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Assessment of root canal morphology of mandibular first molar in Indian population

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ABSTRACT

Background: *The morphology of the root canal systems of mandibular molars may vary according to ethnic differences and origin, age, gender, and study design. The present study was conducted to assess root canal morphology of mandibular first molar in Indian population.*

Materials & Methods: *The present invitro study was conducted on 120 extracted mandibular first molars (MFMs). Root canal curvature was assessed according to Schneider's method. The samples were evaluated using a stereomicroscope under 10X magnification. The number of root canals, the type of canals based on Vertucci's classification and the isthmii at the distances of 2, 4 and 6 mm from the apex, were recorded for each tooth.*

Results: *Mesial root had 2 canals in 100% samples and distal roots had 1 in 65% and 2 in 35%. The most common canal morphology was type IV in 50%, type II seen in 41%, type III in 6.5% and type V in 2.5% in mesial root and type I in 62%, type II in 24%, type IV in 9%, type III in 3% and type V in 2% in distal canal. The mean length of mesial root was 15.4 mm, distal root was 15.1 mm and disto-lingual root was 8.2 mm. In mesial root, isthmii 2 mm from apex was seen in 22%, at 4 mm in 45% and at 6 mm in 33%. At distal root, 34% at 2 mm, 36% at 4 mm and 30% at 6 mm.*

Conclusion: *Authors found that most common mandibular first molar morphology in mesial root was type IV in mesial and type I in distal root.*

Keywords: *Isthmii, Mandibular first molar, Morphology*

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I. Introduction

Successful outcome of endodontic treatment largely depends on proper cleaning and shaping of the entire root canal system. The morphology of the root canal systems of mandibular molars may vary according to ethnic differences and origin, age, gender, and study design.[1] The quality of root canal fillings is associated with ideal biomechanical instrumentation and followed by homogeneity obturation of the root canal structure. On the other hand, the type of roots and the morphology characteristics of mandibular molar teeth present clinical complications that often jeopardize the endodontic therapy.[2]

Thorough understanding of the root canal morphology and configuration is mandatory. Mandibular first molars are amongst the most commonly teeth requiring endodontic treatment due to their early emergence in the oral cavity and subsequent caries. Mandibular first molars commonly have two roots and three root canals. However, due to genetic, ethnic and gender varieties, a wide range of anatomic and morphological variations can be encountered.[3]

Commonly used methods to evaluate root canal morphology include root canal staining and tooth clearing, plastic injection, conventional and digital radiography and radiopaque gel infusion and radiography.[4] Therefore, clinicians must be able to identify the root canal structure before or during a root canal treatment. It is known that the presence of additional canals or deviations of the main root canals can cause endodontic flare-ups and failures. Successful treatment of endodontic complications is associated with diagnostic imaging techniques that provide information about the teeth and their surrounding structures.[5] The present study was conducted to assess root canal morphology of mandibular first molar in Indian population.

II. Materials & Methods

The present invitro study was conducted in the department of Endodontics. It comprised of 120 extracted mandibular first molars (MFMs). The study protocol was approved from institutional ethical committee.

The teeth disinfected in 5.25% NaOCl for 1 hour. The teeth were stored in sterile normal saline. The number of the roots and root lengths were recorded. In each teeth access cavity preparation was done and canal orifices were located with 10 K-file. Two parallel digital radiographs were taken in bucco-lingual and mesio-distal directions with a #15 K-file placed to the working length and root canal curvature was assessed according to Schneider's method. The root canals were irrigated with 5.25% NaOCl solution and distilled water. Following this, Indian ink was completely distributed in entire root canal and the teeth were stored in a vertical position. The teeth were dehydrated by immersing subsequently in 80, 90 and 100% ethanol for 1 day. The samples were inserted in 50% methyl salicylate for 5 hours. The samples were evaluated using a stereomicroscope under 10X magnification. The number of root canals, the type of canals based on Vertucci's classification and the isthmii at the distances of 2, 4 and 6 mm from the apex, were recorded for each tooth. Results were tabulated and subjected to statistical analysis. P value less than 0.05 was considered significant.

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III. Results

Table I Distribution of the root canal number

Roots	1	2	3
Mesial	0	100%	0
Distal	65%	35%	0

Table I shows that mesial root had 2 canals in 100% samples and distal roots had 1 in 65% and 2 in 35%.

Table II Root canal configuration (Vertucci's classification)

Type	Mesial	Distal	P value
Type I	0	62%	0.001
Type II	41%	24%	0.02
Type III	6.5%	3%	0.05
Type IV	50%	9%	0.001
Type V	2.5%	2%	0.91
Type VI	0	0	0
Type VII	0	0	0
Type VIII	0	0	0

Table II, graph I shows that most common canal morphology was type IV in 50%, type II seen in 41%, type III in 6.5% and type V in 2.5% in mesial root and type I in 62%, type II in 24%, type IV in 9%, type III in 3% and type V in 2% in distal canal. The difference was significant ($P < 0.05$).

Graph I Root canal configuration

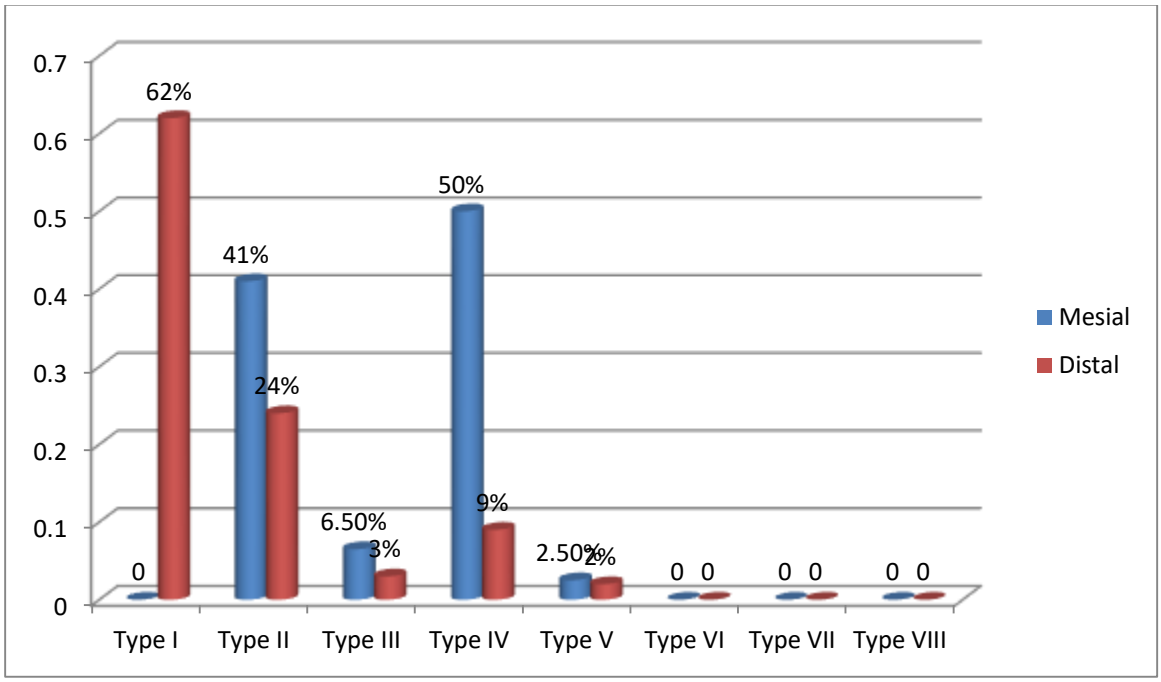
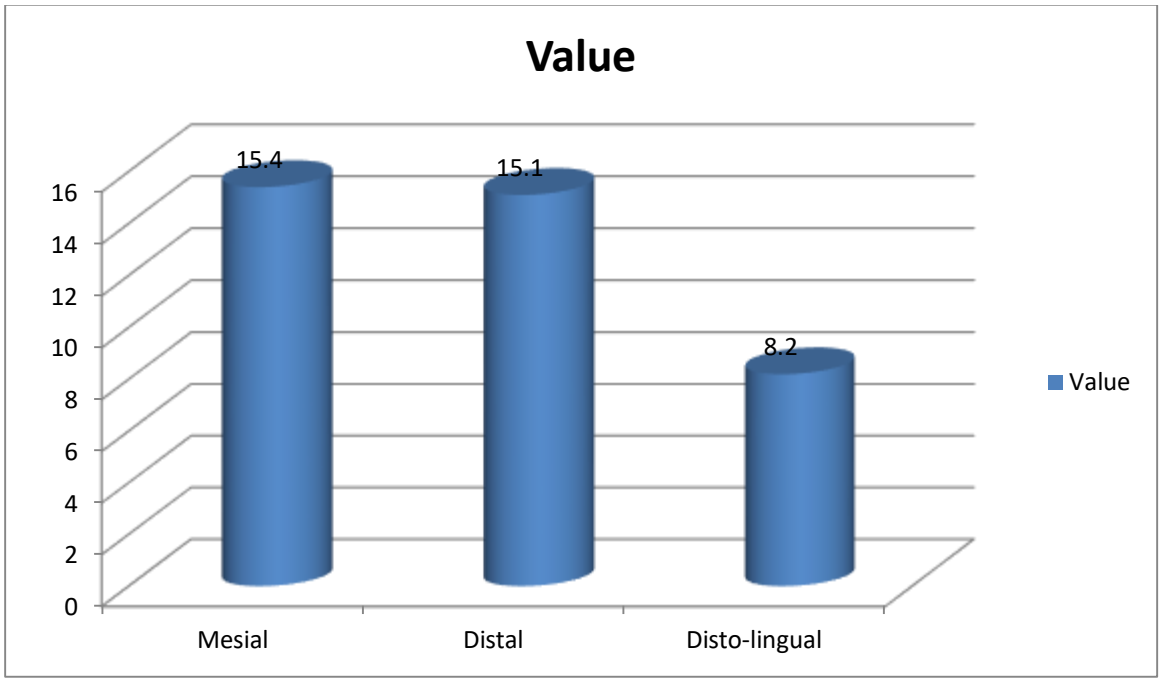


Table III Degree of canal curvature in mandibular first molars (Schneider's method)

Canal	Canal curvature (Degree)	
	Bucco-lingual	**Mesio-distal**
Mesio-buccal	13.7	11.6
Mesio-lingual	9.2	7.51
Disto-buccal	5.0	5.2
Disto-lingual	7.5	2.6
Distal	22.6	18.2

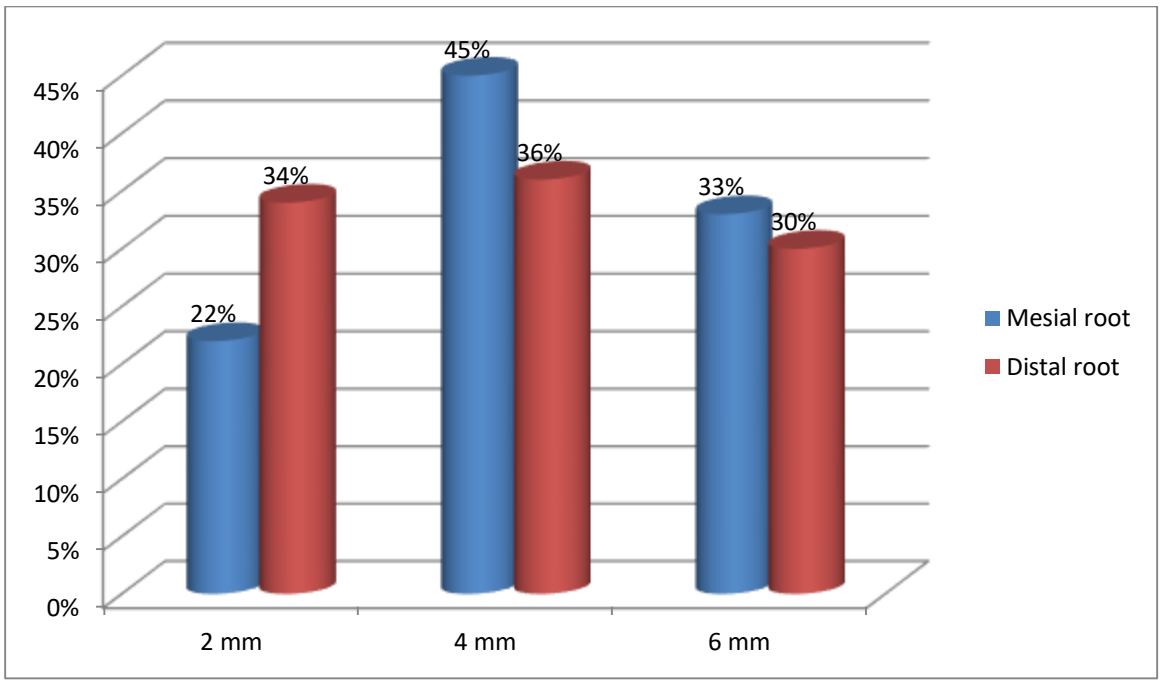
Table III shows mean of degree of canal curvature in mandibular first molars.

Graph II Root length in mandibular first molars



Graph II shows that mean length of mesial root was 15.4 mm, distal root was 15.1 mm and disto-lingual root was 8.2 mm.

Graph III Location of isthmii



Graph III shows that in mesial root, isthmii 2 mm from apex was seen in 22%, at 4 mm in 45% and at 6 mm in 33%. At distal root, 34% at 2 mm, 36% at 4 mm and 30% at 6 mm.

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IV. Discussion

It is essential to have a thorough knowledge of root canal morphology and configuration for successful endodontic treatment. The failure to determine additional canals and incomplete instrumentation are the most likely causes of endodontic flare-ups and failures. Many studies have examined root and canal morphology using various methods such as canal staining and clearing technique, cross-sectioning technique, contrast medium-enhanced radiography, modified canal staining and clearing, radiographic examination, and computed tomography scanning. However, canal staining and clearing technique and cross-sectioning technique are invasive and result in irreversible damage to samples.[6] The present study was conducted to assess root canal morphology of mandibular first molar in Indian population.

In this study, we used 120 mandibular first molars. We found that mesial root had 2 canals in 100% samples and distal roots had 1 in 65% and 2 in 35%. Akhlagi et al[7] included a total of 150 extracted mandibular first molars. Two and three roots were present in 96.7% and 33% of the teeth, respectively. All the teeth (100%) had two canals in the mesial root, while 61.3% of the samples had one distal root canal. The root canal configuration in the mesial canal included type IV (55.3%) and type II (41.3%). In doubled-canalled distal roots, 68.8% and 24.3% were type II and type IV, respectively. Isthmii were observed in 44.6% of mesial and 27.3% of distal roots.

We found that most common canal morphology was type IV in 50%, type II seen in 41%, type III in 6.5% and type V in 2.5% in mesial root and type I in 62%, type II in 24%, type IV in 9%, type III in 3% and type V in 2% in distal canal. The mean length of mesial root was 15.4 mm, distal root was 15.1 mm and disto-lingual root was 8.2 mm.

Nur et al[8] determined the root and canal morphology of the mandibular first and second permanent molars in a Turkish population using cone-beam computed tomography (CBCT). CBCT images of mandibular first (n = 966) and second molar (n = 1165) teeth from 850 Turkish patients were evaluated. The root canal configurations were classified according to the method of Vertucci. The majority of mandibular molars were two rooted with three canals; however, three roots were identified in 0.05% of the first molars and 0.01% of the second molars, and 100% of the additional root canals were of type I configuration. Mesial roots had more complex canal systems with more than one canal, whereas most distal roots had a type I configuration.

We found that in mesial root, isthmii 2 mm from apex was seen in 22%, at 4 mm in 45% and at 6 mm in 33%. At distal root, 34% at 2 mm, 36% at 4 mm and 30% at 6 mm. Schäfer et al[9] stated that the overall incidence of three-rooted mandibular first molars in a selected German population was rare (1.35%). Moreover, all three-rooted molars occurred unilaterally (0.80% in left and 0.57% in right side). Qudah and Awawdeh[10] conducted a similar study on Jordanian population and reported the majority of mandibular first molars to have three (48%) or four (46%) canals, whilst 4% had a third distolingual root. The most common configuration in the mesial root was type IV (53%) and in distal root was type I (54%). Zhang et al[11] reported the majority of mandibular first molars (70%) had two separate roots and three roots were identified in 29% of first molars. Three canals were found in 56% of teeth and most distal roots had a simple type I configuration.

Chourasia et al[12] determined the number of roots, root canals, root canal configurations and frequency of isthmii and apical deltas in mandibular first molars in an Indian population, using clearing technique in vitro. They reported two mesial and distal roots and a separate DL root in 94.6 and 5.3% of the mandibular first molars. Moreover, 36% of the two-rooted molars had separate DL canals.

In present study, the limitation is small sample size. The variation in results from other studies may be due to ethnic variability.

V. Conclusion

Authors found that most common mandibular first molar morphology in mesial root was type IV in mesial and type I in distal root.

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