

Detection of MB₂ Canal in Maxillary Primary Second Molar using Cone Beam Computerized Tomography (CBCT) – An In vitro study

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Abstract

Background: The success of Endodontic therapy is mainly dependent on the quality of cleaning the root canal system. Therefore, the ability to locate all the canals in the system is an important factor in determining the eventual success of the case. Various authors have investigated the frequency of second canal (MB₂) in the mesiobuccal root of maxillary permanent molar, predominantly first molar. Literature regarding the presence of MB₂ canal in the maxillary primary second molar is sparse.

Aim: The aim of the study was to compare the efficacy of Cone Beam Computed Tomography (CBCT) and ground sections in the detection of MB₂ canal in the mesiobuccal root of maxillary primary second molar.

Materials and Methods: 29 freshly extracted teeth were collected. Access opening with no.330 bur was done. The samples were mounted on a horse shoe shaped wax and subjected for analysis under Cone Beam Computerized Tomography. The detection of MB₂ canal was analysed under axial plane. The samples were then subjected for histological clearing method. Descriptive statistics were made.

Results: 33.3% of samples (n=21) were detected of second mesiobuccal canal in Histological clearing technique. 45% of samples (n=29) were detected of MB₂ canal using CBCT.

Conclusion: This study highlights the detection accuracy, importance and the potential use of CBCT as an assessment tool in the identification of second mesiobuccal canal (MB₂) when compared to the gold standard (histological clearing technique).

Keywords: Root canal morphology, MB₂ canal, CBCT, primary maxillary second molars.

INTRODUCTION

Root canal system of primary teeth exhibits distinct morphological differences from permanent teeth. Knowledge of the size, morphological and variation of the root canals of primary teeth are useful to improve the success of endodontic treatment and to maintain a bacteria free environment. In 1925, the presence of two canals in the mesiobuccal root of maxillary permanent molars was first reported and documented [1]. Since then, clinicians have been concerned with the identification and treatment of additional canals with respect to permanent teeth.

A variety of techniques have been used to study root canal morphology including radiographic examination [2], root sectioning [3] and staining and clearing techniques [4]. It has been reported that fine details of the root canal system can be visualized by staining and clearing [5] and this method was used in the present study.

Radiographic techniques also have been used to obtain a two-dimensional image [2,5-9]. Some of these techniques are complicated and time-consuming, and many difficulties can be encountered during their execution, introducing artifacts and distortion of the internal anatomy of the specimens. Furthermore, these techniques do not allow for the observation of the external and internal anatomy of teeth in three dimensions at the same time. Three-dimensional methods for the morphological study of teeth are replacing the more limited two-dimensional techniques. Historically, several techniques have been described for visualization of the 3D anatomy of root canals in human teeth. This usually has been done by reconstructing the image derived from tracings of the contours from serial cross-sections of the specimens, as the first study cited,

published by Hess [10-16]. It must be underlined that in the process of making the sections, the specimens are destroyed, and an accurate image cannot be obtained owing to the thickness of the sections.

Computed tomography (CT) images can be formed from planar slices through objects. These can be physical sections, optical sections or CT reconstructions [17]. The development of X-ray computed transaxial microtomography, or micro-CT, has gained increasing significance in the study of hard tissues [18-22].

Patel et al indicated, 'CBCT should only be considered in situations where information from conventional imaging systems does not yield an adequate amount of information to allow appropriate management of the endodontic problem [23]. They also indicated that evidence-based selection criteria for the use of CBCT in dentistry and endodontics need to be established. Whilst Wolcott et al. indicated that CBCT may be used to evaluate root canal anatomy, there are no evidence-based criteria indicating scan parameters that are optimal for viewing small anatomical features, such as the MB₂ canal. There are also no criteria for the use of CBCT as a laboratory standard [24].

Several methods were used to investigate the anatomy of root canals, such as direct observation with the aid of Magnifying loupes, Operating microscope, filling of canals with inert materials, decalcification, clearing the tooth and computerized tomography. But all these methods showed serious limitations, as most of the relationship of the external structure of the pulp was lost during preparation of these samples and high radiation dose. Cone Beam Computerized Tomography (CBCT), a contemporary,

three- dimensional, diagnostic imaging system has been specifically designed for the use on the maxillofacial skeleton. Its application in endodontic practice in the diagnosis and management has proved its efficiency against all the other conventional methods. Literature revealed very few studies on root canal morphology of the primary teeth and none using a Cone beam Computerized Tomography. The aim of the study was to assess Cone Beam Computed Tomography (CBCT) and histological clearing technique in the detection of MB2 canal in the mesiobuccal root of maxillary primary second molar.

MATERIALS AND METHODS

Armamentarium

1. Extracted primary second molars
2. No.330 bur
3. Airtor hand piece
4. Modelling wax
5. 10% Formalin
6. Saline for Irrigation
7. 3D Cone Beam Computerized Tomography (Premium Planmeca)
8. 10% Nitric acid
9. Ethyl alcohol
10. Methyl Salicylate
11. Carbamyl Fsuchin (Dye)

Preparation of Sample

A sample size of 29 extracted primary maxillary second molars was collected. The samples were stored in 10% formalin for 7 days and later transferred to distilled water [25]. The samples were selected based on the status of root resorption, with presence of atleast one third of the remaining root structure. The specimens were well debrided and the existing fillings were removed. Access opening was done in all the samples (Fig1). The root canals were well exposed.

Cone Beam Computerized Tomography

The specimens were then mounted on an arch shaped modeling wax block after determining the various aspects of the tooth i.e, buccal, lingual, mesial and distal (Fig 2). The samples were numbered and marked with a permanent marker. The mounted samples were then subjected to Cone Beam Computerized Tomography in sections of approximately 5-6 teeth per arch. The scanned samples were then studied under Multiplanar Volume Reconstruction (MPR) and Panoramic view using the Galileos 3D viewer (Fig 3). The images produced on the axial, cross-sectional and sagittal planes were analyzed accordingly and the identification of second mesiobuccal canal was done. The identification of canal was done by both the authors of this study.

Histological Clearing technique

After the analysis under CBCT, the specimens were subjected to histological clearing technique sectioning. The samples were placed in a bath containing 10% nitric acid for 3 hours for decalcification. There was an attrition of 8 samples during the decalcification process due to the thin structure of enamel and dentin in primary tooth. The samples obtained after decalcification were 21(N). The samples were then transferred to ethyl alcohol for

dehydration (70%, 96% and 99%) for 12 h each for 2 days. Later the samples were transferred to methyl salicylate for a day for the clearing process. The specimens were mounted individually on a wax block. Radio opaque dye was injected to view the root canal morphology of the cleared teeth (Fig 4). Detection of the second mesiobuccal canal in primary maxillary teeth was recorded. Descriptive statistics were made

RESULTS

Table 1 shows the descriptive statistics of presence of MB2 canal in CBCT and Histological Clearing technique. About 44.8% of samples (n=13) were detected with MB2 canal in the CBCT, whereas only 33.3% of samples were detected in Clearing technique. There was an attrition rate of 8 samples during the process for clearing technique. 55.2 % of samples in CBCT and 66.6% in Clearing technique were not detected of MB2 Canal.

Table 1. Detection of MB2 in CBCT and Clearing technique.

Number of samples	CBCT (N=29)	Histological Clearing (N=21)
With MB2 canal	13	7
Without MB2 canal	16	14
Percentage of samples with MB2	45%	33.3%



Fig 1. Access opened in all the samples to view the canals.



Fig 2. Mounted on a horseshoe shaped modeling wax.

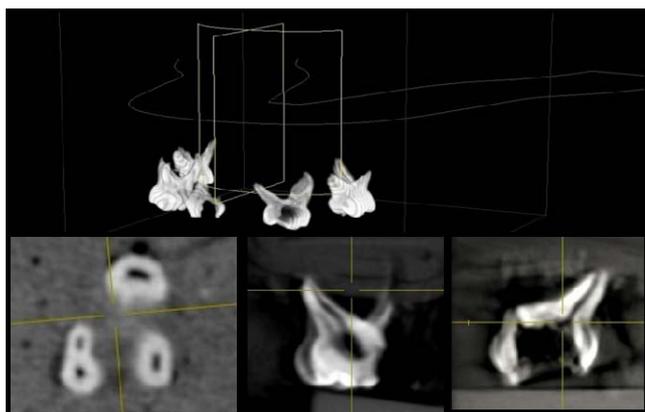


Fig 3. 3D reconstruction under CBCT. Image viewed in axial, cross-sectional and sagittal (right to left).



Fig 4. Samples subjected to decalcification (10% nitric acid).

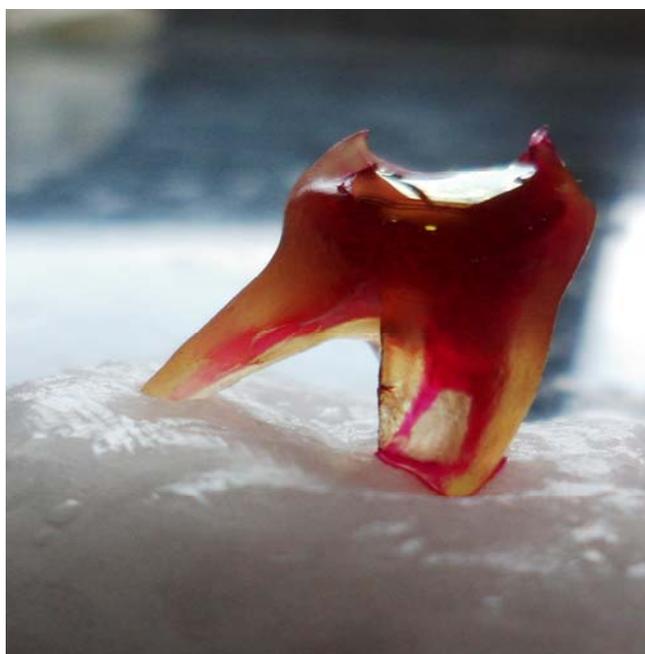


Fig 5. Dye injection in cleared teeth.

DISCUSSION:

In children, tooth loss due to dental caries caused by poor oral hygiene practices, feeding habits, diet and its associated factors have found to reduce the quality of life to a greater extent at an early age. Micro-organisms are the principle etiological factors for pulpal and periapical pathology. The therapeutic goal of the pulp therapy should

ideally eliminate the causative micro-organisms leaving a bacterial free environment for the tooth.

The lack of knowledge in the identification of these accessory canals may be potential reason for the failure of endodontic treatment when left unnoticed and untreated. Sparse evidence of these accessory canals in primary dentition could be due to the resorptive nature of the primary teeth [26].

Several methods were used to investigate the anatomy of the root canals, such as direct observation with the aid of a microscope [27]; macroscopic sections [28]; filling of canals with inert material and then decalcification [29]; filling of canals and clearing [30]. But all these methods had serious limitations, as most of the relationship of the external structure to the pulp was lost during preparation of samples [31]. A significant constraint of conventional radiography is the superimposition of overlying structures, which obscures the object of interest. Tachibana and Matsumoto studied the applicability of Computerized Tomography to endodontics. They concluded that this method allowed the observation of the morphology of the root canals, the roots and the appearance of the tooth in every direction. Moreover, the image could be analyzed, altered and reconstructed by the computer. [32]

The mesial root canals of the mandibular molars and the mesiobuccal root canals of the maxillary molars showed more frequent and greater variations than did the distal and distobuccal root canals of these molar teeth. The mesial root diverge more than the distal root in the primary mandibular molars whereas in the maxillary primary molars the palatal root showed the greatest divergence. [26] An increase in the detection of the second mesiobuccal canal (MB2) was demonstrated clinically with the help of Cone beam Computerized Tomography. CBCT has also been found to overcome the limitations to a large extent in the field of computerized imaging. There are no sample loss in the CBCT whereas the clearing technique showed a sample loss of about 27%. CBCT overcome all the possible limitations of other technique. However, the use of CBCT as a diagnostic aid must be weighed based on

- Age of the patient
- Prognosis of the treatment
- Time of exfoliation of the primary teeth

CONCLUSION

This study highlights the importance and the potential use of CBCT as an assessment tool in the identification of second mesiobuccal canal (MB2). This three dimensional imaging technique overcomes the limitations of conventional radiography and is a beneficial adjunct to the Pedodontist armamentarium. Nevertheless, the effective radiation dose of CBCT is higher than in conventional intra oral radiography and any benefit to the patient of CBCT scans should outweigh any potential risks of the procedure, in order to be justified. The Radiation should be as low as reasonably achievable (ALARA). However, the decision to prescribe CBCT in the management of endodontic problems must be based on a case- by – case basis and only when sufficient diagnostic information is not attainable from other diagnostic test.

Conflict of Interest

There are no potential conflicts of interest or any financial or personal relationships with other people or organizations that could inappropriately bias conduct and findings of this study.

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