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Original Article

# Total Number of Root Canals Commonly Found During Endodontic Treatment of Primary Molars in North Indian Population - An *In Vivo* Study

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## Abstract

**Introduction:** Preserving primary teeth in the dental arch is a beneficial concept, thus it is advisable to employ endodontic therapy instead of extraction procedure wherever possible. To achieve and deliver successful endodontic therapy, the operator is required to have a comprehensive understanding of the anatomy of the tooth along with different variations that exist within the primary teeth. Even though CBCT remains the gold standard method for studies involving root canal morphologies, its limitations such as higher dose of radiation as well as procedural time and high cost makes its regular use in children difficult.

**Purpose:** The purpose of this study was to evaluate the total count of root canals found in primary maxillary and mandibular molars in the pediatric population of Delhi-NCR region (India) using routine radiographs during pulpectomy procedure, highlighting that conventional IOPA radiographs can be accurately utilized to determine the total number of root canals, as routine usage of CBCT in pediatric dental operatory is still in question. Majority of the studies that were carried out to determine root canal morphologies of primary teeth were performed on extracted teeth, but as the present study was done in-vivo, it got added to rationale behind using conventional radiographic technique for this study.

**Method:** 173 primary maxillary and mandibular molars were included and examined for the study. Data was collected and recorded from the operators who were performing pulpectomy in the department. The root canal orifices were clinically located according to the dentinal map and their number were determined following the clinical steps of access cavity preparation and de-roofing of the pulp chamber. The number of root canals were verified by placing number 15 or 20 endodontic files within the canals followed by taking routine IOPA radiographs.

**Results:** Out of 173 primary molars requiring pulpectomy, both 1st and 2nd primary maxillary molars were found to have 3 canals (mesiobuccal, distobuccal and palatal). 11% of 54 primary mandibular 1st molars had a single distal canal and 2 mesial canals, rest 89% had 2 canals in both mesial and distal roots. 100% of the primary mandibular 2nd molars had four root canals, two mesial and two distal.

**Conclusion:** IOPA radiography is still an effective and safe method that can be used in routine dental practice for endodontic procedures especially in pediatric patients.

**Key words:** Number of root canals, Primary molars, Intraoral periapical, Routine radiography, Root canal configuration

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## INTRODUCTION

Deep carious lesion being the leading cause for pulpal involvement in a tooth entails treatment for preservation of the tooth's integrity. Due to a narrower strip of mineralized tissue dividing the outer and inner tooth surfaces, increased bacterial penetration into the pulp can be observed in primary teeth when compared to permanent teeth.[1] Primary

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teeth have a leading part in carrying out functions such as mastication, speech, and maintenance of adequate room for eruption of permanent dentition and consequently, and their pre-mature loss can adversely affect these roles.[2]

As preserving primary teeth in the dental arch is a beneficial concept, there is a routine demand for employment of endodontic therapy instead of extraction procedure.[3,4] Root canal therapy in primary teeth comprises pulp tissue removal, debriding and preparing, irrigating, and obturating the canals three dimensionally.[3] Through each of these stages, it is imperative that every step gets executed carefully for attaining overall success.[2] To achieve this, the operator is required to have a comprehensive understanding of the anatomy of the tooth along with different variations that exist within the primary teeth.[5]

The morphologic variations of root canals in primary teeth often produce complications in endodontic therapy.[6] When compared to permanent teeth, root canals of primary teeth present evident anatomical disparities in respect of size, shape, and internal and external morphology.[7] The presence of atypical internal geometry of the pulp cavity showing furcal and horizontal anastomosis makes endodontic therapy of primary teeth considerably challenging.[1] Mostly, a simpler root canal network is exhibited by primary teeth that have fully formed roots, featuring single canal per root. Though this system of simple canals may turn complex gradually in response to factors like secondary dentin formation that can change the number & size of the canals, and other factors like constriction of the canals as well as the beginning of physiologic root resorption.[3,8]

The literature accommodates various researches that have analyzed primary root canals including their morphologies in varied population groups utilizing different histologic and radiographic methods such as root sectioning, staining and clearing techniques, IOPA radiographs, cone beam computed tomography (CBCT), micro-computed tomography (micro-CT), and spiral computed tomography (SCT).[2,3,6,9,10]

Since their introduction, the non-invasive technologically advanced imaging methods such as CBCT and micro-CT have been extensively used for in-depth study of root canal networks.[3] Even though CBCT remains the gold-standard method for newer studies involving root canal morphologies, its limitations such as the cost of the device as well as the procedural cost, requirement of a trained staff, and specifically higher dose of radiation as well as procedural time make its regular use in children difficult.[5,11]

Although conventional radiographs provide only a 2D image which may lead to superimposition of the root canals, giving an inaccurate data, they are still used as the main diagnostic aid in routine practice for finding the size of carious lesion and analyzing canal morphology.[10] This is because they are more economical, readily available and provide much less exposure when compared to CBCT or spiral CT, therefore reducing the risk of radiation-induced carcinogenesis in children.[11,12]

Previous studies have observed an association of differences in root canal anatomies to racial and genetic factors.[5] Therefore, the aim of this *in vivo* study was to evaluate the total count of root canals found in primary maxillary and mandibular molars in the pediatric population of Delhi-National Capital Region (NCR) (India) using routine radiographs during pulpectomy procedure. Such a study can shed light on the commonly encountered root canals in primary molar teeth, which may increase the ease of providing superior quality treatment in the routine dental practice.

## MATERIALS AND METHODS

All the children aged 3–9 years reporting to the outpatient department of Pediatric and Preventive dentistry at the FDS-Manav Rachna Dental College, MRIIRS, Faridabad, between January 2021 and January 2022 were analyzed according to the eligibility criteria for this study.

### Inclusion Criteria

1. Children with good general health
2. Children requiring pulpectomy in primary maxillary or mandibular molars
3. Cooperative patients according to Frankl's behavior rating scale (scores 3 and 4).
4. Teeth with at least two-third roots remaining.

### Exclusion Criteria

1. Teeth exhibiting ">Grade 1" mobility
2. Teeth with non-restorable coronal structure
3. Patients with special health-care needs.

173 primary maxillary and mandibular molars were included and examined for the study. Data were collected and recorded from the operators who were performing pulpectomy in the department.

The root canal orifices were clinically located according to the dentinal map and their number was determined following the clinical steps of access cavity preparation and de-roofing of the pulp chamber.

The number of root canals were verified by placing number 15 or 20 endodontic K files within the canals followed by taking IOPA radiographs and wherever required at different angulations using Sidexis XG (Sirona Dental Systems)

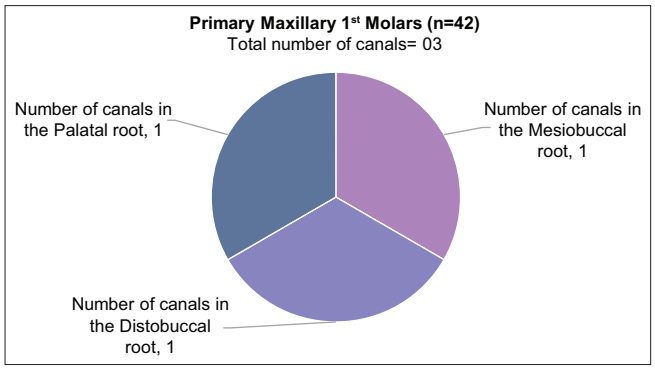


**Figure 1: Number of maxillary 1st molars and frequency of the number of root canals found in them**

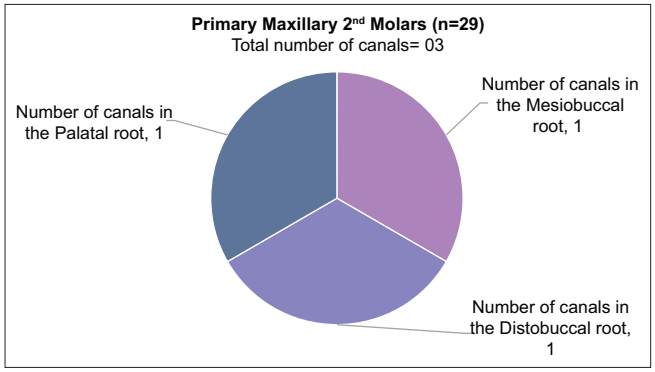


**Figure 2: Number of maxillary 2st molars and frequency of the number of root canals found in them**

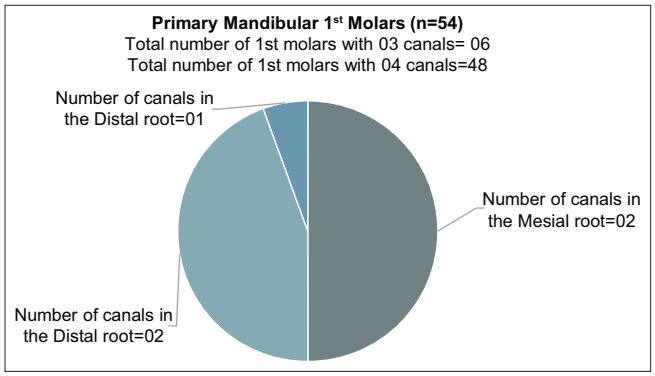


**Figure 3: Number of mandibular 1st molars and frequency of the number of root canals found in them**

software. The IOPAs were zoomed to obtain a magnified image for performing proper assessment of the root canals.

## RESULTS AND DISCUSSION

A total of 173 primary molars were included in this study, out of which 71 molars were primary maxillary molars and 102 were mandibular molars.

Among the maxillary primary molars, 42 (59%) were 1st molars, all of which had 3 root canals. 29 (41%) were 2nd molars with 100% of them having a total of 3 root canals [Figures 1 and 2].

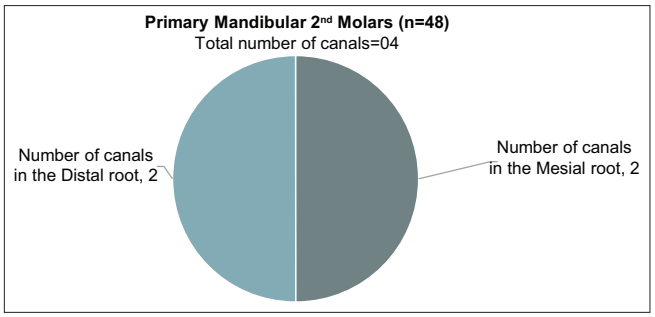


**Figure 4: Number of mandibular 2nd molars and frequency of the number of root canals found in them**

Out of 102 mandibular primary molars, 54 (53%) were 1st molars. 6 out of 54 mandibular 1st molars had only 1 canal in the distal root and 2 canals in the mesial root, rest 48 mandibular 1st molars had 2 canals each in mesial and distal roots [Figure 3].

48 (47%) out of 102 were mandibular 2nd molars, all of which had a total of 4 canals, 2 canals each in mesial and distal roots [Figure 4].

In pediatric patients, losing teeth due to caries brought about by substandard maintenance of oral hygiene, feeding, and dietary habits can affect a child's well-being profoundly since an early age.[9]

The chief objective of pulp treatment is to eradicate the etiological bacteria and create an uncontaminated environment within the tooth.[9] A root canal therapy's success depends on clinician's thorough grasp of the internal and external root canal morphology of the tooth. Treatment failures can mostly result from erroneous diagnosis of total number of root canals leading to improper debridement.[11] Complete knowledge of variations in root canal numbers and anatomy of primary molars can effectively reduce challenges faced by pediatric dentists while performing pulp therapies and increase effectiveness of the treatment.[1]

Various approaches have been employed to examine the root canal anatomy, including direct microscopic observation, macroscopic sectioning, packing inert material into the canal and then decalcifying it, filling of canals followed by clearing. Nonetheless, all these techniques result in loss of relation between the external structure and the pulp due to sample preparation procedures which is a significant limitation.[9]

In the present study, conventional IOPA radiographs have been utilized to determine the total number of root canals,

as routine usage of CBCT in pediatric dental operatory is still in question and its availability is still not widespread due to the cost.[13] CBCT contributes in more radiation exposure than the conventional techniques (effective radiation dose of CBCT and IOPA is 20–599 μSv and 5–35 μSv, respectively), which is a major issue in children, as due to their higher rate of tissue growth; they have a greater risk of receiving DNA damage.[13,14] It has been observed that a CBCT scan can have a 4 times higher average cancer risk for children younger than 12 for patients over 60 years.[15] In addition, majority of the studies that were carried out to determine root canal morphologies were performed on extracted teeth, but as the present study was done *in vivo*, it got added to rationale behind using conventional radiographic technique for this study.

The main restriction while employing conventional radiography for determining the root canal anatomy is overlapping of structures that result in concealment of the object of interest.[9] Attempt was made to overcome this limitation by taking radiographs from different angulations.

Several studies have reported that the root canal anatomy can differ in various races and ethnicities.[16] Such as studies performed in China by Wang *et al.* and Yang *et al.* have shown a higher prevalence of three-rooted primary mandibular second molar with varying root canal numbers in the population. The three-rooted variant has even been frequently observed through studies done by Ozcan *et al.*, in Turkey and Bagherian *et al.*, in Iran, but studies such as done by Katge and Wakpanjar have rarely reported such a variation in Indian population.[11] Thus, this study involved observing the total number of frequently encountered root canals in the pediatric population of Delhi-NCR region (India).

In the present study, both 1st and 2nd primary maxillary molars were found to have 3 canals (mesiobuccal, distobuccal, and palatal). Similar observations were mentioned in a short review done by Ramakrishnan *et al.*,[4] on the root canal configuration of primary maxillary molars where they found that 3 canals are the most common canal morphology in both the 1st and 2nd maxillary molars. Vijayakumar *et al.*[10] in their study found that 13 out of 15 primary maxillary 1st molars and 13 out of 15 primary maxillary 2nd molars had 3 canals. Study done by Katge and Wakpanjar[5] also reported that almost 90% of the maxillary 1st and 2nd primary molars had a total of 3 canals. Krishnamurthy *et al.*[1] reported that 80% of the primary maxillary second molars had a total of 3 canals, even with varying root anatomy.

In this study, 6 (11%) out of 54 primary mandibular 1st molars had a single distal canal and 2 mesial canals, rest 48 (89%) had 2 canals in both mesial and distal roots. In the study done by Gupta and Grewal,[6] on "root canal configuration of primary mandibular first molars", 100% of the teeth had 2 canals in mesial root, with 53.33% showing 2 canals in the distal root and 46.67% having only 1 root canal in the distal root. The result of the present study was not in agreement with Katge and Wakpanjar,[5] as they reported the presence of 2 root canals in the mesial root in 80% of the samples and 2 root canals in the distal root in 23% of the samples, therefore showing predominance of 1 root canal in the distal root.

Through the present study, it was seen that 100% of the primary mandibular 2nd molars had four root canals, two mesial and two distal. Similar results were found in the study performed by Aminabadi *et al.*,[7] which stated that 100% of the mesial roots and 100% of the distal roots had two canals in primary mandibular 2nd molars. Demiriz *et al.*[2] in their study mentioned that according to the previous studies done for evaluating the anatomy of primary mandibular 2nd molars, the most frequently reported root canal forms in primary mandibular 2nd molars were 2 canals in the mesial root and 2 canals in the distal root. Katge and Wakpanjar[5] in their study reported that mesial root had 2 canals in 100% sample teeth and 56.6% sample teeth had 2 canals in the distal root.

The dissimilarities in the number of root canals may be affected by differences in the ethnic groups making up the sample in various studies and also on the diagnostic aids used in those studies.[11]

## CONCLUSION

Utilizing the results of the present study while keeping in mind, the limitations of the sample size, diagnostic aid used, and biases due to involvement of multiple operators, it can be concluded that majority of the primary maxillary molars had a total of 3 root canals and primary mandibular molars had a total of 4 root canals.

It can also be concluded that IOPA radiography is still an effective and safe method that can be used in routine dental practice for endodontic procedures, especially in pediatric patients, which goes in accordance with the AAPD guidelines which state that "intraoral imaging should be maintained as the standard diagnostic tool".[12]

## AKNOWLEDGMENTS

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## ETHICS STATEMENT

Approved.

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