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ORIGINAL ARTICLE

Dentin Thickness of Pulp Chamber Floor in Primary Molars: Evaluation by Cone-Beam Computed Tomography

Mariane Bovino[1], Larissa de Souza Santos[1], Larissa Lopes Freitas de Albuquerque Cavalcante[1], Cacilda Castelo Branco Lima[1], Marina de Deus Moura de Lima[1], Marcoeli Silva de Moura[1], Paulo de Tarso Silva de Macêdo[2], Lucia de Fátima Almeida de Deus Moura[1]

[1]Postgraduate Program in Dentistry, Federal University of Piaui, Teresina, PI, Brazil.
[2]UNIFACID University Center, Teresina, PI, Brazil.

Correspondence: Lúcia de Fátima Almeida de Deus Moura, Postgraduate Program in Dentistry, Federal University of Piaui, Ministro Petrônio Portella, Bloco 5, Campus Universitário, Teresina, Piauí, Brazil. 64049-550. **E-mail:** mouraiso@uol.com.br

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ABSTRACT

Objective: Use cone-beam computed tomography (CBCT) images to evaluate the dentin thickness of the pulp chamber floor in primary molars. **Material and Methods:** Cross-sectional study, conducted with CBCT images of teeth of children. Primary molars with preserved pulp chamber floor were included. The dentin thickness of the pulp chamber floor in the primary molars was measured linearly in CBCT cross-sections. Data were descriptively analyzed and the Mann-Whitney test was applied ($p<0.05$). **Results:** 27 CBCT exams and 123 primary molars of children aged 4 to 13 years were analyzed; the majority was female (52.0%). In maxillary molars, the median dentin thickness was 1.50 (0.6–2.2) mm in the first and 1.65 (0.6–2.3) mm in the second ($p=0.049$) molars. In mandibular molars, the median was 1.20 (0.3–1.7) mm in the first and 1.60 (1.0–2.2) mm in the second ($p<0.001$) molars. Children aged 4 to 8 years showed less dentin thickness ($p<0.001$). **Conclusion:** The median dentin thickness of the pulp chamber floor in primary molars was 1.50 mm, ranging from 0.3 to 2.3 mm. Less dentin thickness was associated with younger children, teeth in the mandibular arch, and first molars.

Keywords: Dental Pulp Cavity; Dentin; Cone Beam Computed Tomography; Molar; Child.

Introduction

Primary molars have a complex morphology [1,2], with bulky pulp chambers [3,4] that have accessory canals in the floor, and reduced dentin thickness, characteristics that make this region permeable [3,5], favoring communication between the coronal pulp and the periodontal regions [6,7]. In addition, pulp decomposition products and/or drugs used in pulp therapies can spread to the furcation region, where the successor tooth is forming. These are factors associated with dental enamel developmental defects of successor teeth [8-10].

The thickness of dentin in the pulp chamber floor region of primary molars has been studied in interproximal radiographs [11], by stereoscopic light microscope [12] and medical tomography (CT) [13,14]. However, these techniques have limitations. For example, in light microscope techniques, stereoscopic and interproximal radiographs reproduce two-dimensional images and single-plane visualization [12,15]. Furthermore, CT is an exam that emits high doses of radiation that represent a greater biological risk to patients [16].

To minimize the limitations mentioned above, cone beam computed tomography (CBCT) enables the capture of images capable of accurately determining dentin thickness on the floor of pulp chambers in primary molars [17,18]. CBCT is a three-dimensional imaging method that allows visualization of hard tissues in the axial, sagittal and coronal planes [15,16]. The aim of this study, using CBCT images, was to evaluate the dentin thickness of the pulp chamber floor in primary molars and associated factors.

Material and Methods

Ethical Clearance

This study was approved by the Research Ethics Committee (Opinion 3.335.051) in compliance with the precepts established in the Declaration of Helsinki.

Study Design

This was a cross-sectional study conducted with data collected from the files of a dental radiology clinic. CBCT images of the teeth of children of both sexes, aged 4 to 13 years, who had at least one primary molar with preserved pulp chamber floor were included. Tomographic examinations that had artifacts that prevented the evaluation and showed primary molars located near bone lesions were excluded.

Calibration and Compliance

Three evaluators were calibrated by a professor of dental radiology, experienced in studies with CBCT. To guarantee the reliability of the evaluations, 20 CBCT images were randomly selected in order to determine the intra- and inter-examiner agreement. In cases of disagreement, the images were reviewed and discussed. The intra and inter-examiner agreement values were higher than 0.9 (Kappa).

Dentin Thickness Measurements

The CBCT images were captured using the CS 8100 3D device (Carestream Dental, USA) with a 0.15 mm voxel size, 84kV, 4mA and 15s exposure. The images, in DICOM format, were reconstructed and analyzed using CS 3D Imaging software (Carestream Dental, USA, 2017). From an axial section with a thickness of 0.15 mm (Figure 1), a panoramic reconstruction with a thickness of 10 mm was obtained (Figure 2). The cursor was positioned in the interradicular region of the primary molar, following its degree of inclination (long axis of the tooth), thus forming a cross section-shaped image with a thickness of 0.15 mm. From this section, using the software linear measurement tool, the dentin thickness (in millimeters) was measured from the pulp chamber floor to the point closest to the furcation (Figure 3).

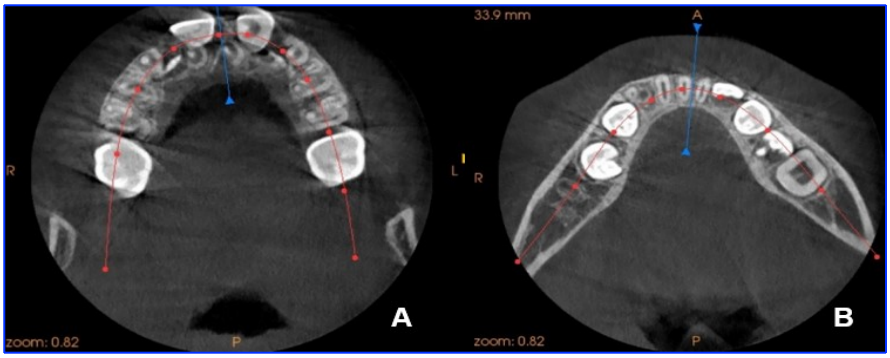

Figure 1. Axial CBCT section of maxillary (A) and mandibular (B) arches.

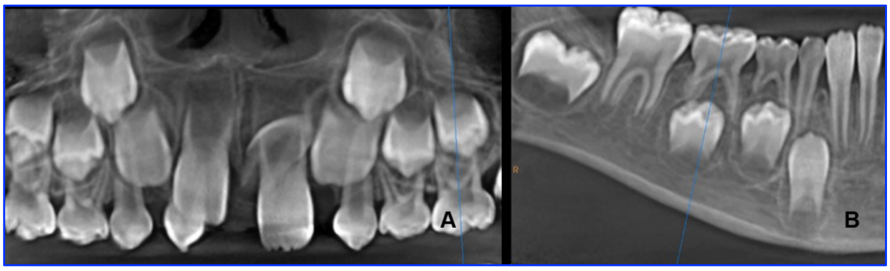

Figure 2. Panoramic reconstruction of maxillary (A) and mandibular (B) arc CBCT. Cursor following long axis of the tooth (blue line).

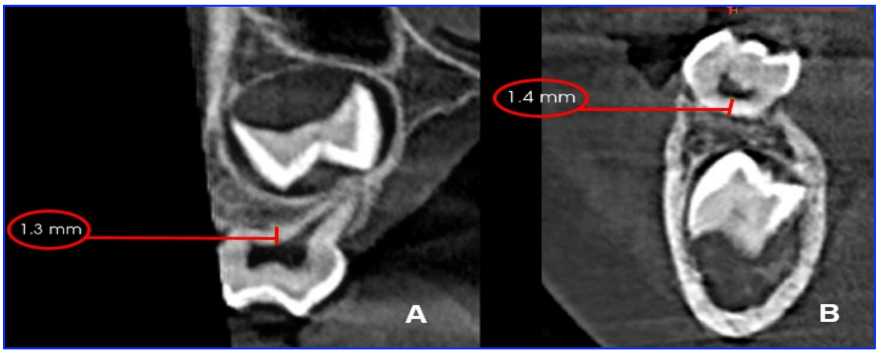

Figure 3. Transverse sections of maxillary (A) and mandibular (B) primary first molar region showing the location of linear measurement of pulp chamber floor to furcation region.

Pilot Study

To evaluate the proposed methodology, a pilot study was carried out with 10 randomly selected CBCT images. The study was conducted at the dental radiology clinic, where the children's CBCT exams were filed. Therefore, there was no need for methodological changes.

Statistical Analysis

The data were analyzed using the Statistical Package for the Social Science program, version 22.0 (IBM Corp., Armonk, NY, USA). Data were initially descriptively analyzed (frequencies, mean, standard deviation, median and minimum and maximum values). Then, the Kolmogorov-Smirnov test was used to verify normality that showed a non-normal distribution of the data (p<0.05). Thus, to analyze the difference in dentin thickness of primary molars in relation to sex, age (4 to 8 years and 9 to 13 years), type of tooth (first or second molar), dental arch (maxillary and mandibular) and homologous teeth. Mann-Whitney test was used. In all analyses, a significance level of 5% (p<0.05) was considered.

Results

In total, 27 CBCT exams and 128 primary molars were analyzed. Three teeth were excluded due to artifacts that made evaluations impossible, and two because they were located close to bone lesions, including 123 primary molars from both dental arches. Most of the teeth analyzed were maxillary molars (59.3%) of female children (52.0%) in the age group from 9 to 13 years (57.7%). There was a higher frequency of second molars (54.8%) (Table 1). Children aged 9 to 13 years showed higher dentin thickness values when compared with those aged 4 to 8 years (p<0.001). The second molars (p<0.001) and teeth in the maxillary arch (p=0.037) showed higher dentin thickness values of the pulp chamber floor (Table 1).

Table 1. Dentin thickness of pulp chamber floor in primary molars, according to sex, age, tooth and dental arch.

Variables	Dentin Thickness of Pulp Chamber Floor in Primary Molars (mm)			
	N (%)	Mean (SD)	Median (Min.–Max.)	p-value*
Sex				
Female	64 (52.0)	1.55 (0.37)	1.60 (0.3–2.3)	0.116
Male	59 (48.0)	1.43 (0.43)	1.50 (0.6–2.2)	
Age (Years)				
4–8	52 (42.3)	1.36 (0.31)	1.35 (0.8–2.2)	<0.001
9–13	71 (57.7)	1.60 (0.43)	1.70 (0.3–2.3)	
Tooth				
First Molar	57 (46.3)	1.35 (0.41)	1.50 (0.3–2.2)	<0.001
Second Molar	66 (53.7)	1.62 (0.36)	1.60 (0.6–2.3)	
Dental Arches				
Maxillary	73 (59.3)	1.55 (0.41)	1.60 (0.6–2.3)	0.037
Mandibular	50 (40.7)	1.42 (0.39)	1.50 (0.3–2.2)	
Total	123 (100.0)	1.50 (0.40)	1.50 (0.3–2.3)	

mm: millimeter; SD: Standard Deviation; Min: Minimum; Max: Maximum; *Mann-Whitney test.

The difference between the dentin thickness on the pulp chamber floor of primary maxillary and mandibular molars is described in Table 2. The second molars, both maxillary (p=0.049) and mandibular (p<0.001) showed higher dentin thickness values when compared with first molars (Table 2).

Table 2. Dentin thickness of pulp chamber floor in maxillary and mandibular primary molars.

Variables	Dentin Thickness of Pulp Chamber Floor in Primary Molars (mm)			
	N (%)	Mean (SD)	Median (Min.–Max.)	p-value*
Maxillary Molars				
First Molar	33 (45.2)	1.44 (0.42)	1.50 (0.6–2.2)	0.049
Second Molar	40 (54.8)	1.64 (0.37)	1.65 (0.6–2.3)	
Mandibular Molars				
First Molar	24 (48.0)	1.22 (0.35)	1.20 (0.3–1.7)	<0.001
Second Molar	26 (52.0)	1.60 (0.33)	1.60 (1.0–2.2)	

mm: millimeter; SD: Standard Deviation; Min: Minimum; Max: Maximum; *Mann-Whitney test.

The comparison of dentin thickness between homologous primary molars is shown in Table 3. There was no difference in thickness values between homologous teeth (p>0.05) (Table 3).

Table 3. Comparison of dentin thickness of pulp chamber floor in homogeneous primary molars.

Variables	Dentin Thickness of Pulp Chamber Floor in Primary Molars (mm)			
	N (%)	Mean (SD)	Median (Min.–Max.)	p-value*
First Maxillary Molars				
Right	17 (51.5)	1.38 (0.41)	1.50 (0.6 – 2.0)	0.338
Left	16 (48.5)	1.51 (0.44)	1.60 (0.8 – 2.2)	
Second Maxillary Molars				
Right	19 (47.5)	1.76 (0.32)	1.70 (1.0 – 2.3)	0.091
Left	21 (52.5)	1.52 (0.39)	1.60 (0.6 – 2.1)	
First Mandibular Molars				
Right	12 (50.0)	1.23 (0.43)	1.45 (0.3 – 1.7)	0.598
Left	12 (50.0)	1.22 (0.27)	1.15 (0.8 – 1.7)	
Secondt Mandibular Molars				
Right	14 (53.8)	1.6 (0.38)	1.6 (1.0 – 2.2)	0.876
Left	12 (46.2)	1.6 (0.28)	1.6 (1.3 – 2.2)	

mm: millimeter; SD: Standard Deviation; Min: Minimum; Max: Maximum; *Mann Whitney test.

Discussion

The dentin thickness of the pulp chamber floor in primary molars showed higher values in older children, corroborating the results found in another study [19]. This is due to the continuous formation of dentin throughout life [20]. Thus, knowledge of the dentin thickness on the pulp chamber floor represents a guiding factor in clinical practice, especially during the coronal opening for endodontic interventions in young children [20,21].

In the present study, the primary first molars showed less dentin thickness on the pulp chamber floor when compared with the second molars. This smaller thickness was expected due to the reduced dimensions of these teeth compared to the second molars [4]. However, no consensus was found in the literature regarding these data [11-14].

Maxillary primary molars were also observed to have higher dentin thickness values when compared with the mandibular molars, a result that was in agreement with another study [11]. This difference could perhaps be attributed to the fact that maxillary molars have three roots, differentiating them anatomically from the mandibular type that has two.

CBCT images make it possible to accurately assess the dentin thickness of the pulp chamber floor in primary molars [22-24]. The method, characterized as being non-invasive, provides easy clinical application. In addition, this study presents the differential of standardizing the reference points for the measurement of dentin thickness. This standardization will enable other researchers to reproduce the methodology used.

A limitation of the present study arose due to the similarity of tomographic density between dentin and cementum because it was not possible to distinguish these two tissues from each other in the images of CBCT. However, the cementum thickness of primary teeth is micrometric; therefore, it did not interfere in the dentin thickness measurement, which is millimetric [25].

This study has added to the literature by finding the mean values of dentin thickness on the pulp chamber floor in primary molars. Despite its clinical relevance, this condition has been little studied. Thus, this information provides important knowledge in the pediatric dental clinic since the reduced dentin thickness associated with accessory channels makes the pulp chambers floor region permeable.

Conclusion

The median dentin thickness of the pulp chamber floor of primary molars was 1.50 mm, ranging from 0.3 to 2.3 mm. Less dentin thickness was associated with younger children, teeth in the mandibular arch, knowledge and first molars.

Authors' Contributions

MB	https://orcid.org/0000-0002-1142-2335	Conceptualization, Methodology, Formal Analysis, Investigation and Writing - Original Draft.
LSS	https://orcid.org/0000-0003-0373-7270	Methodology, Formal Analysis, Investigation and Writing - Original Draft.
LLFAC	https://orcid.org/0000-0001-6499-1999	Methodology, Formal Analysis, Investigation, Writing - Original Draft, Writing - Review and Editing, Visualization, Supervision, Project Administration, Funding Acquisition
CCBL	https://orcid.org/0000-0002-2977-6035	Methodology, Formal Analysis and Writing - Review and Editing.
MDML	https://orcid.org/0000-0002-7641-6331	Methodology, Formal Analysis and Writing - Review and Editing.
MSM	https://orcid.org/0000-0002-9044-9025	Methodology, Validation andWriting - Review and Editing.
PTSM	https://orcid.org/0000-0003-4092-9829	Methodology, Formal Analysis, Investigation, Writing - Review and Editing and Supervision.
LFDM	https://orcid.org/0000-0002-4112-1533	Conceptualization, Methodology, Formal Analysis, Investigation, Writing - Original Draft, Writing - Review and Editing, Supervision and Project Administration.
All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.		

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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References

[1] Ahmed HMA, Khamis MF, Gutmann JL. Seven root canals in a deciduous maxillary molar detected by the dental operating microscope and micro-computed tomography. Scanning 2016; 38(6):554-7. https://doi.org/10.1002/sca.21299

[2] Ariffin SM, Dalzell O, Hardiman R, Manton DJ, Parashos P, Rajan S. Root canal morphology of primary maxillary second molars: a micro-computed tomography analysis. Eur Arch Paediatr Dent 2020; 21(4):1-7. https://doi.org/10.1007/s40368-020-00515-z

[3] Sharma U, Gulati A, Gill N. An investigation of accessory canals in primary molars–an analytical study. Int J Paediatr Dent 2016; 26(2):149-56. https://doi.org/10.1111/ipd.12178

[4] Cheong J, Chiam S, King NM, Anthonappa RP. Pulp chamber analysis of primary molars using micro-computed tomography: Preliminary findings. J Clin Pediatr Dent 2019; 43(6):382-7. https://doi.org/10.17796/1053-4625-43.6.4

[5] Kramer PF, Faraco Júnior IM, Meira R. A SEM investigation of acessory foramina in the furcation áreas of primary molars. J Clin Pediatr Dent 2003; 27(2):157-61. https://doi.org/10.17796/jcpd.27.2.98132n48870n3303

[6] Kumar VD. A scanning alectron microscope study of prevalence of acessory canals on the pulpar floor of deciduous molars. J Indian Soc Pedod Prev Dent 2009; 27(2):85-9. https://doi.org/10.4103/0970-4388.55332

[7] Lugliè PF, Grabesu V, Spano G, Lumbau A. Acessory foramina in the furcation area of primary molars. A SEM investigation. Eur J Paediatr Dent 2012; 13(4):329-32.

[8] Cordeiro MMR, Rocha MJC. The effects of periradicular inflamation and infection on a primary tooth and permanent sucessor. J Clin Pediatr Dent 2005; 29(3):193-200. https://doi.org/10.17796/jcpd.29.3.5238p10v21r2j162

[9] Guglielmi CAB, Romalho KM, Scaramucci T, Silva SREP, Imparato JCP, Pinheiro SL. Evaluation of the furcation area permeability of deciduous molars treated by neodymium: yttrium-aluinum-garnet laser or adhesive. Lasers Med Sci 2010; 25(6):873-80. https://doi.org/10.1155/2016/1429286

[10] Sousa HCS, Lima MDM, Lima CCB, Moura MS, Bandeira AVL, Moura LFAD. Prevalence of enamel defects in premolars whose predecessors were treated with extractions or antibiotic paste. Oral Health Prev Dent 2020; 18(1):793-8. https://doi.org/10.1155/2016/1429286

[11] Dabawala S, Chacko V, Suprabha BS, Rao A, Natarajan S, Ongole R. Evaluation of pulp chamber dimensions of primary molars from bitewing radiographs. Pediatr Dent 2015; 37(4):361-5.

[12] Gentner MR, Meyers IA, Symons AL. The floor of the pulp chamber following pulpotomy. J Clin Pediatr Dent 1991; 16(1):20-4.

[13] Vijayakumar R, Selvakumar H, Swaminathan K, Thomas E, Ganesh R, Palanimuthu S. Root canal morphology of human primary maxillary molars in Indian population using spiral computed tomography scan: An in vitro study. SRM J Res Dent Sci 2013; 4(4):139-42. https://doi.org/10.4103/0976-433X.125587

[14] Selvakumar H, Kavitha S, Vijayakumar R, Eapen T, Bharathan R. Study of pulp chamber morphology of primary mandibular molars using spiral computed tomography. J Contemp Dent Pract 2014; 15(6):726-9. https://doi.org/10.5005/jp-journals-10024-1606

[15] Patel S, Brown J, Pimentel T, Kelly RD, Abella F, Durack C. Cone beam computed tomography in Endodontics – a review of the literature. Int Endod J 2019; 52(8):1138-52. https://doi.org/10.1111/iej.13115

[16] Scarfe WC, Farman AG, Sukovic P. Clinical applications of cone-beam computed tomography in dental practice. J Can Dent Assoc 2006; 72(1):75-80.

[17] Azim AA, Azim KA, Deutsch AS, Huang GTJ. Acquisition of anatomic parameters concerning molar pulp chambre landmarts using cone-beam computed tomography. J Endod 2014; 40(9):1298-1302. https://doi.org/10.1016/j.joen.2014.04.002

[18] Xu J, He J, Yang Q, Huang D, Zbou X, Peters DA, et al. Accuracy of cone-beam computed tomography in measuring dentin thickness and its potential of predicting the remaining dentin thickness after removing fractured instruments. J Endod 2017; 43(9):1522-7. https://doi.org/10.1016/j.joen.2017.03.041

[19] Amano M, Agematsu H, Abe S, Usami A, Matsunaga S, Suto K, et al. Three-dimensional analysis of pulp chambers in maxillary second deciduous molars. J Dent 2006; 34(7):503-8. https://doi.org/10.1016/j.jdent.2005.12.001

[20] Tsatsoulis IN, Filippatos CG, Floratos SG, Kontakiotis EG. Estimation of radiographic angles and distances in coronal part of mandibular molars: A study of panoramic radiographs using EMAGO software. Eur J Dent 2014; 8(1):90-4. https://doi.org/10.4103/1305-7456.126254

[21] Kurthukoti AJ, Sharma P, Swamy DF, Shashidara R, Swamy EB. Computed tomographic morphometry of the internal anatomy of mandibular second primary molars. Int J Clin Pediatr Dent 2015; 8(3):202-7. https://doi.org/10.5005/jp-journals-10005-1313

[22] Moshfeghi M, Tavakoli MA, Hosseini ET, Hosseini AT, Hosseini IT. Analysis of linear measurement accuracy obtained by cone beam computed tomography (CBCT-NewTom VG). Dent Res J 2012; 9(Suppl 1):S57-S62. https://doi.org/10.4103/1735-3327.107941

[23] Lascala CA, Panella J, Marques MM. Analysis of the accuracy of linear measurements obtained by cone beam computed tomography (CBCT-NewTom). Dentomaxillofac Radiol 2004; 33(5):291-4. https://doi.org/10.1259/dmfr/25500850

[24] Stratemann SA, Huang JC, Maki K, Miller AJ, Hatcher DC. Comparison of cone beam computed tomography imaging with physical measures. Dentomaxillofac Radiol 2008; 37(2):80-93. https://doi.org/10.1259/dmfr/31349994

[25] Yawaka Y, Osanai M, Akiyama A, Ninomiya R, Oguchi H. Histological study of deposited cementum in human deciduous teeth with pathological root resorption. Ann Anat 2003; 185(4):335-41. https://doi.org/10.1016/S0940-9602(03)80054-7