

Evaluation of Root and Canal Morphology of Mandibular First Molars: A Clearing Method in an Iranian Population

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Abstract

Background: Successful endodontic treatment is dependent on the knowledge of root canal anatomy.

Objectives: This study aims to investigate the root canal anatomy of mandibular first molars in an Iranian population.

Materials and Methods: One hundred human mandibular first molars were collected and stored in 5.25% NaOCl. Radiographic images of the teeth were taken in mesial, distal, and buccal aspects using digital radiography. The root numbers were recorded, and the teeth were covered with lacquer. Access cavities were prepared, pulp tissue was dissolved, the apex was covered with liquid glue, and the root canals were injected with methylene blue. Decalcification of the teeth meant they were kept in 10% nitric acid, and final dehydration meant they were kept in 100% Isopropyl alcohol for 72 hours and rendered clear by immersion in methyl salicylate. The number of root canals per tooth, the number of canals per root, and canal configuration in each tooth were recorded.

Results: Ninety-nine of the 100 teeth had two roots and the other had three roots. The teeth were classified based on the number of canals; there were 2% with two canals, 59% with three canals, and 39% with four canals. Based on the Vertucci classification, the most prevalent canal configurations in the mesial root were types II and IV, and type I in the distal root.

Conclusions: The most common root morphology is the two rooted morphology with three canals. Both the mesial and distal roots show wide variations in canal anatomy with type IV and type I canal configuration predominating in the mesial and distal roots, respectively. Iranian mandibular first molar teeth exhibit features close to the average Caucasian, Jordanian, and Kuwaiti's root and canal morphology.

Keywords: Mandibular First Molar, Clarification, Root Canal Morphology

1. Background

The success of root canal therapy depends on the knowledge of the root canal morphology and the proper cleanliness, shape, and obturation of the root canal in a three-dimensional space (1). Knowledge of the number of roots, canals in each root, their position and situation, roots' form of longitudinal and transverse intersection, the most prevalent curvatures, and roots' external limits are important in all aspects (1). Ingle reported that the most important factor in root treatment failure is the lack of knowledge of the root canal anatomy, which leads to the insufficient cleaning and filling of canals (2).

The first mandibular molar is a double root tooth with mesial and distal roots. This form has an incidence rate of 85.2% differences between Asian and non-Asian populations. Non-Asian populations have a 96.9% incidence rate of two roots while the Asian populations have an incidence

rate of 79.5%. Therefore, three roots may occur in one-fifth of patients from Asian populations (2).

Pattanshetti et al. examined root and canal morphology of the mesiobuccal and distal roots of 110 permanent first mandibular molars in a population from Kuwait. Results showed that 96% of teeth had two roots and 4% had three roots. Overall, 51% of distal roots had one canal and 49% had two canals (3). Schafer et al. identified that the incidence of mandibular first molars with three roots was 1.35% (4). Reuben et al. determined root canal morphology of 125 mandibular first molars from an Indian population; the results of this study predominately showed (84.48%) that the teeth had three canals (5). Al-Qudah et al. determined different results for the root and canal morphology of mandibular permanent first and second molar teeth in a Jordanian population. The most common canal configuration in the mesial root of both (53%) was identified as type

IV, and in distal roots it was type I (6).

2. Objectives

The aim of this study was to investigate the root canal anatomy of mandibular first molars in an Iranian population using Vertucci classification and to compare these findings with the published reports of different populations.

3. Materials and Methods

One hundred extracted human adult mandibular first molar teeth were collected from an Iranian population (Isfahan) and stored in 5.25% NaOCl. The inclusion criteria was mandibular first molar teeth with intact roots. Calculus and stains were removed using an ultrasonic scaler. They were imaged using a digital radiography (PSP, Genoray Co., Korea) set from buccal, mesial, and distal angles and were encoded. The system was set in 70KV and 0.08 mAs. Access cavities were prepared using No. 2 round bur (Tizkavan, Tehran, Iran), and the pulp tissue was dissolved by 2.5% sodium hypochlorite (Tage, Iran). The teeth were then rinsed under running tap water for two hours and dried overnight. After they were dried, except for the apex region, other parts of the teeth were covered with two layers of lacquer (Lilium, Iran), and the apex was covered with liquid glue (Razi, Iran). A syringe with a gauge 27 needle was used to inject the methylene blue 2% (Merck, Germany) into the root canal spaces for staining coronally. The teeth were air dried and decalcified in 5% nitric acid (Merck, Germany) for 4 to 5 days. The acid solution was changed daily, and the end of decalcification was determined by periodic radiographs. The teeth were washed under running water to remove traces of nitric acid, dried, and dehydrated using increasing concentrations of ethanol (70%, 95%, 100%) (Merck, Germany) for 24 hours. Finally, the teeth were rendered transparent by immersing them in methyl salicylate (Merck, Germany). The clear teeth were examined under a stereomicroscope using 7.5× magnification (MJC IO-Russian-Moscow). The canal configurations were categorized into the first seven types of Vertucci's classification (1984) as follows:

- Type I, a single canal present from the pulp chamber to the apex;

- Type II, two separate canals leave the pulp chamber and join at the apex to form one canal;

- Type III, one canal leaves the pulp chamber, divides into two within the root, and then merges to exit in one canal;

- Type IV, two separate and distinct canals are present from the pulp chamber to the apex;

- Type V, a single canal leaves the pulp chamber but divides into two separate canals with two separate apical foramina;

- Type VI, two separate canals leave the pulp chamber but join at the midpoint and divide again into two separate canals with two separate apical foramina; and

- Type VII, one canal leaves the pulp chamber, divides, and rejoins within the canal, and finally redivides into two distinct canals short of the apex.

4. Results

Of the teeth studied, 99% had two roots, and 1% had three roots; 2% had two canals, 59% had three canals, and 39% had four canals. Canal categorization was done according to Vertucci's classification. All the teeth with two canals had two roots and one canal in each root (100%), which is type I. Out of 59 teeth with three canals, 100% had two roots. In the mesial root, 41% was type II and 59% was type IV. In three-canal teeth, the distal roots were type I (100%). Thirty-seven of the 38 teeth with four canals (97%) had two roots, and the one remaining tooth (3%) had three roots. In two rooted teeth that were evaluated, 73% were type IV and 27% were type II in the mesial root.

Distal roots were evaluated as 21 (57%) for type II, 15 (41%) for type IV, and one (2%) for type V. The three-rooted tooth had two canal-type IV (100%) in the mesial canal. In addition, all of them were type I in distal roots (100%).

5. Discussion

One of the predominant causes of root canal treatment failure in mandibular first molars is the variations in root canal anatomy (2). This study examined the root canal morphology of mandibular first molar teeth in an Iranian population. Although many studies on root canal anatomy have been carried out, decalcification and clearing techniques have provided the most detailed information while being simple and inexpensive.

Ninety nine percent of teeth had two roots, which is similar to the findings of Pattanshetti, Schafer, Reuben, and Colak (3-5, 7), but it was different to Zhang, Gu, Karale, and Chandra (8-11). In the present study, 1% of teeth had three roots, but in Zhang's study the percentage was 29. In Huang's study the number was 27%. Tu reported 33.33% in a Taiwanese population, Karale recorded 7.67%, and Chandra et al. reported 13.3%. Pattanshetti reported 4% in a population in Kuwait, and in Schafer's study the percentage was 1.35 (3, 4, 8, 10-13).

The most prevalent canal patterns in this study were types IV, II, and I. In the mesial root, type IV had an incidence rate of 59%, and type II had an incidence rate of

34.69%. Gu's investigation revealed a lower rate. In both studies, however, the distal root predominately revealed type I (9). Wang showed that canal variation of the first mandibular by CBCT 93.9% type IV in the mesial root and 62.9% type I in the distal (14). In the literature review by de Pablo, the incidence of type I in distal roots was evaluated to be 62.7% (62.24% in the present study), type II was 14.5% (21.42% in the present study), and type IV was 12.4% (15.30% in the present study) (15). The results of the recent study are comparable with the present study.

Al-Qudah et al. (2009) examined anatomic variation of first mandibular molars and showed that the most common canal configuration in mesial roots was type IV (53%) and in distal roots was type I (54%) (6). Although these findings emphasize the present results of type IV being the most prevalent canal configuration in mesial roots and type I in distal roots, the incidence rate of this canal variation is lower than our study.

Chen visually illustrated the evaluation of first mandibular molars, and results revealed that the most prevalent canal configurations of mesial roots were type IV (46%) and type II (23%). Type I was observed in 54% of the distal roots (16). The incidence rate of the existence of two canals with type IV in mesial roots is higher in the present study, although the rate of type II canal configuration is lower. In this study, distal roots predominantly continued a type I, one canal with higher incidence than Chen's investigation. Like Chen's investigation, this study's results emphasize that the most prevalent canal configurations in mesial roots are types IV and II. For distal roots it is type I (categorization in the present study and the other studies is according to Vertucci). This study was done in laboratory conditions to obtain these findings. It is recommended to evaluate this study with a larger number of teeth to achieve more accurate findings.

5.1. Conclusion

There was a high prevalence rate of two-rooted mandibular first molars in the Iranian population. The most common root morphology in Iranian first molars is the two rooted morphology with three canals. Both the mesial and distal roots showed wide variations in canal anatomy with type IV and type I canal configurations predominating the mesial and distal roots, respectively. Iranian mandibular first molar teeth exhibit features close to the average Caucasian, Jordanian, and Kuwaiti root and canal morphology.

The limitations of this study were the difficulties in finding the mandibular first molar with relatively intact crowns and intact roots. Although this study was supposed to take CBCT for evaluation of an anatomical variety of sam-

ples, a lack of facilities and high costs did not allow us to do this.

Footnotes

Authors' Contribution: Study concept and design: Maryam Zare Jahromi and Mohammadreza Saei; Analysis and interpretation of data: Razieh Moghaddam.

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