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RESEARCH ARTICLE

CBCT ANALYSIS OF PULP CHAMBER THICKNESS AND MORPHOLOGY IN PRIMARY MOLARS: AN OBSERVATIONAL STUDY

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Abstract

Objective: To evaluate the thickness of pulp chamber and morphologic characteristics in order to plan the treatment of deciduous molars using cone beam computed tomography.

Material and Methods: Cross-Sectional study is done with CBCT images of primary teeth of children. Evaluation of Pulp chamber thickness and morphology of each maxillary right primary second molar was done through CBCT. Data were analyzed and sent for statistical analysis.

Results: Total 50 teeth i.e., right maxillary primary second molars of children age group 4-10 years were analyzed. Male shows the horizontal and vertical Mean (SD) values 4.5 (0.76) and 1.7(0.58) respectively greater than females. Mesial and Distal pulp horns were also greater in height for males with Mean (SD) 3.1(0.51) and 2.5(0.52) respectively.

Conclusion: General variations might be involved however, when preparing a course of treatment for a child it is important to take note of gender differences in the mesiobuccal pulp horn. Even small restorations have a significant effect on pulp size. Probably it becomes exposed when the cavity is being prepared.

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Introduction:-

In order to understand why primary teeth generally need pulpal treatment, their anatomy should be examined [Lewis and Law, 1973]. Enamel and dentin thickness in primary teeth is approximately 1/2 of permanent teeth and the coronal pulp volume-to-crown volume ratio is greater in primary teeth [Lewis and Law, 1973; Mathewson and Primosch, 1995; Johnsen, 2002]. The primary objective of pulp therapy is to maintain the integrity and health of the teeth and their supporting tissues [AAPD, 2009]. Primary molars have a very complex form of morphology^{1,2}, with clumsy pulp chambers^{3,4} that have accentuated canals within the floor, and reduced dentin thickness, traits that makes this area permeable^{3,5}, favoring relationship among the coronal pulp and the periodontal regions^{6,7}. In addition, pulp decomposition products and/or drugs used in pulp therapies can unfold to the furcation region, in which the successor teeth are forming⁸⁻¹⁰. The thickness of dentin within the pulp chamber floor of primary molars has been studied in interproximal radiographs¹¹, through stereoscopic microscope¹² and computed tomography (CT)^{13,14}. CT is an examination that emits excessive doses of radiation that constitute an extra biological risk to patients¹⁵. Dentin formation produces age-related decrease in pulp chamber volume that is variable among different populations and both sexes^{16,17,18}. CBCT gives the benefit of inflicting no magnification errors because of geometric distortion, giving more specified information, much less artefacts, and having a decrease

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radiation dose than CT ¹⁹. In the literature there are limited investigations on the pulp chamber thickness and morphology of primary molars. Therefore, the purpose of this study is to evaluate the thickness of pulp chamber and morphologic characteristics of deciduous molars using Cone Beam Computed Tomography (CBCT).

Materials and Methodology:-

Ethical Clearance

This study was approved by the Research Ethical Committee of KD Dental College and Hospital.

Study Design

This study was conducted with data collected from the files of patients from the Department of Pedodontics and Preventive dentistry, KD Dental College and Hospital. CBCT images of teeth of children from both sexes age group (4-10 yrs.), who had at least one primary molar with adequate pulp thickness. Tomographic examinations that had artifacts that averted the assessment and confirmed primary molars positioned close to bone lesions had been excluded.

Calibration and Compliance

The study was conducted with the help of a Pediatric dentist and the calibration was done by an Oral and Maxillofacial Radiologist. Before the study began, the program was consisted of theoretical knowledge and discussions about CBCT image evaluation, followed by practical sessions.

Pulp Chamber thickness and Pulp Horns height

The CS 8100 3D device was used to capture the CBCT pictures, which were then examined using the CS 3D Imaging programmed at 0.15 mm voxel size, 84kV, 4mA, and 15s exposure. A panoramic reconstruction with a thickness of 10 mm was created from an axial segment with a thickness of 0.15 mm (Figure 1) (Figure 2). The cursor was positioned inside the interradicular area of the primary molar, following the angle of the tooth's long axis, creating the appearance of a cross section. The horizontal and vertical pulp chamber thickness (in millimeters) was measured using the software's linear measuring tool (Figure 3). The mesiobuccal and distobuccal pulp horn heights (in millimeters) were also measured (Figure 4).

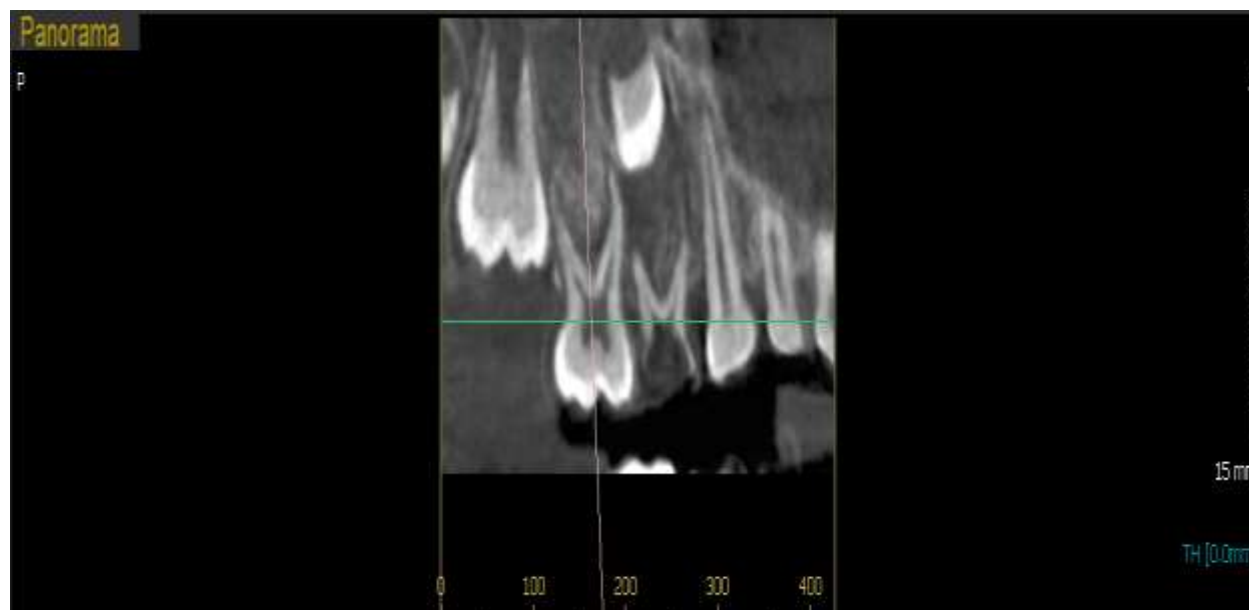


Figure 1:- Panoramic reconstruction of primary maxillary right second molar. Cursor following long axis of the tooth (pink line).

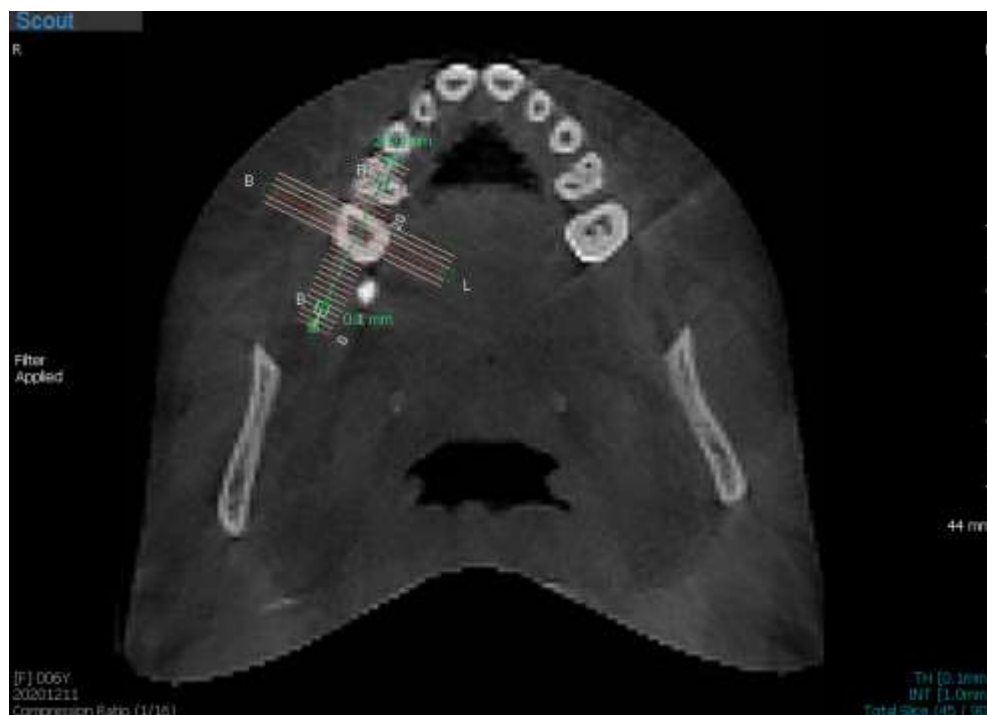


Figure 2:- Axial CBCT section of primary maxillary right second molar.



Figure 3:- Horizontal and Vertical thickness of Pulp Chamber.



Figure 4:- Height of mesiobuccal and distobuccal pulp horns.

Statistical Analysis

The data are tabulated in Microsoft excel and analyzed with SPSS V.24 software. Thus, to analyze the difference in pulp chamber thickness and pulp horn morphology of primary molars in relation to sex, age (4 to 10 years), type of tooth (primary right second molar), the continuous variables were presented with mean and standard deviation. Chi-Square test was used for the statistical analysis. The p value <0.05 is considered statistically significant.

Results:-

A total of 50 teeth included in the present study. They were divided into 25 each in two groups based on gender. Pulp chamber thickness and the height of mesiobuccal and distobuccal pulp horns were measured in both groups. Data were analyzed by Chi-square test. So, on the basis of gender, the maximum horizontal and vertical thickness of pulp chamber were seen in males with mean (SD) 4.5(0.76) and 1.7(0.58) with p-value (0.001) and (0.014) respectively. The height of mesiobuccal and distobuccal pulp horns were also seen more in males with mean (SD) 3.1(0.51) and 2.5(0.52) with p-value (0.006) and (0.001) respectively as seen in Table 1 & 2.

Table 1:- Mean values for primary right 2nd Maxillary Molar.

Dimensions of 2 nd Maxillary Molar	Mean (SD)	
	Male	Female
Horizontal thickness of pulp	4.5(0.76)	3.7(0.36)
Vertical thickness of pulp	1.7(0.58)	1.4(0.57)
Height of mesiobuccal pulp horn	3.1(0.51)	2.6(0.59)
Height of distobuccal pulp horn	2.5(0.52)	1.9(0.48)

Table 2:- Comparison of dimension of primary right 2nd Maxillary Molar according to gender.

Dimensions of primary 2 nd Maxillary Molar	Chi-square value	p-value
Horizontal thickness of pulp	0.924	0.001**

Vertical thickness of pulp	1.320	0.014**
Height of mesiobuccal pulp horn	1.171	0.006**
Height of distobuccal pulp horn	0.812	0.001**

p-value ≤ 0.05 (* - significant) and p-value ≤ 0.001 (** - highly significant) Chi-square test

Discussion:-

The endodontic literature lacks studies that measure anatomic landmarks relating to the pulp chamber. The great variation in the size, shape, and position of molar teeth may have led to the belief that the dimensions of the pulp chamber would also vary so much that measuring them would be clinically impractical²². Conventional clinical radiography is a common method for determining the pulp anatomy of a tooth. However, this method only produces a two-dimensional (2D) image of the tooth, which can make it difficult to visualize the three-dimensional (3D) anatomy of the pulp chamber and root canals²³. CBCT provides a more accurate and detailed view of the internal anatomy of teeth than conventional clinical radiography. Thus, we have done our study on CBCT images.

Deutsch and Musikant (2004) conducted a morphological study of the anatomical landmarks in the pulp chambers of human maxillary molars²⁴. They found that the mean distance between the tip of the palatal cusp and the closest point of the furcation was 11.15 mm. They also found that the mean distance between the tip of the palatal cusp to the floor of the pulp chamber was 8.08 mm, and the mean distance from the tip of the palatal cusp to the roof of the pulp chamber was 6.24 mm²⁴. In another study conducted by Haridoss Selvakumar et al (2014) found that height of the pulp chamber of deciduous mandibular 1st molar was 1.8 mm¹⁴. Zhaleh Shafiei Sabet et al (2017) conducted a study in which mean height of the pulp chamber in permanent maxillary 1st molar was found to be 2.1mm and that in permanent mandibular 1st molar was found to be 1.1mm²⁶. However, in our study we measured vertical and horizontal thickness of pulp chamber of primary maxillary second molar. The mean horizontal thickness of pulp was found to be 4.5 mm for males and 3.7mm for females respectively. Mean Vertical thickness of pulp chamber was found to be 1.7 mm for males and 1.4 mm for females.

Amano et al. (2006) studied the crown contour and pulp chamber morphology of deciduous maxillary second molars in different dentition periods. They found that the mesiobuccal pulp horn was the most prominent pulp horn in both the deciduous and mixed dentition periods²³. In another study conducted by Chandler et al (2003) height of the mesial pulp horn was found to be 1.4 mm for maxillary 1st molar and 1.7 mm for mandibular 1st molar whereas the height of distal pulp horn was 1.01 mm for maxillary 1st molar and 1.09 mm for mandibular 1st molar²⁷. In our study we compared the mesiobuccal and distobuccal height of pulp horns of primary maxillary second molars of males and females and we found that the mesiobuccal pulp horn was more prominent in deciduous dentition. The mean height of the mesiobuccal pulp horn was found to be 3.1 and 2.6 mm in males and females, and mean height of the distobuccal pulp horn was 2.5 mm and 1.9mm in males and females respectively. So, height of mesiobuccal pulp horn was more than distobuccal pulp horn.

To ensure a successful endodontic access preparation, the dentist should integrate their knowledge of pulp chamber morphology with a review of preoperative radiographs and intraoperative tactile sensation. This will help them to identify and avoid potential complications²².

Clinical Significance

1. The correct location and number of canal orifices can be ensured by knowledge of pulp chamber anatomy and morphology.
2. While treating a child, gender difference should be kept in mind as males have bigger pulp dimension as compared to females and also mesiobuccal pulp horn is highly placed in males. So, during cavity preparation, dentists can avoid accidentally exposing the mesiobuccal pulp horn.

Conclusion:-

CBCT can be used to create detailed, three-dimensional images of teeth, which can be helpful for understanding the unique shape and structure of each tooth. Dentists who have a thorough understanding of the internal anatomy of teeth are better equipped to provide successful treatment even a small restoration can have a significant impact on the size of the pulp chamber, reducing the pulp area in the clinical crown and the height of the mesial pulp horn.

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