Original Article

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Dentistry Section

Evaluation of Root Canal Diameters and Radicular Wall Thickness of the Human Primary Molars by using Multidetector Computed Tomography: A Cross-sectional Study

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ABSTRACT

Introduction: Paediatric endodontics is critical for preserving the primary tooth until its physiologic exfoliation and ensuring the child's quality of life. Endodontic treatment of human primary molars with varying internal geometry of the root canal necessitates extensive knowledge and skills.

Aim: To evaluate the diameters of the root canals and the radicular wall thickness of human primary molars using Multidetector Computed Tomography (MDCT).

Materials and Methods: This cross-sectional study was performed in the Department of Paediatric and Preventive Dentistry in collaboration with the Department of Oral and Maxillofacial Surgery, Department of Antaomy of Guru Nanak Institute, Kolkata, West Bengal, India on selected 64 human primary maxillary and mandibular molars through inclusion and exclusion criteria and grouped them (Group 1, maxillary 1st molars; Group 2, maxillary 2nd molars; Group 3, mandibular 1st molars; and Group 4, mandibular 2nd molars). After proper sterilisation, the teeth were mounted on a wax platform, and the mounted teeth block was scanned by a computed tomography scanner. Analysis of these Computed Tomography (CT) scan images was done through Denta Scan (GE Healthcare, USA) software. In each of the corresponding cross-sections, the diameters of the root and the root canals were measured at their greatest diameter. The radicular wall thickness of the roots was derived by subtracting the measured diameter of the root canals from that of the roots in their respective cross-sections. Descriptive statistical analysis (Student's t-test) was performed. A p-value less than equal to 0.05 was considered statistically significant.

Results: The maximum mean diameter of the canal was found in the mesiobuccal root canal of both primary mandibular first molars (1.16±0.22 mm at cervical third) and second molars (1.12±0.16 mm at cervical third); and the minimum diameter was found in the distolingual root canal of both primary mandibular first molars (0.87±0.12 mm at cervical third) and second molars (0.89±0.16 mm at cervical third). The mean radicular wall thickness of the roots gradually increased from the apical third to the cervical third of both primary molars.

Conclusion: The maximum root canal diameter and radicular wall thickness were found in the cervical third of the palatal root of maxillary second molars. The study evaluates the mean maximum and minimum diameters of each canal of human primary molars and radicular wall thickness in different cross-sections, which enables paediatric dental practitioners to establish effective paediatric endodontic treatment.

Keywords: Dentinal wall thickness, Endodontics, Paediatric

INTRODUCTION

The success of endodontic therapy in human primary molars is pivotal to the removal of necrotic pulpal tissue. Unlike their permanent counterparts, human primary molars possess great variations in root canal anatomy, including thinner dental walls, curved and tortuous paths of propagation, complexity and irregularity of root canal diameter, and the presence of multiple accessory canals [1]. Additionally, the presence of permanent tooth germs in the inter-radicular space and the inability to determine the anatomical apex due to physiological resorption make root canal preparation a challenging task for paediatric dental practitioners.

The difficulties in canal preparation in primary molars can be minimised by using endodontic files that closely resemble the paediatric tooth root canal anatomy, i.e., the diameters, length, and tapering of the canals [2].

However, there is a paucity of knowledge on the diameter of root canals in primary teeth, notably radicular wall thickness, which could lead to issues in instrumentation during pulpectomy, impeding clinical success. To date, multiple researchers have studied primary tooth root canals through different case reports, in-vitro and ex-vivo research using various types of dye, clearing techniques [3,4], histological cross-sections, longitudinal and transverse cross-sectioning in scanning electron microscopes [5], and digital radiographs [6,7].

In the last few decades, there has been immense development in the field of radioimaging [8], especially in the arena of cross-sectional imaging. Advanced cross-sectional imaging modalities like computed tomography [9,10] and magnetic resonance imaging are rapidly replacing conventional modalities in medical and dental research and treatment. However, there is a significant scarcity of research pertaining to the non invasive morphological analysis of human primary molar teeth using computed tomographic imaging tools.

To address the aforementioned gap in research, the present cross-sectional study was designed to determine different parameters of roots and root canals of human primary molar teeth (e.g., number, length, diameter of roots and canals, and radicular wall thickness) at different heights of the tooth roots.

Part of the observations obtained in the present research relating to the number and length of roots and root canals has already been published by the author in indexed English literature [1]. The aim of present research paper is to discuss the research question, methodology, and inferences for the observations related to the diameters of the root canals and the radicular wall thickness of human primary molars using MDCT.

MATERIALS AND METHODS

A cross-sectional study was performed in the Department of Paediatric and Preventive Dentistry in collaboration with the Department of Oral and Maxillofacial Surgery, Department of Anatomy of Guru Nanak Institute of Dental Sciences and Research, Kolkata, West Bengal, India and Eko-X-ray and Imaging Institute, Kolkata. The study duration was from January 2014 to March 2016. Clearance was obtained from the internal Institution Ethical Committee (GNIDSR/IEC/13/01).

Inclusion and Exclusion criteria: The teeth with completely formed root apices, teeth without any macroscopic root resorption, and teeth that had been extracted due to malalignment, crowding, serial extraction, retained deciduous teeth, etc., were included in the study. The teeth with any root fracture, grossly carious, teeth with root resorption, and non restorable teeth were excluded from the study.

Sample size: Based on inclusion and exclusion criteria, 64 human primary molar teeth were selected from among 117 study samples of human primary teeth collected from the Department of Oral and Maxillofacial Surgery and Department of Anatomy of the Institution.

Study Procedure

The collected tooth samples were handled and sterilised as per guidelines for infection control and dental health care [11,12] (i.e., first cleaning with running tap water, followed by storing in 5.25% sodium hypochlorite solution, 40 minutes of autoclaving cycle, immersing in 10% formalin solution for seven days, and ultimately storing in an airtight container). The selected teeth were divided into four groups:

Group 1: Primary maxillary first molars - 16

Group 2: Primary maxillary second molars - 16

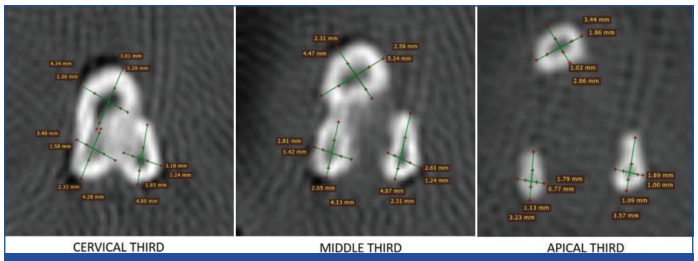
Group 3: Primary mandibular first molars - 16

Group 4: Primary mandibular second molars - 16

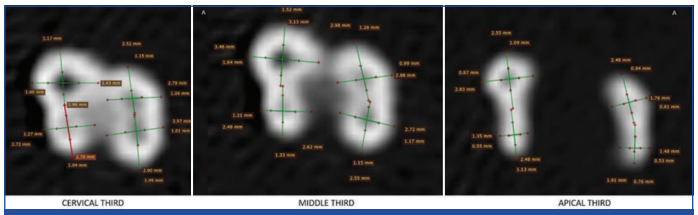
The teeth were mounted on a wax platform made for each group by joining four modeling wax (T-Dents R) sheets (thickness 1.5 mm, length 160 mm, width 90 mm) [Table/Fig-1]. The mounted teeth blocks were scanned by computed tomography scanner (GE light speed 16 slice CT, DFOV: 9.8 cm, 120 kVp, 140 mA, "0" gantry tilt and 0.625 mm section thickness, GE Advantage workstation version 4.2), and each of the corresponding axial CT scan images was analysed using Denta Scan (GE healthcare, USA) software [Table/Fig-1].

[Table/Fig-1]: Wax mounted tooth samples as per groups before CT scanning.

To achieve standardisation, the axial sections were arranged along the long axis of each tooth, and the sections were calculated using minimal section thickness settings. The measurements were then noted in the axial sections representing the cemento-enamel junction, middle third, and apical third for each of the tooth roots [Table/Fig-2,3] [13].



[Table/Fig-2]: Cross-sectional image of maxillary 2nd primary molar at cervical third, middle third and apical third measuring the diameter of the root canals. (red dots demarcates the end of each measuring lines which are marked as green).



[Table/Fig-3]: Cross-sectional image of mandibular 2nd primary molar at cervical third, middle third and apical third measuring the diameter of the root canals. (red dots demarcates the end of each measuring lines which are marked as green).

The diameter of the root and the root canals were measured at their greatest diameter [Table/Fig-2,3] [13].

The radicular wall thickness of the root was derived individually for the buccal, mesial, distal, and lingual/palatal sides of the tooth by calculating the distance between the edge of the root to the edge of the root canal on respective sides [14,15].

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 12.0 and Instat GraphPad Software, Inc., San Diego, CA. Descriptive statistical analysis (Student's t-test) was performed to calculate the means with corresponding standard deviations. A p-value ≤0.05 was considered statistically significant.

RESULTS

At the cervical third, the maximum mean diameter of the canal was found in the palatal root canal of Group 2 (1.43±0.24 mm), and the minimum mean diameter was found in the distobuccal root canal of Group 1 (0.83±0.13 mm). At the apical third, the maximum mean diameter of the canal was found in the mesiobuccal root canal of Group 2 (0.58±0.13 mm), and the minimum mean diameter was found in the distobuccal root canal of Group 1 (0.52±0.05 mm).

According to the t-test, the mean diameter of the middle third of the distobuccal root of the two groups differed significantly from each other (p-value=0.01). Also, the mean diameters of the cervical third of the distobuccal root and palatal root of the two groups differed significantly from each other (p-values=0.0002 and 0.01, respectively). All other measurements showed no significant difference (p>0.05) [Table/Fig-4].

At the cervical third, the maximum mean diameter of the canal was found in the mesiobuccal root canal of Group 3 (1.16±0.22 mm), and the minimum mean diameter was found in the distolingual root canal of Group 3 (0.87±0.12 mm). At the apical third, the maximum mean diameter of the canal was found in the distobuccal root canal of Group 4 (0.65±0.25 mm), and the minimum mean diameter was found in the mesiobuccal root canal of Group 4 (0.51±0.01 mm).

According to the t-test, the mean diameter of the apical third of the mesiobuccal root canal of the two groups differed significantly

Cross section of the root	Mesiobuccal root (MB)				Distobuccal root (DB)				Palatal root (P)			
	Mean diameter (in mm) Gr. 1	Mean diameter (in mm) Gr. 2	t30 value	p-value	Mean diameter (in mm) Gr. 1	Mean diameter (in mm) Gr. 2	t30 value	p-value	Mean diameter (in mm) Gr. 1	Mean diameter (in mm) Gr. 2	t30 value	p-value
Apical 3rd	0.54±0.11	0.58±0.13	0.94	0.34	0.52±0.05	0.55±0.12	0.92	0.36	0.53±0.11	0.57±0.12	0.98	0.33
Middle 3rd	0.80±0.13	0.84±0.16	0.77	0.45	0.73±0.09	0.91±0.21	3.15	0.01*	0.95±0.14	1.05±0.23	1.48	0.15
Cervical 3rd	1.05±0.41	1.14±0.23	0.76	0.44	0.83±0.13	1.15±0.26	4.40	0.0002*	1.24±0.14	1.43±0.24	2.73	0.01*

[Table/Fig-4]: The root canal diameter in Group 1 and Group 2 and t-value (as per t-test) and p-values between the root canal diameter.
Values are means±SD, (all measurements are in mm). *Statistically significant

from each other (p-value=0.029). Also, the mean diameters of the middle third and cervical third of the mesiolingual root canal of the two groups differed significantly from each other (p-values=0.02 and 0.01, respectively). No significant difference was found for all other measurements (p>0.05) [Table/Fig-5].

The mean radicular wall thickness of the root gradually increased from the apical third to the cervical third of the roots in both primary maxillary and mandibular molars.

At the cervical third, the maximum radicular wall thickness was found in the palatal root canal of Group 2 (1.23±0.19 mm), and the minimum mean diameter was found in the distobuccal root canal of Group 1 (0.71±0.19 mm). At the apical third, radicular wall thickness of all the roots of primary maxillary second molars were found to be almost equal (0.67±0.12 mm, 0.67±0.16 mm, and 0.67±0.15 mm), whereas the minimum radicular wall thickness was found in the palatal root of Group 1 (0.59±0.06 mm). T-test reveals a statistically significant difference in the mean radicular wall thickness with respect to the palatal root at the cervical third (p-value 0.0012) of Group 1 and Group 2 [Table/Fig-6].

At the cervical third and apical third, the maximum radicular wall thickness was found in the mesiobuccal root (0.82±0.23 mm) and distolingual root (0.54±0.08 mm) of Group 4, and the minimum radicular wall thickness was found in the distolingual root of Group 3 (0.56±0.16 mm and 0.49±0.13 mm). The t-test reveals a statistically significant difference in the mean radicular wall thickness with respect to the mesiobuccal root at the cervical third (p-value 0.002) of Group 3 and Group 4 [Table/Fig-7].

DISCUSSION

The present study evaluates the diameters of the root canals and radicular wall thickness of the roots of human primary maxillary and mandibular molars at different levels. It enlightens clinicians to deal with the complex anatomy of human primary molars.

According to present study, for the primary maxillary teeth, the maximum diameters for the middle (1.05±0.23 mm) and cervical third (1.43±0.24 mm) of the root canals were found in the palatal root of the second molar tooth, whereas for the apical third, the maximum diameter (0.58±0.13 mm) was found in the mesiobuccal root of the same tooth. In contrast, the minimal diameter of all the root canals was found in the distobuccal root canal of the first molar tooth, which are 0.52±0.05 mm, 0.73±0.09 mm, and 0.83±0.13 mm for apical, middle, and cervical thirds, respectively. Through the use of a microscopic approach, Montoya Funegra J et al., assessed

Cross-section of the root	Mesiobuccal root canal (MB)				Mesiolingual root canal (ML)				Distobuccal root canal (DB)				Distolingual root canal (DL)			
	Mean diameter (in mm) Gr. 3	Mean diameter (in mm) Gr. 4	t30 value	p-values	Mean diameter (in mm) Gr. 3	Mean diameter (in mm) Gr. 4	t30 value	p-values	Mean diameter (in mm) Gr. 3	Mean diameter (in mm) Gr. 4	t30 value	p-values	Mean diameter (in mm) Gr. 3	Mean diameter (in mm) Gr. 4	t30 value	p-values
Apical 3rd	0.58± 0.12	0.51± 0.01	2.32	0.029*	0.53± 0.08	0.55± 0.10	0.62	0.54	0.63± 0.19	0.65± 0.25	0.25	0.80	0.55± 0.11	0.51± 0.11	1.02	0.31
Middle 3rd	0.87± 0.12	0.81± 0.14	1.30	0.19	0.72± 0.11	0.83± 0.15	2.36	0.02*	0.82± 0.23	0.83± 0.19	0.13	0.89	0.71± 0.15	0.74± 0.13	0.58	0.56
Cervical 3rd	1.16± 0.22	1.12± 0.16	0.58	0.55	0.98± 0.18	0.95± 0.14	2.46	0.01*	1.03± 0.26	1.08± 0.27	0.29	0.59	0.87± 0.12	0.89± 0.16	0.40	0.69

[Table/Fig-5]: The root canal diameter in Group 3 and Group 4 and t-value (as per t-test) and p-values between the root canal diameters.
Values are means±SD, (all measurements are in mm). *Statistically significant

Cross section of the root	Mesiobuccal root (MB)				Distobuccal root (DB)				Palatal root (P)			
	Mean radicular wall thickness (in mm) Gr. 1	Mean radicular wall thickness (in mm) Gr. 2	t30 value	p-value	Mean radicular wall thickness (in mm) Gr. 1	Mean radicular wall thickness (in mm) Gr. 2	t30 value	p-value	Mean radicular wall thickness (in mm) Gr. 1	Mean radicular wall thickness (in mm) Gr. 2	t30 value	p-value
Apical 3rd	0.64±0.11	0.67±0.12	0.73	0.46	0.59±0.11	0.67±0.16	1.64	0.12	0.59±0.06	0.67±0.15	1.98	0.05
Middle 3rd	0.86±0.26	0.85±0.19	0.12	0.91	0.68±0.19	0.82±0.21	1.97	0.56	0.74±0.21	1.08±0.15	5.27	0.05
Cervical 3rd	0.93±0.26	1.03±0.31	0.98	0.33	0.71±0.19	0.91±0.21	2.82	0.008*	0.93±0.27	1.23±0.19	3.63	0.0012*

[Table/Fig-6]: The mean radicular wall thickness of the root in Group 1 and Group 2 in different cross-sections and t-value (as per t-test) and p-values.
Values are means±SD, (all measurements are in mm). *statistically significant

Cross section of the root	Mesiobuccal root (MB)				Mesiolingual root (ML)				Distobuccal root (DB)				Distolingual root (DL)			
	Mean radicular wall thickness (in mm) Gr. 3	Mean radicular wall thickness (in mm) Gr. 4	t30 value	p-value	Mean radicular wall thickness (in mm) Gr. 3	Mean radicular wall thickness (in mm) Gr. 4	t30 value	p-value	Mean radicular wall thickness (in mm) Gr. 3	Mean radicular wall thickness (in mm) Gr. 4	t30 value	p-value	Mean radicular wall thickness (in mm) Gr. 3	Mean radicular wall thickness (in mm) Gr. 4	t30 value	p-value
Apical 3rd	0.55±0.11	0.53±0.08	0.58	0.55	0.53±0.09	0.51±0.11	0.56	0.57	0.52±0.12	0.49±0.15	0.63	0.54	0.49±0.13	0.54±0.08	1.31	0.20
Middle 3rd	0.61±0.13	0.67±0.18	1.08	0.28	0.55±0.11	0.56±0.14	0.23	0.82	0.58±0.12	0.56±0.14	0.43	0.66	0.55±0.15	0.54±0.09	0.23	0.83
Cervical 3rd	0.59±0.12	0.82±0.23	3.54	0.002*	0.61±0.09	0.64±0.21	0.53	0.61	0.57±0.12	0.59±0.15	0.416	0.68	0.56±0.16	0.57±0.11	0.21	0.84

[Table/Fig-7]: The mean radicular wall thickness of the root in Group 3 and Group 4 in different cross-sections and t-value (as per t-test) and p-value.
Values are means±SD, (all measurements are in mm). *statistically significant

root canal diameter and noted values ranging from 0.50 mm at the cervical level, 0.38 mm in the middle third, and 0.19 mm in the apical third [16]. The observation of the current study in perspective of the primary maxillary molar teeth presents significant diversification, which is likely due to differences in study population and perhaps study methodology. It also proves the wide range of diversification in root canal morphology as reported by many previous researchers.

It is also noted in the study that, for the primary mandibular teeth, the maximum diameter for the cervical third (1.16±0.22 mm) and middle third (0.87±0.12 mm) was found in the mesiobuccal root of the first molar, whereas for the apical third (0.65±0.25 mm), it was found in the distobuccal root canal of second molars. In contrast, the minimal diameter for the cervical third (0.87±0.12 mm) and middle third (0.71±0.15 mm) was found in the distolingual root of the first molar, and for the apical third (0.51±0.01 mm), the minimal diameter was found in the mesiobuccal root canal of second molars.

According to Zoremchhingi TJ et al., the maximum diameter in each third of the root of mandibular primary first molars was seen in the distal canal (mean canal diameter of 1.1 mm, 0.83 mm, and 0.51 mm in the cervical, middle, and apical thirds of the root, respectively), and the minimum diameter was seen in the mesiolingual canal (cervical third - 0.57 mm, middle third - 0.40 mm, and apical third - 0.30 mm) [17]. Similarly, in primary mandibular second molars, the mesiolingual root had the lowest canal diameter (cervical third - 0.73 mm, middle third - 0.55 mm, and apical third - 0.4 mm), while the distal root had the largest canal diameters (cervical third - 1.6 mm, middle third - 1.2 mm, and apical third - 1.0 mm). Some other studies [18-20] also reported that the maximum diameters in each third of both roots of primary mandibular molars were found in the distal canal, and the minimum diameter was seen in the mesiolingual canal. The observations of the aforementioned studies are significantly parallel to the observation of the current study for the primary mandibular molar teeth.

The maximum mean radicular wall thickness of primary maxillary molars was found in the cervical third of the palatal root of second molars (1.23±0.19 mm), and the minimal radicular wall thickness was found in the apical third of the palatal root of first molars (0.59±0.06 mm). For primary mandibular molars, the maximum radicular wall thickness was found in the mesiobuccal root of the second molars (0.82±0.23 mm), and the minimal radicular wall thickness was found in the distolingual root of mandibular first molars (0.49±0.13 mm).

The mean radicular wall thickness of primary maxillary first molars showed somewhat similar measurements in both mesiobuccal and palatal roots in both apical and cervical thirds, but it was greater in the middle third of the mesiobuccal root. In primary maxillary second molar teeth, the radicular wall thickness of the three canals in the apical third was somewhat similar, but it differed in the cervical and middle thirds. The mean radicular wall thickness of primary mandibular first and second molars showed a gradual increase from the apical third to the cervical third of the root. The maximum radicular wall thickness was found in the cervical third of all roots. There was a statistically significant difference in the mean radicular wall thickness with respect to the mesiobuccal root at the cervical third of primary mandibular first and second molar teeth. However, the other roots showed no significant differences between each other. The observations of this study for primary maxillary and mandibular molar teeth present minimal yet significant deviations from the findings of Justiniano-Navarro C et al., in their recent study, which is probably due to differences in methodology, standardisation, and study population [2]. However, due to a lack of similar reports in the literature for primary maxillary and mandibular second molar teeth, the results cannot be compared to any other similar research.

Limitation(s)

Standardisation of cross-sectional image viewing protocols and the lesser submillimeter thickness of CT scan images compared to Cone Beam Computed Tomography (CBCT) remain limitations of the aforementioned research. This advocates the necessity for more elaborate research with extended samples and newer radio-imaging technologies like CBCT for further evaluation of the anatomy of the root canal system.

CONCLUSION(S)

The maximum root canal diameter and radicular wall thickness were found in the cervical third of the palatal root of maxillary second molars. The study observes great variation in the root canal morphology of human primary molar teeth pertaining to the diameter and demonstrates the potential of MDCT for qualitative and quantitative assessment of the root canal anatomy of human primary molars. It also helps paediatric dental practitioners understand the morphometric variability of the root and its canal for appropriate paediatric endodontic therapy.

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REFERENCES

[1] Datta P, Zahir S, Kundu GK, Dutta K. An in vitro study of root canal system of human primary molars by using multidetector computed tomography. J Indian Soc Pedod Prev Dent. 2019;37:120-26.
[2] Justiniano-Navarro C, Caballero-García S, López-Rodriguez G, Geller-Palti D. Evaluating the thickness of the root canal dentin wall in primary first molars using cone-beam computed tomography. Int J Clin Pediatr Dent. 2023;16(S-2):S122-S127.
[3] Robertson D, Leeb IJ, McKee M, Brewer E. A clearing technique for the study of root canal systems. J Endod. 1980;6:421-24.
[4] Venturi M, Prati C, Capelli G, Falconi M, Breschi L. A preliminary analysis of the morphology of lateral canals after root canal filling using a tooth-clearing technique. Int Endod J. 2003;36:54-63.
[5] Dammaschke T, Witt M, Ott K, Schäfer E. Scanning electron microscopic investigation of incidence, location, and size of accessory foramina in primary and permanent molars. Quintessence Int. 2004;35:699-705.
[6] Tachibana H, Matsumoto K. Applicability of x-ray computerized tomography in endodontics. Dent Traumatol 1990;6:16-20.
[7] Desai PD, Dutta K, Sarkar S. Multidetector computed tomography dentascan analysis of root canal morphology of maxillary canine. Indian J Dent Res. 2015;26:31-37.
[8] Rachana D, Nadig P, Nadig G. The palatal groove: Application of computed tomography in its detection- A case report. J Conserv Dent. 2007;10:83-88.
[9] Fumes AC, Sousa-Neto MD, Leoni GB, Versiani MA, da Silva LAB, da Silva RAB, et al. Root canal morphology of primary molars: A micro-computed tomography study. Eur Arch Paediatr Dent. 2014;15(5):317-26. Doi: 10.1007/s40368-014-0117-0.
[10] Krishnamurthy NH, Jacob CD, Thimmegowda U, Ramachandra JA, Arali V, Bhat PK, et al. Anatomical configuration of roots and canal morphology of primary mandibular first molars: A CBCT study. J Clin Diagn Res. 2017;11(11):ZC09-11. Doi: 10.7860/JCDR/2017/32284.10838.
[11] American Dental Association; Guidelines for Infection Control in Dental Health-Care Settings November, 2003. Available from: http://www.ada.org. [Last accessed on 2003 Dec 19].
[12] Dominici JT, Eleazer PD, Clark SJ, Staat RH, Scheetz JP. Disinfection/sterilization of extracted teeth for dental use. J Dent Educ. 2001;65(11):1278-80.
[13] Kfir A, Mostinsky O, Elyzur O, Hertzeanu M, Metzger Z, Pawar AM. Root canal configuration and root wall thickness of first maxillary premolars in an Israeli population- A Cone-beam computed tomography study. Nature research, Scientific Reports. 2020;10:434. Available from: https://doi.org/10.1038/s41598-019-56957-z.
[14] Shaikh SY, Shaikh SS. Direct linear measurement of root dentin thickness and dentin volume changes with post space preparation: A cone-beam computed tomography study. Contemp Clin Dent. 2018;9(1):77-82.
[15] Martos J, Tatsch GH, Tatsch AC, Silveira LF, Ferrer-Luque CM. Anatomical evaluation of the root canal diameter and root thickness on the apical third of mesial roots of molars. Anat Sci Int. 2011;86(3):146-50. Doi: 10.1007/s12565-011-0102-1.
[16] Montoya Funegra J, Torres Ramos G, Blanco Victorio DJ, Cassaretto Gamonal M, Apaza Ramos S. Consideraciones anatómicas para la preparación de conductos radiculares en la primera molar inferior decidua. Odontol Pediatr. 2016;15(1):41-52.
[17] Zoremchhingi TJ, Varma B, Mungara J. A study of root canal morphology of human primary molars using computerised tomography: An in vitro study. J Indian Soc Pedod Prev Dent. 2005;23(1):07-12.

[18] Ahmed HMA, Musale PK, Shahawy OI, Dummer PMH. Application of a new system for classifying tooth, root and canal morphology in the primary dentition. Int Endod J. 2020;53(1):27-35. Doi: 10.1111/iej.13199.
[19] Salama FS, Anderson RW, McKnight-Hanes C, Barenie JT, Myers DR. Anatomy of primary incisor and molar root canals. Pediatr Dent. 1992;14(2):117-18.
[20] Aminabadi NA, Farahani RM, Gajan EB. Study of root canal accessibility in human primary molars. J Oral Sci. 2008;50(1):69-74.

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