Anatomical variations of mandibular first molar and their implications in endodontic treatment

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Abstract
The possible variations of anatomical and morphological characteristics of the teeth are very important especially for the endodontic practitioner. Before beginning any kind of endodontic treatment, the clinician must be always take into account the morphological variations in pulp anatomy. Among all human teeth, the mandibular first permanent molar is one of the most important. It is often affected by caries and usually needs root canal treatment, even at an early age. For the success of its endocanalicular treatment, dentists need to locate all root canals, debride them entirely, and after that fill the whole endocanalicular system with an inert root filling material. Unfiled canals, left like this because they were not detected, can compromise the longevity of the tooth, thus being a source of infection and a main cause of failure of the prosthetic treatment. This article presents two clinical cases of right mandibular first molars with two roots and four canals instead of three.

Keywords: dental anatomy variation, mandibular first molar, endodontics, crown, root canal morphology.

Introduction
Teeth do not always have the same internal anatomy. The anatomical variations in number of roots, number of root canals, or even the shape of root canals are often encountered. Many clinicians used to treat every tooth like being a standard one. In these cases many failures occurred.

In time, other practitioners studied the anatomy of root canal systems and their anatomical variations and they found out that there are many different types of teeth. The respective studies provide information that, if taken into account, might improve the outcome of endodontic treatment.

Patients, Methods and Results
Case No. 1
The patient N.D., 23-year-old, male, came to the office complaining of pain located in the hemimandibular right arch (tooth 4.6), both spontaneous and triggered by many factors, especially cold. After clinical and radiological examination, we found that the molar crown presented a deep cavity, partially filled with light-curing composite, the endodontic treatment not being present. Also, there were no other major treatments in the region, which could cause the symptoms. In this situation, we decided to devitalize this molar and to make a coronary restoration with a porcelain-fused-to-metal crown. The regular X-ray examination (Figure 1) does not show initially any anomaly of radicular configuration of this first mandibular molar.

According to the radiological examination, we were expecting that this molar would have the usual anatomy with two roots and three root canals: two situated in the mesial root and one in the distal root.

Figure 1 – Initial X-ray.

We started the treatment with administration of local anesthesia using 2% lidocaine hydrochloride with 1:200 000 adrenaline. Tooth was isolated using cotton rolls and suction and after that, we have created access to the pulp chamber of the molar through the occlusal surface with a spherical bur. We are removed the pulp chamber roof using a cylindrical bur, the coronary pulp being removed with a hand instrument. After cleaning the resulted cavity, using cotton balls and 3% hydrogen peroxide, we discovered four orifices: two mesial and two distal (Figure 2). Working length was 21 mm on mesio-buccal canal, 20 mm on mesio-lingual canal, 19 mm on disto-buccal canal and 16 mm on disto-lingual canal. The step back instrumentation technique was used to prepare the canals, and the final K file we have used was size 35. In this case, the mechanical treatment of the entire four root canals was successfully performed and we rinsed the endodontic space with...
plenty of antiseptic substances, using for irrigation 3% of sodium hypochlorite. We dried with sterile paper points and the final endocanicular restoration was made with a material containing calcium hydroxide and gutta-percha cones. The final X-ray examination confirmed the quality of the filling (Figures 3 and 4). Finally, the molar was restored with an esthetic crown (Figure 5).

Working length was 19 mm on mesio-buccal canal, 18 mm on mesio-lingual canal, 18.5 mm on disto-buccal canal and 17 mm on disto-lingual canal. Root canal instrumentation was performed also by step back technique, and we have used 5.25% of sodium hypochlorite solution for root canal irrigations, at every change of the instruments. The canals were dried with sterile paper points, and the final root was filled with a material containing calcium hydroxide and gutta-percha cones, using the technique of cold lateral condensation. After endodontic treatment, the tooth was filed down in order to achieve a prosthetic restoration. Due to esthetic requirements of young patients, it was decided to restore these teeth with a total esthetic prosthetic restoration- a porcelain-fused-to-metal crown (Figure 8).

In both clinical cases presented above, we see that right mandibular first molar has two roots, but four root canals instead of three. Raising this additional root canal was not possible after initial radiological examination. Its presence has been observed during clinical procedures, after removing the pulp chamber roof and gain access to the endodontic system. After finding the orifices of the mesial canals, which was rather easy, when we tried to break into the distal canal, we observed that it was not present into the distal root axis, as we expected, but has an eccentric position. This aspect has made us suspected the existence of two root canals in the distal root, which was revealed later. So, we could succeed in penetrating both distal canals and in observing their direction. Thus, endodontic treatment could be achieved in all four root canals, avoiding possible complications that could occur through lack filling of entire endodontic system. That is why, for the long-term success of these mandibular molars, it is very important to know the different morphological variances of the radicular canals. This will ensure a proper course of action in the endodontic treatment.
Discussion

The radicular morphology of the first mandibular molar is usually described by two roots and three canals: two canals in the mesial root and one large oval canal distally. Since 1925, when Hess W and Zurcher E published a study of permanent teeth anatomy, we know that teeth have complicated root canal systems which are not so basic as previously thought [1]. The number and distribution of root canals is very important. A mandibular first molar usually presents three root canals, two of them being located in the mesial root and one root canal in the distal root. According to Skidmore AE and Bjorndal AM [2], one third of these molars have four canals. Vertucci F and Williams R (1974) [3], Fabra-Campos H (1985) [4], Martinez-Berná A and Badanelli P (1985) [5] have been reported molars with three root canals in the mesial root. The other root, the distal one, usually presents one large canal that lies from pulp chamber to the apex. Some clinicians also reported a great variance in the number of canals in the distal root. They found that a percent up to 47.6% of the distal roots have two canals [4, 6]. Reichart PA and Metah D (1981) [7] and Stroner WF et al. (1984) [8] reported the presence of three canals in the distal root. Four canals in this root were found by Martinez-Berná A and Badanelli P in 1985 [5]. The second distal root canal is an anatomic anomaly, despite being most frequently encountered. Goel NK et al. [9] studied extracted mandibular first molar teeth using X-rays and found that 13.3% of these teeth present three mesial canals, 3.3% of cases present four mesial canals and only 1.7% of specimens had three distal canals.

Pomeranz HH et al. [10] also reported the presence of three independent canals in the mesial root. Beatty RG and Krell K [11] arrive at the same conclusion describing a mandibular first molar with three independent canals in the mesial root. Other studies found that the incidence of second canals in distal roots of mandibular permanent first molar was higher than earlier studies [12–15]. Pattanshetti N et al. conducted some studies of first mandibular molars in the Asian populations, and which have shown that the incidence of a second canal in the distal roots of these teeth was higher, and it was comparable to the other populations [16].

There are differences in root canal anatomy due to racial divergence [6, 15, 17, 18] and to prove that, a great number of clinicians studied the problem and reported their results. Since 1925, when Hess [19] studied the anatomy of the root canals of the teeth of the permanent dentition we can say we know that the mandibular permanent first molar has three root canal in only 78% of cases. Vertucci F and Williams R, Al-Nazhan S, Pineda F and Kuttler Y showed that a two-rooted mandibular first permanent molar has in the mesial root two root canals with one apical foramen [3, 15, 20] in 40–45% of cases. In an in vitro study, Skidmore AE and Bjorndal AM [2] concluded that the prevalence of two root canals in the distal root of a mandibular first molar was about 30%. Wasti F et al. [17] showed that a percent of 47% of mandibular first permanent molars have four root canals, distributed in the two well-known roots. Ahmed HA et al. [21] studied the first mandibular permanent molar in a Sudanese population and reported that 59% of these teeth have four root canals. Also, four canals, all located in one root – the distal one, were reported by Ghodds M et al. [22]. Hess W [19] reported that 0.3% of the 512 mandibular first molars he studied had only one canal, 17.7% had two canals, 78% had three and only 4% had four canals. A similar study was done by De Deus QD [23], which analyzed 75 mandibular molars and found that in 8% of cases the molars had two canals, in 56% of cases had three, and in 36% of cases had four canals. The percent that he found four canals in was higher than in Hess’ case. Five root canals in the mandibular first molar roots were found by Fabra-Campos H [4], which studied 145 teeth. The percent was only 2.75%. Also, Martinez-Berná A and Badanelli P [24] investigated 2362 mandibular permanent molars, and found that 29 teeth had five root canals. Jacobsen EL et al. [25] studied one hundred mandibular permanent first molars and he reported that 12 of them had a third mesial canal.

One of the causes of failure of endodontic treatments is an incomplete instrumentation or filling of all root canals [26]. Also, Ingle JJ [27] considered that one of the most important causes of endodontic treatment failure is the incomplete filling of the root canal system. Similarly, Vertucci FJ [28] and DeGrood ME and Cunningham CJ [29] reported that a considerable number of failures could be assigned to anatomical variations, such as the presence of canals not usually found.

Conclusions

These clinical cases, presented in this article, demonstrate that morphological variations of mandibular first molars may occur in our country, as was shown in the foreign specialty literature. Therefore, it was important that before beginning any kind of endodontic treatment all clinicians must take into account the possible dental anatomical variations to help them prevent the failure of treatment by omission to fill an additional canal.

We should know that incomplete or inexistent filling of a root canal by omitting its presence are the main causes of endodontic treatment failure, which would compromise the following prosthetics restoration, causing the loss of incorrect treated tooth.

Knowledge of the variations in the anatomy of first mandibular permanent molar is necessary, because the correct location of all root canals, their instrumentation, and the filling of entire root canal system are a condition for a successful endodontic treatment and for the long-term success of the prosthetic restoration of the tooth.

References


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