Bahuguna[12] (17.39%), Shetty[19] (11.97%),and Sharma[16] (16.67%).

In the current study, the prevalence of Type III configuration was 6% which is similar to the incidence reported by Ahmad[17] (6%), Banga[15] (6.33%) and Parekh[18] (5%). However, Shetty[19] reported the similar distribution of canal pattern but with the lower incidence of 2.10% in Indian population. The Type II morphological variance was encountered in 3% of the sample in our study. Surprisingly, Type II canal pattern was the highest canal variance after Type I in Banga[15] (11.66%) and in Velmurugan and Sandhya[20] (9%) study in Indian population. The next configurations with minimal occurrence were Type VI and VII with the incidence of 1% each in the present study. The occurrence of Type VI varying from 0.1-8%. Whereas Type VII was only observed in Ahmad et al[17] study in Kashmiri population. Type IV and Type VIII canal configurations were not found in the present study.

Three examined specimens exhibited 3 additional canal system configurations that are not included in Vertucci's classification and are classified under Sert and Bayirli classification. One tooth (1%) showed Type IX canal pattern and other Type X (1%) canal. Apart from these canal pattern, 2% of the sample in the present study exhibited C-shaped canals. Our results were in agreement with the results of Velmurugan and Sandhya[20] (2%) and Banga[15] (2.33%) in the Indian population, however they differed from Sikri and Sikri[21] (10%) who have reported a higher incidence.

In the present study, one tooth (1%) had an aberrant canal pattern which has not been reported previously in any of the studies. The morphology seen here was 1-2-3-2-1 with one orifice and one apical foramen. The pulp chamber divides into two separate root canals, these root canals further separated into three root canals, then joining into two canals and exiting through one apical foramen.

Morphological studies which were conducted to examine root canal morphology in mandibular second premolar showed Type I configuration was the most common canal configuration at 86.45%. The next frequent variation in our study was Type V with an occurrence of 9.37%. These results were similar to Parekh (17.5%)[18], Shetty (3.9%)[19] and Ahmad (24%)[17] which were done on the Indian population. Contrary to our finding Banga[15] (20%) and Singh[14] (30%) observed Type II and Iyer[13] (20.8%) observed Type IV as the second most prevalent canal pattern of India. The third most prevalent configuration in our study was Type III with the incidence of 3.12%. This was close to Shah et al[7] (2%) in Indian population. The next configuration with minimal occurrence in our study was Type II with the incidence of 1.04%. The result of the present study was similar to Shah et al[7] who reported 0.5%, Shetty[19] reported 1.4%, Iyer[13] reported 1% in Indian population. Type IV, Type VI, Type VII, and Type VIII were not found in this study.

In the present study, average length of canal bifurcation from the crown tip in mandibular first premolar was 12.66 mm. In the previous studies by Sandhya and Velmurugan[20] (India) the point of canal bifurcation was found to be 13mm from crown tip and from CEJ it was 7.4mm according to Robinson[22] and 6.87mm according to Llena[23] (Spain) in case of the mandibular first premolars.

In the present study, mandibular second premolar canal bifurcated at 11.52 mm when measured from crown tip.

The present study has a few limitations. For the study extracted teeth were collected irrespective of age, gender. Collection of only sound intact teeth makes study selection bias.[7] Age plays as an important role in the root canal, as deposition of secondary dentin, increases with age thereby decreasing and disappearance of root canals. Next factor which was excluded was gender, studies in the literature showed a greater incidence of variations in female than men.[24] The regional, ethnic and racial factors could influence the morphological pattern. The variation in canal morphology could also be influenced by the sample size, method of examination. Whatever the differences, mandibular first premolar tends to show more variation when compared to mandibular second premolar. There is a diverse ethnic variation in the population of the Indian subcontinent and this is reflected in the diverse data available on the morphological variation in mandibular variation.

Conclusion

The result of the present study thus emphasizes the higher incidence of two or more canals in mandibular premolar and signifies the importance to locate all the canals. Thorough knowledge about root canal morphology and its variations plays an important role in dictating the success rate of root canal treatment.

'Modern-day endodontist needs to be vigilant all times to avoid missing canals and consequent failures'

References

1. Kararia N, Kararia V. Root canal treatment of a mandibular second premolar with atypical canal pattern. J Conserv Dent. 2012; 15(4): 392-94.
2. Awawdeh LA, Al-Qudah AA. Root form and canal morphology of mandibular premolars in a Jordanian population. Int Endod J. 2008; 41(3): 240-248.
3. Iqbal A. The Factors Responsible for Endodontic Treatment Failure in the Permanent Dentitions of the Patients Reported to the College of Dentistry, the University of Aljouf, Kingdom of Saudi Arabia. J Clin Diagn Res. 2016; 10(5): ZC146-148.
4. Mittal S, Kumar T, Mittal S, Sharma J. Mandibular premolars with aberrant canal morphology: An endodontic challenge. J Conserv Dent. 2014; 17(5): 491-94.
5. Balakasireddy K, Kumar KP, John G, Gagan C. Cone Beam Computed Tomography Assisted Endodontic Management of a Rare Case of Mandibular First Premolar with Three Roots. J Int Oral Health. 2015; 7(6):107-109.
6. Slowey RR. Root canal anatomy. Road map to successful endodontics. Dent Clin North Am. 1979 Oct; 23(4): 555-73.
7. Shah V, Vaidya R, Chokshi S, Sanghvi Z, Patel P, Thakkar K. Evaluation of root and canal morphology of mandibular premolars in urban Indian population: an in-vivo cone beam computed tomographic study. Int J Med and Dent Sci 2016; 5(2): 1214-1221.
8. Udayakumar JR, Mylswamy S. Root canal morphology of maxillary premolars in an Indian population. J Conserv Dent. 2010; 13(3): 148-151.
9. Vertucci F. J. Root canal morphology and its relationship to endodontic procedures, Endo Topics 2005; 10(1): 3–29.
10. Matherne RP, Angelopoulos C, Kulild JC, Tira D. Use of cone-beam computed tomography to identify root canal systems in vitro. J Endod. 2008 Jan; 34(1): 87-89.
11. Alhadainy HA. Canal configuration of mandibular first premolars in an Egyptian population. J Adv Res. 2013 Mar; 4(2):123–128.

12. Jain A and Bahuguna R. Root Canal Morphology of Mandibular First Premolar in a Gujarati Population. Dent Res J. 2011; 8(3):118–122.
13. Iyer VH, Indira R, Ramachandran S, Srinivasan MR. Anatomical variations of mandibular premolars in Chennai population. Indian J Dent Res. 2006; 17(1): 7-10.
14. Singh S and Pawar M. Root Canal Morphology of South Asian Indian Mandibular Premolar Teeth. J Endod. 2014 Sep; 40(9): 1338-1341.
15. Banga KS, Pawar AM, Nagpal D, Landge J, Thakur B, Rastogi S. Root canal morphology premolar teeth in the population of Maharashtra (Pune) compared to the other Indian population. Endodontology 2018; 30: 15-20.
16. Sharma D, Mathur M. A computed tomographic study of canal variations in maxillary and mandibular first premolar teeth in Jaipur population: An in vitro study. People J Sci Res. 2011; 4: 1–5.
17. Ahmad S, Sartaj M, Zargar W, Farooq R, Rashid A and Ahmad F. Root canal morphology in mandibular premolars in Kashmiri population: A clearing sectional in vitro study. Int J Appl Res 2018; 4 (1): 197-199.
18. 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 Jul; 12(4): 318-321.
19. Shetty A et al. A three dimensional study of variation in root canal morphology using cone-beam computed tomography of mandibular premolars in south Indian population. J Clin Diagn Res. 2014 Aug; 8(8): ZC22–ZC24.
20. Sandhya R, Velmurugan N, Kandaswamy D. Assessment of root canal morphology of mandibular first premolars in the Indian population using spiral computed tomography: An in vitro study. Indian J Dent Res. 2010; 21(2): 169-173.
21. Sikri VK, Sikri P. Mandibular premolars: aberrations in pulp space morphology. Indian J Dent Res. 1994 Jan-Mar; 5(1): 9-14.
22. Robinson S, Czerny C, Gahleitner A, Bernhart T, Kainberger FM. Dental CT evaluation of mandibular first premolar root configurations and canal variations. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;93:328-32.
23. LlenaC, Fernandez J, Ortolani PS, Forner L. Cone-beam computed tomography analysis of root and canal morphology of mandibular premolars in a Spanish population. Imaging Sci Dent. 2014 Sep; 44(3): 221-227.
24. Verma GR, Bhadage C, Bhoosreddy AR, et al. Cone Beam Computed Tomography Study of Root Canal Morphology of Permanent Mandibular Incisors in Indian Subpopulation. Pol J Radiol. 2017;82:371-375.