Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/17238
DOI URL: http://dx.doi.org/10.21474/IJAR01/17238

RESEARCH ARTICLE

"EVALUATING THE VARIATION IN ROOT CANAL MORPHOLOGY OF MANDIBULAR PREMOLARS USING CONE BEAM COMPUTED TOMOGRAPHY IN NORTH INDIAN POPULATION - AN IN VITRO STUDY"

Savrose Kaur, Litik Mittal, Munish Singla, Harleen Kaur and Saloni Gupta
Department of Conservative Dentistry and Endodontics, Adesh Institute of Dental Sciences, Bathinda, Punjab, India.

Manuscript Info

Manuscript History
Received: 10 May 2023
Final Accepted: 14 June 2023
Published: July 2023

Key words:-
CBCT, 2-Dimensional, 3-Dimensional, Mandibular Premolar, Vertucci's

Abstract

Aim: This invitro study aimed to evaluate the variation in root canal morphology of Mandibular premolars using CBCT in North Indian population.

Methods and Material: In this invitro study 120 single rooted extracted mandibular first premolar teeth free of any root caries were included. The teeth were stored in 5.25% sodium hypochlorite for 30 minutes, then cleaned using ultrasonic scalers and finally stored in 10% formalin. The sample was subjected to 3D scan and images were obtained and evaluated to check root canal configuration using Vertucci's classification, shape of canal orifice and length of tooth.

Statistical analysis used: The software used for the statistical analysis were SPSS (statistical package for social sciences) version 25.0 and MedCalc software. The statistical tests used were One-way ANOVA (Analysis of Variance) test and chi square test.

Results: The results were drawn, and Type I was found to be maximum (80.0%) followed by Type V, Type II, Type IV, Type III. Type VI was minimum (0.8%). There were no samples found for Type VII and Type VIII. Maximum of oval shape was found with a percentage of 31.7% and minimum of 2 orifices in 2.5% of samples. The overall length of mandibular first premolar in north Indian population with a maximum of 25.60 mm and a minimum length of 17.30 mm.

Conclusions: Hence concluding that mandibular premolar still stands a mystery in varied region and population in every single case attempted for endodontic treatment and thorough knowledge of the canal anatomy is must for successful endodontic treatment.

Introduction:-

Understanding and mastering the appearance and internal structure of human teeth are essential for successful endodontic treatment.[1]Lack of knowledge about root canal anatomy in terms of configuration of the pulp and possible variation is one of the main reasons for failure in treatment.[2,3]These missed roots are the blind folds where microbial flora gets inherently colonized. To avoid or minimize failures, proper access to all hidden regions should be done.[3]

Corresponding Author:- Dr Savrose Kaur
Address:- Department of Conservative Dentistry and Endodontics, Adesh Institute of Dental Sciences and Research, Bathinda, Punjab, India.
E-mail: kaurshabsidhu09@gmail.com

Endodontically, the mandibular premolars are considered to be the most difficult teeth to treat with the highest failure rate (up to 11.45%) reported during RCT. Interestingly, there is a wide variation in coronal shape, external root form, and internal canal space morphology in the Asian population.[4]Different cross-sectional canal shapes are seen in
mandibular premolars which are categorized into oval, round, irregular, dumbbell and C- shape.[5]

The first attempts were made by **Hess** and **Zurcher**, who visualized lateral canals and isthmi.**Vertucci et al.** suggested a classification that is still used despite the recent implementation of further sub-classes.[6] Numerous techniques have been developed and implemented to investigate the root canal anatomy, such as canal staining and tooth clearing techniques as well as alternative and conventional imaging methods.[7]

To overcome the disadvantages of conventional radiography and to reveal the hidden mysteries modern radiographic techniques like cone beam computed tomography and micro-computed tomography are highly helpful in making a proper diagnosis as they offer noninvasive reproducible techniques for three-dimensional assessment of root canal system.[8] Cone beam tomography is a useful recent diagnostic methodology that provides additional information compared to conventional intraoral radiography regarding the tooth and the surrounding structures.[9]

Material and Method:-

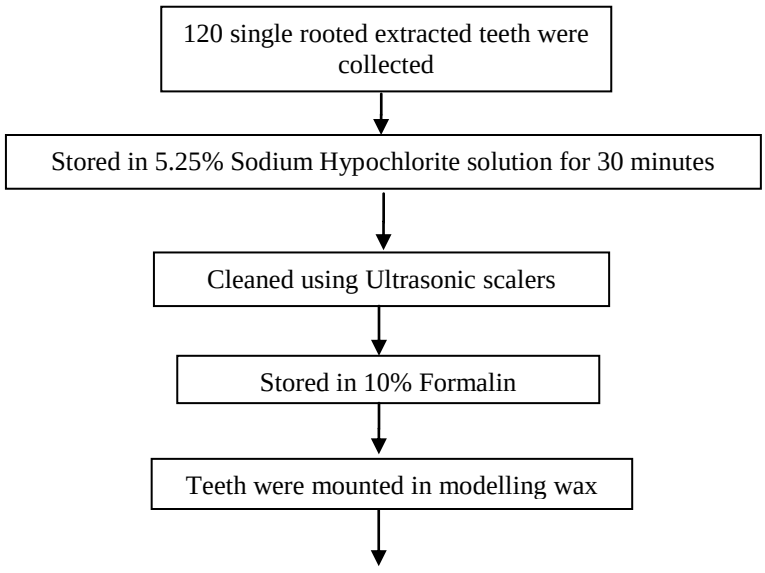
The present in vitro study was done in the Department of Conservative Dentistry and Endodontics. A total of 120 extracted single rooted permanent mandibular premolar teeth were selected for the study. The teeth were collected from the Department of Oral and Maxillofacial Surgery. Permission was taken from the institutional Ethical Committee provided with a manuscript number 80AIDSR280323.

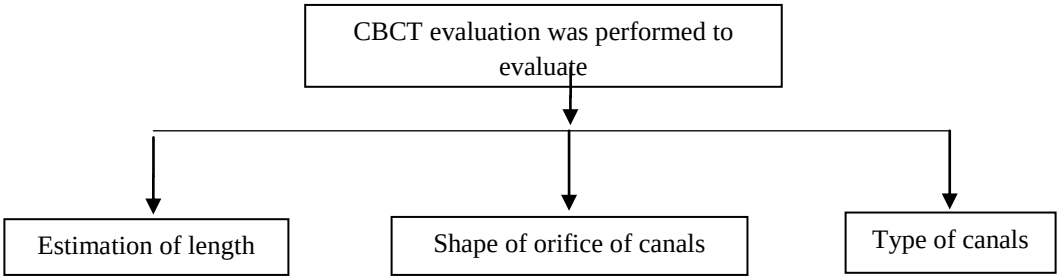
Teeth were washed with soft brush, under water to remove blood, saliva and soft debris. The teeth were then placed in 5.25% sodium hypochlorite solution for 30 minutes to remove organic debris from the surface. If any calculus, it was removed using ultrasonic scalers. The cleaned specimens were then stored in 10% formalin until further investigation was carried out.[10]

The teeth were mounted on to the wax rims made with modeling wax in such manner that they mimic the human mandibular arches. The samples with the rims were then coded and numbered separately for easy identification.

CBCT Scanning

CBCT scans were performed placing the wax rims in position and images were obtained using Fussen D50 CBCT extraoral imaging system at Diagnostic Centre. The scan parameter was set with 80kv, 4.5 mA with an exposure time of 12 seconds. With the voxel size of 0.2 mm a fixed FOV was set i.e. 5x5 cm across the whole rim. The images were taken by an experienced radiologist at Advance Diagnostic Centre, Ludhiana for further analysis. After acquisition data was exported and transferred in DICOM format to be assessed by CS 3D Imaging software. The consecutive slice images on axial, coronal and sagittal planes were set by 0.20mm thickness for accurate evaluation.[11]





Result: -

In the present study the Descriptive statistics was performed by calculating mean and standard deviation for the continuous variables. Categorical variables are presented as absolute numbers and percentage.

The software used for the statistical analysis were **SPSS (statistical package for social sciences) version 25.0 and MedCalc software**. **The statistical tests used were One-way ANOVA(Analysis of Variance) test and chi square test.**The result drawn are stated in Table 1-3 with CBCT images in Figure 1-2.

Figure 1-Shape of orifices

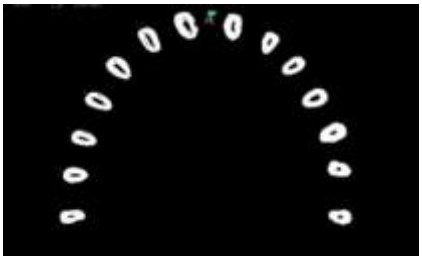


Figure 2- Types of canal configuration

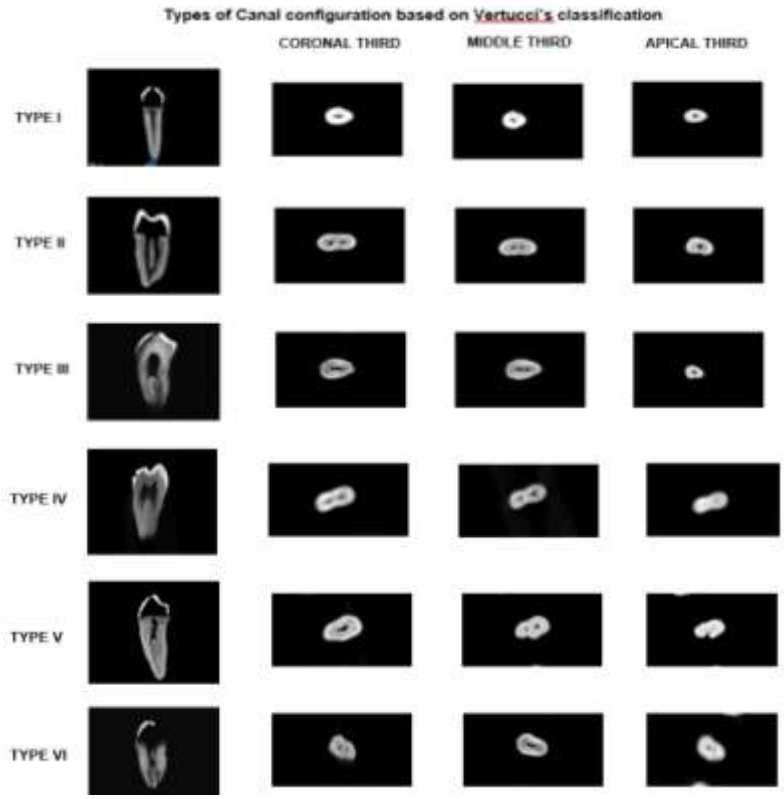


Table 1:-Distribution of study population according to Type of canal morphology.

Types of canal morphology	Frequency	Percent
Type I	96	80.0%
Type II	6	5.0%
Type III	3	2.5%
Type IV	4	3.3%
Type V	10	8.3%
Type VI	1	0.8%
Type VII	0	0.0%
Type VIII	0	0.0%

Table 2:- Distribution of study population according to Type of canal and shape of orifice in comparison.

	Round	**Oval**	**Ribbon**	**Dumbbell**	**Triangular**	**Two Orifice**
Type I	24	33	15	10	14	0
	25.0%	34.4%	15.6%	10.4%	14.6%	0.0%
Type II	0	1	1	3	0	1
	0.0%	16.7%	16.7%	50.0%	0.0%	16.7%
Type III	1	1	1	0	0	0
	33.3%	33.3%	33.3%	0.0%	0.0%	0.0%
Type IV	0	0	1	2	0	1
	0.0%	0.0%	25.0%	50.0%	0.0%	25.0%
Type V	2	3	4	1	0	0
	20.0%	30.0%	40.0%	10.0%	0.0%	0.0%
Type VI	0	0	0	0	0	1
	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
p-value	0.582	0.656	0.492	0.023*	0.555	0.001*

Table 3:- Distribution of study population according to length of mandibular 1st premolar based on type of canals.

	Length			
	Mean	**Std. Deviation**	**F-value (ANOVA test)**	**p-value**
Type I	21.16	1.92	0.845	0.520
Type II	20.63	2.43		
Type III	21.13	2.34		
Type IV	19.75	0.93		
Type V	21.86	1.23		
Type VI	21.90	-		

Discussion:-

An in-depth comprehension of external and internal anatomy of tooth is imperative for successful endodontic therapy.[3] Hoen and Pink reported a 42% incidence of missed canal or root while Karabucak et al reported an overall prevalence of 23%.[12]

Mandibular premolars are often considered as an ENIGMA TO ENDODONTIST due to high occurrence of additional roots or canals certainly an endodontic challenge. Sherman and Hasselgren reported a higher incidence of multiple roots and canals in mandibular premolar teeth.[13]According to a Washington study, mandibular first premolars had the highest failure rate of 11.45% with a wide discrepancy in the failure rates among mandibular premolars.[4]

A higher incidence of two canals in mandibular first premolars was reported in several populations, up to 50% in Indian populations and approximately 40% in Middle Eastern populations from Kuwait, Jordan, and Turkey.[14]

In the present study, CBCT was used to analyze the root canal anatomy. Iqbal A et al also used CBCT as a diagnostic tool over the routine periapical radiography stating its 3D image projection which is a major disadvantage of routine radiographs as they provide a 2D image of a 3D structure.CBCT subdues the limitation that conventional radiography encounters such as early detection of lesion 3D visualization of canal trajectory which contributed to an accurate identification of canal morphology.[9,10] Hence, CBCT has proved to be a bizarre tool in endodontics.

For assessing the root canal classification in anatomical and morphological terms, the data from the CBCT scans were collected and evaluated using vertucci classification as it is still widely used classification in the literature of modern ages.[15]A mean length of 21.18 mm was observed with a minimum length of 17.3 mm and maximum length of 25.60 mm which was in corresponding to the study done by Sandhya R and Velmurugan (2009).Observations for shapes of canal orifices were obtained with a maximum value of Oval (31.7%) followed by Round (22.5%), Ribbon (18.3%), Dumbbell (13.3%), Triangular (11.7%), Two orifices (2.5%) which were also supported by the previous studies done by AbrahamSB and Gopinath VK (2015)[50] and Jain A and Bahuguna H (2011).

Mylswamy S and Raj UJ evaluated root canal morphology of maxillary second premolars in an Indian population using Vertucci's classification.[16] Elnour M et al conducted an invitro study to evaluate root canal morphology using Vertucci's classification of maxillary second premolars in a Saudi Arabian sub-population.[17]

In conclusion to the present study, it reveals that high variation have been reported in mandibular premolar teeth enhancing the need for an endodontist to be aware of the high anatomical variabilities, complexities, and intricacies of root canal architecture of mandibular premolars in accordance to avoid any failures caused by additional missed canals.[18]Hence not just knowing the anatomy but employing the most up-to-date and precise armamentarium is a perquisite. Therefore, limiting the limitations of 2D radiography in normal dental operatory, adjuncts like CBCT, dental operating microscope play an important role in root canal identification in a human dentition with suspected complex root canal morphology.[19]

References:-

1. Dinakar C, Shetty U, Salian V, Shetty P. Root canal morphology of maxillary first premolars using the clearing technique in a South Indian population: an in vitro study. International journal of applied and basic medical research. 2018; **8**(3): 143–47.
2. Dou L, Li D, Xu T, Tang Y, Yang D. Root anatomy and canal morphology of mandibular first premolars in a Chinese population. Scientific Report. 2017; **7**(1): 1-7.
3. Parekh V, Shah N, Joshi H. Root canal morphology and variations of mandibular premolars by clearing technique: an in vitro study. The Journal of Contemporary Dental Practice. 2011; **12**(4): 318-21.
4. Albuquerque D, Kottoor J, Hammo M. Endodontic and clinical considerations in the management of variable anatomy in mandibular premolars: a literature review. Biomed Research International. 2014; **2014**: 512574.
5. Jain A, Bahuguna R. Root canal morphology of mandibular first premolar in a gujarati population - an in vitro study. Dental Research Journal. 2011; **8**(3): 118-22.
6. Jain P, Balasubramanian S, Sundaramurthy J, Natanasabapathy V. A Cone Beam Computed Tomography of the Root Canal Morphology of Maxillary Anterior Teeth in an Institutional-Based Study in Chennai Urban Population: An In vitro Study. Journal of International Society of Preventive and Community Dentistry. 2017; **7**(2): 68-74.
7. Rajakeerthi R, Neevidhitha N. Use of cone beam computed tomography to identify the morphology of maxillary and mandibular premolars in Chennai population. Brazilian Dental Sciences. 2019; **22**(1): 55-62.
8. Bansal R, Hegde S, Astekar MS. Classification of Root Canal Configurations: A Review and a New Proposal of Nomenclature System for Root Canal Configuration. Journal of Clinical and Diagnostic Research. 2018; **12**(5): 1-5.
9. Maghfuri S, Keylani H, Chohan H, Dakkam S, Atiah A, Mashyakhy M. Evaluation of root canal morphology of maxillary first premolars by cone beam computed tomography in Saudi Arabian Southern region subpopulation: an in vitro study. International Journal of Dentistry. 2019; **2019**: 2063943.
10. Senan EM, Alhadainy HA, Genaid TM. Root form and canal morphology of maxillary first premolars of a Yemeni population. BMC Oral Health. 2018; **18**(94): 1-10.
11. Verma GR et al. Cone Beam Computed Tomography Study of Root Canal Morphology of Permanent Mandibular Incisors in Indian Subpopulation. Polish Journal of Radiology. 2017; **82**(7): 371-75.
12. Mashyakhy M et al. Prevalence of Missed Canals and Their Association with Apical Periodontitis in Posterior Endodontically Treated Teeth: A CBCT Study. International Journal of Dentistry. 2021; **2021**: 9962429.

13. Shenoy A, Bolla N, Vemuri S, Kurian J. Endodontic retreatment - unusual anatomy of a maxillary second and mandibular first premolar: Report of two cases. Indian Journal of Dental Research. 2013; **24**(1): 123-27.
14. Kottoor J, Albuquerque D, Velmurugan N, Kuruvilla J. Root anatomy and root canal configuration of human permanent mandibular premolars: a systematic review. Anatomy Research International. 2013; **2013**: 254250.
15. Rajakeerthi R, Neevidhitha N. Use of cone beam computed tomography to identify the morphology of maxillary and mandibular premolars in Chennai population. Brazilian Dental Sciences. 2019; **22**(1): 55-62.
16. Jayasimha U, Mylswamy S. Root canal morphology of maxillary second premolars in an Indian population. Journal of Conservative Dentistry. 2010; **13**(3): 148-51.
17. Elnour M, Khabeer A, Alshwaimi E. Evaluation of root canal morphology of maxillary second premolars in a Saudi Arabian sub-population: An in vitro microcomputed tomography study. Saudi Dentistry Journal. 2016; **28**(4): 162-8.
18. Hosseinpour S, Kharazifard MJ, Khayat A, Naseri M. Root Canal Morphology of Permanent Mandibular Premolars in Iranian Population: A Systematic Review. Iranian Endodontic Journal. 2016; **11**(3): 150-56.
19. Al-Zubaidi SM et al. Root and Canal Morphology of Mandibular Premolars in a Saudi Subpopulation: A Cone-Beam Computed Tomography Study. International Journal of Dentistry. 2022; **2022**: 4038909.