

Evaluation of internal morphology in third molars using four different methods

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ABSTRACT

This research assessed the amount and configuration of root canals in maxillary and mandibular third molars by means of four methods (radiographic, macroscopic, microscopic, and serial sections). A total of 100 third molars were selected, and the following exclusion criteria were applied: teeth with crowns completely destroyed by caries; incomplete root formation; root resorption or fractures. Healthy teeth or teeth with minor restorations were included. Samples were divided into two groups (GS and GI) consisted of maxillary third molars (n=50) and mandibular third molars (n=50), respectively. Subsequently, teeth were assessed by radiographic,

macroscopic, microscopic and serial section methods. There was a higher prevalence of three root canals (68.7% in GS and 65.3% in GI). The most predominant root canal configuration was circular (64.9% in GS and 51.3% in G I), followed by flattened (27.6% in GS and 38% in GI), and oval (7.4% in GS and 7% in GI). According to the outcomes and methods of this study, it is concluded that third molars have a wide variation in internal anatomy, which is key to know and master whenever endodontic treatment is recommended.

Keywords: Molar. Dental pulp cavity. Anatomy. Endodontics.

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Introduction

Endodontic canal treatment aims at reducing microbiota and removing pulp tissue present in root canals. Mechanical preparation allows root canal shaping which, in turn, provides maximum sealing with the filling material, and subsequent, adequate restoration of the tooth, thus enabling maintenance of its functions.¹ To this end, knowing and mastering the internal anatomy of root canals is rendered necessary during treatment.

The complexity of internal dental anatomy has been studied by a number of methods, such as clearing techniques, radiographs, and recent micro-computed tomography (CT).¹⁻⁴ The literature describes, by means of epidemiological studies carried out in different populations, alterations in the internal anatomy of teeth potentially connected to genetic factors.⁵⁻¹¹

Additionally, over the years, there is deposition of secondary dentine to the fullest extent of pulp chamber and root canals, thus changing and hindering the field of internal anatomy.¹²

Third molars are a challenge to endodontic treatment due to being subject of a limited number of studies, unlike first and second molars, both maxillary and mandibular, which have been constantly mentioned and widely studied.

Sidow et al¹³ carried out a study with 150 maxillary third molars and 150 mandibular third molars through decalcification and application of dyes. According to the authors, 17% of mandibular third molars had one root, with two root canals in 40% of them. A total of 77% of teeth were found with two roots, 2.2% of which had C-shaped canals. As for maxillary third molars, the authors found 15% of teeth with one root, 32% with two roots, 45% with three roots, and 7% with four roots. One-root cases showed greater variation in the number of root canals, ranging from one to six.¹³

Thus, this study aimed at assessing the internal anatomy of third molars root canals systems. To this end, four different methods were used, so as to specifically assess the amount and shaping of root canals.

Material and Methods

This is an exploratory, descriptive, quantitative, cross study. All steps were performed in laboratory.

Extracted teeth (in vitro) were used. A total of 100 third molars were selected and divided into two groups (GS and GI): maxillary third molars (n = 50) and mandibular third molars (n = 50), respectively. Inclusion criteria required healthy teeth, with minor carious lesions or minor restorations. Exclusion criteria were as follows: uncrowned teeth regardless of the reason that caused such loss; endodontically treated teeth; and those with internal or external resorption, perforations or fracture. The research project was submitted to the Ethics Committee of Universidade de Fortaleza (Coética / UNIFOR) and approved under protocol #181.388/12.

After selection, all teeth were submitted to the criteria of the following methods: radiographic, macroscopic, microscopic, and serial sections, with the latter being divided into two: tooth crown section at the tooth cervix, and root middle third section).

Radiographic assessment

Each tooth was individually secured to an intra-oral radiograph periapical film (Kodak Insight, USA) with the aid of utility wax at a 20-degree angle horizontally, so as to simulate Clark's method and determine the relative position of the tooth during radiography. The latter corresponds to a distortion in the horizontal angle of X-ray beam incidence, with a view to minimizing overlap of root canal imaging and, thus, improving assessment. Exposure time was 0.22 seconds.

Film processing was carried out in a darkroom with a two-minute immersion period in developing solution. After rinsing in water for 20 seconds, films were immersed in fixative solution for five minutes. Finally, radiographic films were cleaned in running water for five minutes, followed by drying and subsequent assessment. Teeth of which film was not correctly exposed to x-rays, or of which radiographic image did not provide correct distortion, were exposed again, so as to correct the error and supply an appropriate image.

Macroscopic assessment

The entire process of pulp chamber access was carried out by the same operator, a dental surgeon previously trained in a pilot study applying the same methods used in the present research.

Initially, pulp chamber access in healthy teeth was carried out with the aid of a 1013 round diamond bur (KG Sorensen Barueri, Brazil) coupled to a high-speed handpiece (Kavo 605C Model). The diamond tip was replaced every 20 teeth to ensure proper drill cutting capacity. Initial drilling was carried out in the middle of the central sulcus, with drilling parallel the longitudinal axis of the tooth, thus shaping according to the internal anatomy of the pulp chamber. In carious teeth, shaping was determined in accordance with caries extent, which was removed with a round bur at low speed (Sorensen Barueri, Brazil) compatible with the cavity size and assembled to a low-speed engine (Kavo model 161 and model 2068). The bur was exchanged every 30 teeth.

Subsequently, pulp chamber roof was removed and surrounding walls became more divergent occlusally with the aid of an Endo-Z bur at high-speed (Dentsply Maillefer, Switzerland) in order to facilitate viewing, lightness and direct access to the pulp chamber.

Once access was completed, a straight exploratory probe was used on pulp chamber floor, so as to find all root canal openings. To improve visualization of all root canals found, a sequence of files was used to enlarge the entrance of the root canal opening, starting with a manual file #10 (Dentsply Maillefer, Ballaigues, Switzerland), followed by a Kerr file #15 (Dentsply Maillefer, Ballaigues, Switzerland), and #20 and #25 Flexofiles (Dentsply Maillefer, Ballaigues, Switzerland). Files were exchanged in each group of teeth. Sodium hypochlorite solution (2.5% Biodynamics, Ibioporã, Brazil) was used throughout root canal exploration phase, with five milliliters of solution to each file exchange.

Microscopic evaluation

Visual magnification was performed with an optical microscope (DF Vasconcellos M900) which enhances viewing of the pulp chamber floor. All teeth were viewed under 16x magnification, so that root canals could be viewed, accessed and operated with the aforementioned sequence of files.

Serial sections assessment

Tooth cervix

In order to better identify rather narrow root canals, the tooth crown was separated from the root.

Crown sectioning was carried out at the cementoenamel junction with a 2200 diamond bur (KG Sorensen, Barueri, Brazil) assembled to a high-speed handpiece (Kavo Model 605C) and exchanged every 50 teeth.

Visualization and access with the aid of a straight exploratory probe were performed under 16x magnification in an optical microscope, thus allowing identification of root canals possibly unidentified by the clinical approach. Root canals found at this stage underwent access carried out with the aforementioned sequence of files.

Middle third of roots

For the sectioning of middle third of roots, a carborundum disc mounted on a straight-piece mandril (Kavo model 10 ABN), coupled to a micromotor (Kavo model 161) was used. Discs were exchanged every ten sectioned teeth. The middle third of roots was determined by measurements taken with the aid of a millimeter ruler. Access and viewing of root canals were carried out with Kerr file #15 (Dentsply Maillefer, Ballaigues, Switzerland) under 16x magnification.

Results

The three-root-canal configuration was the most prevalent in both groups, followed by the two-root-canal, four and subsequently five-root-canal configuration. Teeth with five root canals were found in the last assessment stages in which visual magnification was key (Tables 1 and 2).

It is important to highlight that, in the present study, radiographic assessment did not allow analysis of root canal shape. Therefore, root canal anatomy was determined only on the basis of macroscopic and other assessment methods.

In this study, circular root canals were predominant in both groups (maxillary and mandibular), followed by flattened mesiodistally, long buccolingually, and oval anatomies. C-Shaped canals were found in the group of mandibular third molars, probably due to the larger amount of teeth with tapered and fused roots (Table 3).

Discussion

While frequently referred to extraction, third molars can be treated endodontically whenever this therapy is recommended for teeth in function, when

Table 1. Percentage and frequency (amount of root canals), in addition to complete assessment of maxillary third molar root canals according to each evaluation method.

	Evaluation				
	Radiographic	Macroscopic	Microscopic	Tooth cervix	Middle third
One root canal	3.97%	2.29%	2.02%	3.59%	3.73%
Two root canals	26.98%	22.90%	10.82%	10.08%	14.92%
Three root canals	59.53%	68.7%	64.87%	69.07%	69.40%
Four root canals	9.52%	6.11%	18.92%	17.26%	11.95%
Five root canals	0%	0%	3.37%	0%	0%
Total (100%)	126 root canals	131 root canals	148 root canals	139 root canals	134 root canals

Table 2. Relative and total frequency of the amount of in mandibular third molars root canals (Group 2) according to each evaluation method.

	Evaluation				
	Radiographic	Macroscopic	Microscopic	Tooth cervix	Middle third
Narrow	1.70%	0%	0%	0%	0%
One root canal	2.57%	0.68%	0.63%	0.62%	1.41%
Two root canals	44.44%	12.25%	8.81%	7.45%	18.30 %
Three root canals	41.03%	65.30%	47.16%	46.59%	57.04%
Four root canals	10.26%	21.77%	40.25%	42.24%	19.72%
Five root canals	0%	0%	3.15%	3.10%	3.53%
Total (100%)	117 root canals	147 root canals	159 root canals	161 root canals	142 root canals

Table 3. Results of root canal configuration found by means of macroscopic, microscopic, and serial sections (tooth cervix and root middle third) assessment methods.

	Maxillary third molars	Mandibular third molars
Macroscopic	78.64% circular 6.10% oval 15.26% flattened	44% circular 13% oval 43% flattened 16% C-Shaped
Microscopic	70.94% circular 8.78% oval 20.28% flattened	43.3% circular 13.3% oval 43.4% flattened 16% C-Shaped
Tooth cervix	64.70% circular 8.08% oval 27.22% flattened	42.9% circular 13.6% oval 43.5% flattened 16% C-Shaped
Middle third	64.92% circular 7.46% oval 27.62% flattened	42.9% circular 13.6% oval 43.5% flattened 16% C-Shaped

there is a potential for restorative or orthodontic treatment, or cases in which patient has a systemic contraindication hindering surgery. In spite of difficulties arising during treatment, such as the positioning of teeth in the dental arch, the clinician must use means which enable successful treatment. Thus, knowing the anatomy third molars root canal systems is rendered critical.

The methods applied in this study allowed us to conclude the presence of three root canals was the most prevalent in both the maxillary third molar group (69.40% with a total of 93 canals) and the mandibular third molar group (57.04% with a total of 81 canals). Nevertheless, some teeth presented with five root canals, as evinced by analysis carried out by means of the third method, in both groups (3.37%; and 3.53% for maxillary and mandibular third molars, respectively). During the present study, each method contributed to identify narrow root canals.

Although scarce, the literature presents cases of third molars with a mesial root canal having an independent root.¹⁵ Tomar et al¹⁶ reported the case of a mandibular third molar with four root canals and four roots, in which tomography was used to assist in the management of the case. The authors emphasized the importance of knowing the anatomy of root canal systems, with the use of scans to assist in the diagnosis, in addition to mastering tooth crown characteristics.

Guerisoli et al¹⁷ assessed the internal and external anatomy of 279 third molars by the clearing technique. Significant variation was found with the presence of up to five roots in maxillary third molars and three in mandibular third molars. The amount of root canals followed the same pattern.

Interpreting auxiliary radiographic scans is fundamental to acquire knowledge of tooth anatomy, however, even in the present in vitro study radiographic assessment was poorer than the other methods of assessment. This highlights the use of this examination during clinical treatment serves as an auxiliary and is not decisive to determine the anatomy of teeth.

Our study aimed to assess the anatomy of root canals, and found a predominance of circular canals in both groups. However, root canals of oval and flattened shape were also found. This result is of clinical importance, since more circular root canals provide better mechanical action of files with lower risk of fracture. Root canals of flattened and oval shape have some root canal walls that can remain untouched by instruments, with only the pecking motion or in-and-out motion kinematics.

As a result, pulp tissue debris and microbial out-breaks remain in the root canal and can cause treatment failure. Thus, in those canals, it is important to apply brush motion against canal walls, combined with irrigating solutions that assist in full or maximum cleaning of those areas.¹⁹⁻²⁴

Sert et al²⁵ conducted a comparative study on the anatomy of maxillary and mandibular third molars, and previously determined anatomies of maxillary and mandibular first and second molars. The authors found that 34.13% of third molars had three roots, whereas 77.7% had three root canals. As for mandibular third molars, 69.1% had two roots, with 58.9% having two root canals.

The results of our study were similar to those of the aforementioned authors, particularly in relation to data on maxillary third molars; however, our research found the three-root-canal configuration was higher among mandibular third molars.

Conclusion

According to the outcomes and methods (radiographic, macroscopic, and serial sections) of this study, it is concluded that third molars have a wide variation in internal anatomy: 69.4% of maxillary third molars presented with three root canals, 64.92% of which had a circular shape. Among mandibular third molars, 57.04% had three root canals, 51.3% of which were of circular shape. However, other anatomical traces and different amounts of root canals can be found in both maxillary and mandibular third molars.

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