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Mandibular First Molar with Six Canals: Case Report of Radix Entomolaris and Middle Mesial Canal

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ABSTRACT

The purpose of this article is to report a successful endodontic treatment of a mandibular first molar with six canals; three root canals in the mesial root, two root canals in the distal root, and one radix entomolaris. The incidence of two anatomical variations presented in this report, middle mesial canal and radix entomolaris, is generally low. Knowledge of the internal anatomy of the root canals and their possible variations, and use of magnification, such as the operating microscope or loupes, can increase the chances of finding additional canals, contributing to the success of endodontic treatment.

Keywords: Anatomic Variation; Middle Mesial Canal; Radix Entomolaris; Root Canal

Introduction

The objectives of endodontic treatment are the prevention and treatment of apical periodontitis. Maximum amount of organic, live, or decomposed substrate and microorganisms must be eliminated to achieve the root canal system disinfection [1-4].

The internal anatomy of the root canal systems has been pointed out as one of the main limiting factors of endodontic treatment, which could hinder cleaning procedures. The biggest challenges for clinicians and specialists are the number of roots, number of canals, curvatures, obstructions, and calcifications.

Mandibular first molars usually have two roots [5, 6]: a mesial root with two canals [7-9] and a distal one containing one root canal mostly [5, 7-9]. However, these teeth can present several anatomical variations [10].

Recent studies with cone-beam computed tomography (CBCT) [7-9, 11] and microtomography [12-15] demonstrate the internal anatomy of mandibular molars with precision, often with extra canals, which are difficult to locate, and have small diameter.

The mesial root of mandibular molars usually has two canals, one mesiobuccal and one mesiolingual. For these canals, the most observed variations are Type II and Type IV based on Vertucci´s classification [16]. This root may also have a canal located between the mesiobuccal and mesiolingual canals, called the middle mesial canal. The presence of this anatomical variation was first reported by Vertucci and Williams [3]. Its prevalence varies according to different authors between 0.26% and 53.8% [3, 12, 17]. In a systematic review, the incidence of this canal was reported as 2.6% [18]. In another study in a multiracial population, the reported incidence was 46.2% [19].

Most middle mesial canals converge to the buccal or lingual canal (Type I of Vertucci classification), with greater possibility to the buccal canal [3]. Sometimes the middle mesial canal is accessed, but it soon communicates with one of the other canals, distant from the apical region.

The distal root of mandibular molars can have two canals, and the frequency of this variation may be between 18% [8] and 51% [5].

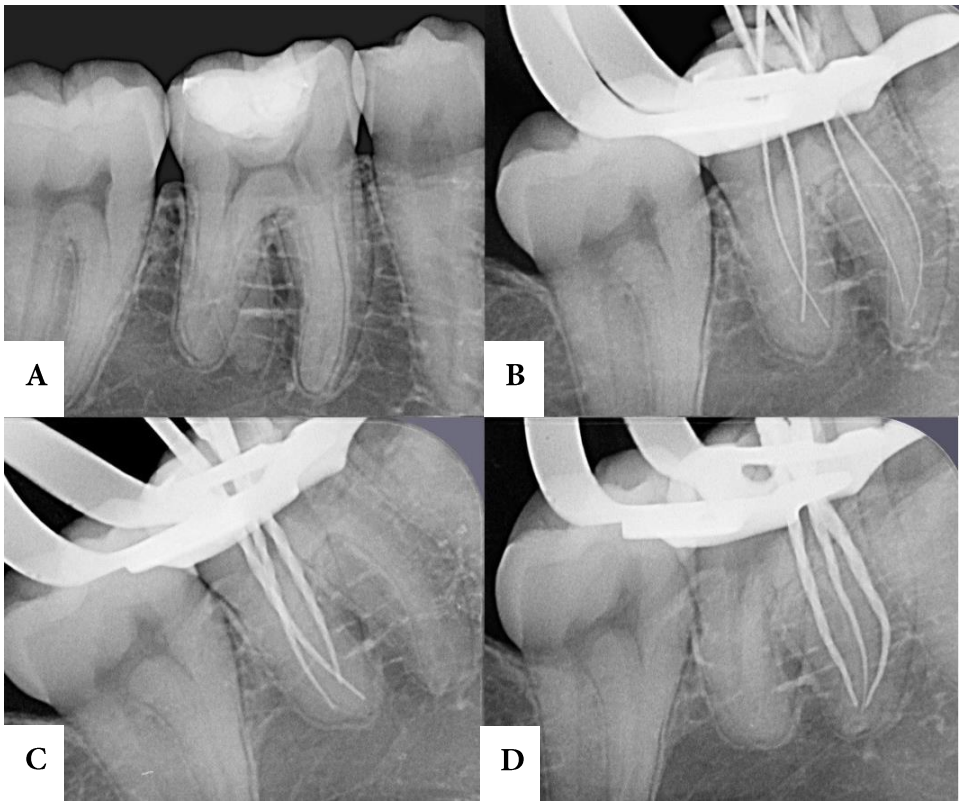

Figure 1. *A*) Initial radiograph showing the radix entomolaris in the distal root; *B*) Instruments determining the working length and showing the anatomy of the mesial canals, the distobuccal canal and the radix; *C*) Instruments F3 and F2 at the distal root; *D*) Instruments F3 and F2 in the mesial root

Extra roots can occur in the lower first molars in both roots (if it occurs in the mesial root, it is called radix paramolaris, and if in the distal root, radix entomolaris). The prevalence of radix entomolaris in an Iranian population was reported as 3.10% [20], and in Brazil it was reported as 4.3% in women and 1.2% in men [9]. The presence of the third root is directly related to the ethnicity of the population studied, being an anatomical variation common in Mongolians, Eskimos, Chinese and native Americans [18].

It is important that the clinician has knowledge of the internal anatomy of this group of teeth [17], so that additional canals can be detected, and the endodontic treatment properly performed [21].

The purpose of this article is to report a successful endodontic treatment of a right mandibular first molar with six canals, three in the mesial root (mesiobuccal, mesiolingual, middle mesial), two in the distal root (distobuccal and distolingual), and one radix entomolaris canal.

Case Report

A 25-year-old female patient was indicated for endodontic treatment of the right mandibular first molar. There was no spontaneous pain, but the tooth was highly sensitive to cold and heat and vertical percussion. No radiographic sign of apical periodontitis was observed. Her medical history was non-contributory. Clinically, an extensive resin restoration with infiltration of caries was observed. The pulpal diagnosis was symptomatic irreversible pulpitis and the periapical diagnosis was acute apical periodontitis. In the initial radiographic image, it was observed two distal roots, one of which is characteristic of a radix entomolaris (Figure 1A). The treatment process was explained to the patient and an informed consent was obtained from her.

Anesthesia with 2% lidocaine plus 1:100,000 epinephrine involved blockade of the lower alveolar nerve, and after signs of total numbness in the region of the lower hemi right lip, supplementation was performed with sub-periosteal infiltration in the tooth apex in vestibular region. In each region, 1.8 mL of 4% articaine with 1:100,000 epinephrine vasoconstrictor (Nova DFL, Rio de Janeiro, Brazil) was used as local anesthetic.

Rubber dam isolation was performed, the area was disinfected with 10% povidone solution, and access cavity was made with a 1016 high-speed spherical diamond-tipped drill (KG Sorensen, Cotia, São Paulo, Brazil), complemented with 3207 diamond-tipped cone drill (KG Sorensen, Cotia, São Paulo, Brazil). Four canal entrances were identified with a DG16 explorer (Hu-Friedy, Chicago, USA), two for the mesial root and two for the distal root. Exploration of the canals and glidepath preparation were

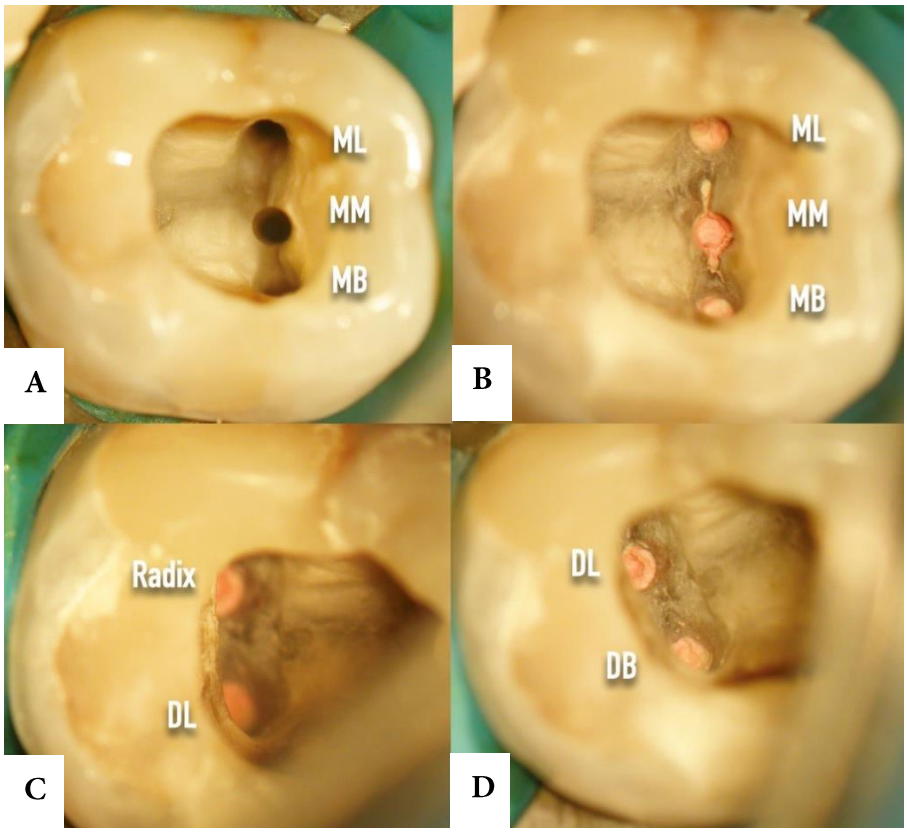

Figure 2. *A)* The mesial canals entrance orifices after instrumentation; *B)* The mesial canals entrance orifices after root canal filing; *C)* The distolingual and the radix entomolaris entrance orifices after root canal filling; *D)* The distobuccal and the distolingual entrance orifices after root canal filling

performed with C-Pilot #10 and #15 files (VDW, Munchen, Germany). Canals were irrigated with a 2.5% sodium hypochlorite (NaOCl) solution in a provisory measure, 3 mm below the apex detected in the initial radiographic image. NiTi CM Pro-T SX #20/.04 rotary instruments (MKLife, Porto Alegre, Brazil) with a speed of 350 rpm and torque of 2 N/cm were used in an electric motor (Silver Reciproc VDW, Munchen, Germany) to perform root access. The definitive working length was determined with the help of an electronic foraminal locator (Root ZX II, J Morita, Osaka, Japan) and established at 1.0 mm below the point where the electronic foraminal locator pointed to the zero marking. Periapical radiography was performed with the instruments positioned in the measurements established to observe curvatures and anatomy (Figure 1B).

Canal instrumentation was performed with NiTi CM Pro-T S1, S2, F1, F2 and F3 instruments (#30/.09) (MKLife, Porto Alegre, Brazil) for the four canals (mesiobuccal, mesiolingual, distobuccal and radix entomolaris canal). After using each instrument, the canals were irrigated with 3 mL of 2.5% NaOCl solution using an Endo-Eze needle (Ultradent, South Jordan, Utah, USA). Intra-canal medication with Ultracal calcium hydroxide paste (Ultradent, South Jordan, Utah, USA) was performed, and then a layer of IsoTape teflon tape (TDV, Pomerode, Santa Catarina, Brazil) was applied to the pulp chamber and coronal seal was established with Ionoseal glass ionomer cement (Indian Land, South Carolina, USA).

The patient presented 10 days later, and her symptoms had already disappeared. In the second session, anesthesia similar to the first session was administered, and the treatment procedures included: rubber dam isolation, removal of the temporary restoration and irrigation with 2.5% NaOCl solution to remove the intracanal medication. A recapitulation was performed with a C-Pilot #15 stainless steel manual file (VDW, Munchen, Germany). With the aid of a DG16 probe and a 12× magnification operating microscope (DF Vasconcelos, Valença, Rio de Janeiro, Brazil), another canal (distolingual) was identified at the distal root between the distobuccal and radix entomolaris canals. With files #10 and #15 (VDW, Munchen, Germany) and gentle turn right and left movements, exploration was performed, and the working measurement was determined with the electronic foraminal locator. Radiography was performed to observe curvatures and anatomy. Instrumentation was performed starting with Pro-T SX instruments (MKlife, Porto Alegre, Brazil) for root access, followed by S1 to F2 (#25/.08), all in the same length. In the mesial root, the middle mesial canal was identified, where the same

Figure 3. Different angulations to show the six filled canals

instrumental procedures were adopted (Figures 1C and 1D). At the end of the instrumentation, 17% ethylenediaminetetraacetic acid (EDTA) was used and remained in contact with the canal walls for 5 min, which were then irrigated with 3 mL of 2.5% NaOCL solution in each canal.

All six canals were filled with gutta-percha cones and AH-Plus sealer (Dentsply DeTrey, Konstanz, Germany) using a single cone technique complemented with hydraulic compression (Figure 2). The access cavity was sealed with glass ionomer cement (High Strength Posterior Restorative; GC America, Alsip, IL, USA) making a filling core above the entrance of the canals, and the patient was referred for the final restoration (Figure 3).

Discussion

Correct cleaning and complete instrumentation of root canals are the factors that influence the success of endodontic therapy, and for the clinician to perform it properly, it is necessary that all root canals are located. Therefore, knowledge of the internal anatomy of root canals is essential.

The study of anatomical variations, and clinical persistence, combined with professional experience contribute significantly to the location and treatment of extra canals. At the end of the instrumentation of traditional canals, it is recommended to check that there are no other possible canals outside the normal standards. In these situations, magnification becomes indispensable, either with loupes or with a microscope, to increase the location index of these canals [22, 23]. According to a previous study, 7% of the canal entrance orifices in the mesial root of mandibular first molars and 3% in mandibular second molars could not be detected even with the use of an operating microscope, in comparison with 100% identification of the distal root canals of both molars [24].

In the present report, the magnification used in the microscope was 12× [25], which helped in visualizing the middle mesial canal, and the second distal root canal. Using magnification and transoperative radiographs in different horizontal angles with instruments in the root canals can contribute to identification of anatomy and visualization of curvatures [22, 26].

The prevalence of four canals in mandibular first molars (two mesial and two distal) has been reported in the literature: 17.7% in a Malaysian population [8]. In another study with a Brazilian population, the prevalence was 51% [5].

Incidence of third canals in the mesial roots of mandibular first molars has been reported in the literature with variations between 1% and 15% [27]. When under the light of the operating microscope, this percentage can increase to 20% [4]. The same authors reported that the presence of this canal decreased with the age of the researched subjects. Additionally, in 60% of the teeth that had the third canal in the mesial root, second canals were found in the distal root. This occurrence is the most frequent variation in mandibular first molars, and was found in the present case. The radiographic images show that the three mesial canals of this case converged in the same apical foramen. This phenomenon has been reported previously in one out of 118 teeth in an anatomical study with microtomograph images [15], and also in two other case reports [22, 27]. This confluence is the most frequent variation related to the presence of the middle mesial canal [3].

The trajectory of the middle mesial canal can present different morphological patterns. The canal can be independent (Vertuccci type I), with independent entrance and foramen, or join the other canal at the apical level (Vertuccci type II). This confluence is more common for the mesiobuccal canal [1]. This canal is not always located in the median region, between the mesiobuccal and mesiolingual canals as in the present case, and may often be very close to the entrance of one of the other canals. Due to this proximity, many clinicians, even specialists in endodontics cannot identify them.

Radix entomolaris is an additional root and can occur in mandibular first molars, usually in the distolingual position [6, 10, 28], as was in the present case. An initial diagnosis, with a correct radiographic interpretation, can help in identifying this anatomical variation [26, 29]. It is usually thinner than other roots, with apical canal diameter of 0.25 mm [28]. The entrance to its canal is usually covered by dentin [6, 28], therefore, features, such as magnification associated with ultrasound can make the treatment more efficient and predictable.

CBCT is an examination technique that can identify anatomical variations with great precision, and is used in several studies that evaluate the morphology of the root canal system [7, 30-32] as well as for the diagnosis of patients in need of endodontic treatment. The benefits of CBCT are undeniable,

however, it is not yet a recommended examination in all cases of endodontics, and the absence of these images did not influence the final result of the case presented. Moreover, it was possible to visualize the presence of the radix entomolaris with the diagnostic periapical radiography and additional canals in the mesial and distal roots were located during endodontic treatment.

In the present case, in the first session it was possible to identify and shape four canals, two from the mesial root (mesiobuccal and mesiolingual) and two from the distal root (distobuccal and radix entomolaris canal). Multiple canals may not be fully identified in a single session because of difficulty in visualization, treatment time, exhaustion of the professional and the patient, and bleeding from the pulp tissue. Physical fatigue has a direct influence on the progress of endodontic treatment, and as treatment time increases, the chances of success in the identification and treatment of extra canals decrease. A second session can increase the chances of success in identifying anatomical variations.

Extra canals can be more easily located after preparing the main canals [1]. With a modified DG16 probe (Hu-friedy, Chicago, IL, USA), the region between the mesiobuccal and mesiolingual canals should be explored, in order to see if the tip of the probe holds somewhere, which can be indicative of a depression and, consequently, the entrance of another canal. Thereafter, fine hand instruments, #06, #08 and #10, should be introduced to explore the canals [1]. Ultrasonic inserts can be used to overcome the typical calcifications at the entrance of the canals [26]. Compensatory application of these instruments and of modified hand instruments can be useful.

Observing points of bleeding at the end of the instrumentation may be a suggestion of the location of non-instrumented canals in vital pulp teeth, which becomes indicative of extra canals. Additionally, at the end of instrumentation of traditional canals, when confluence for a single canal at the level of the apical third is expected, use of a paper cone can help to identify pulp remains as there would be an indication of bleeding, mainly on the side of the paper cone, which could suggest the presence of another canal. Bleeding implies that the canal that is being treated, has not been cleaned of all pulp tissue, or there is an unidentified canal.

The radix entomolaris canals can present marked curvatures, mainly in the buccolingual direction, which can cause difficulties in instrumentation by increasing the chances of instrument fracture as the radius of curvature decreases [29].

Another factor that may contribute to the difficulty in locating and treating mandibular molars is the diameter of the middle mesial canal, which is smaller than other canals. This factor is related to the age of the tooth, which may differ from the patient's age, and depends on the injuries the tooth sustains (cavities, previous restorations, and occlusal trauma) resulting in the constant deposition of secondary and reactive dentin that creates a narrowing of the canal entrance with dentin deposition [1, 2, 22]. In the present case, the extra canals, in the mesial and distal roots, did not have very small diameters, and it was possible to instrument them at the working length up to the Pro-T F2 instrument (#25/.08) without compromising the anatomy.

Conclusion

The incidence of the two anatomical variations middle mesial canal and radix entomolaris presented in this report is low. Knowing internal anatomy of the root canals and their possible variations, and using magnification tools, such as the operating microscope or loupes, can increase the chances of finding additional canals, contributing to the success of endodontic treatment. Whenever possible, CBCT should be used when in doubt about the anatomy of the canal.

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