

The Challenge of Endodontic Treatment of Maxillary First Molar with Unusual Anatomy – A Case Report

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Abstract: *This study presents a case of molar with unusual anatomy in a 21-year old female patient - a case of a maxillary first molar with a canal configuration which hasn't been report in the literature - two roots (MB and P) and three root canals (MB₁, MB₂ and P). Radiographic examination disclosed an unusual anatomical configuration of the roots, suggesting that two roots might be present. The use of magnification enhanced the ability to detect the MB2 canal and the treatment was based on precise observation of pulp chamber floor. Follow-up radiographs demonstrated the maintenance of a functional tooth.*

Keywords: magnification, maxillary first molars, MB₂, pulp chamber floor, unusual anatomy

1. Introduction

Root canal anatomy of maxillary molars is highly complex and unpredictable. The first maxillary molars have the largest volume and have generated more research than any other tooth [4]. The knowledge of the normal anatomy and frequent variations can greatly enhance the success rate of endodontic treatment. The most frequent cause of endodontic failure is the apical percolation and subsequent diffusion stasis into the canal [15]. The main reasons for this failure are incomplete canal obturation or an untreated canal. A canal is often left untreated because the dentist fails to recognize its presence.

Since 1842 when Carabelli [5] published his study describing the internal dental anatomy there are many papers which investigate the complexity of endodontic space. But all of them discuss the challenge of endodontic treatment of maxillary first molars. They have attempted to clarify this topic and have proposed new techniques to provide a broader description of the anatomy of permanent teeth. In the beginning of the 20th, Okumura [21] published his revolutionary study about the transformation of teeth into transparent blocks, revealing complex wefts that were part of root canals. Weine et al. [25] observed that unsuccessful treatment of maxillary molars is related with failures and undetection of second mesiobuccal canal, and found that teeth with a fourth canal occurred more frequently than those with three canals (51.5% versus 48.5%). Studies have shown that the root of a tooth has not only one or two canals, it can also branch out on numerous side and lateral ramifications. Weine divided the position of one or two canals within one root into four categories (Weine I-IV) [35].

A detailed investigation about anatomic variations occurring in 2,400 extracted human permanent teeth submitted to clearing procedures was carried out by Vertucci [34], focusing on the following features: number and types of canals, ramifications associated to the main canal, apical foramen location, presence of transversal anastomoses and frequency of apical deltas. The author classified the canal configurations in 8 groups that were mostly related to the

opening and exit of the main canals. Root canals may be left untreated during endodontic therapy if the dentist fails to identify their presence, particularly in teeth with unusual anatomy [23]. Therefore, a thorough radiographic examination, including preoperative radiographs, is essential for success in endodontic therapy. An apex locator can help in determining the working length during root canal treatment, but it cannot replace periapical radiography because it does not provide the detailed information about root canal morphology that radiography does. Most of the clinical literature on the unusual anatomy in maxillary molars reports an additional second and third mesiobuccal canal [26, 28, 33], additional distobuccal canal [17] and two [6, 30] even three (Wong 1991) palatal root canals.

The present case report describes a case of a maxillary first molar with a canal configuration which hasn't been report in the literature - two roots (MB and P) and three root canals (MB₁, MB₂ and P).

2. Case Report

A 21-year old female patient was referred with severe pain in the left mandibular region. The patient reported that for the last week had experienced spontaneous night pain in this area but could not detect the tooth that was responsible. She also reported that for several days had woken up with formication in the left buccal muscle and the left half of the lower lip.

Preoperative radiographs and the clinical exam of the teeth in the left lower quadrant showed that there is no tooth that can be responsible for that kind of pain.

After a thorough clinical exam of the teeth in the left upper quadrant we revealed a first maxillary molar with an extensive occlusodistal coronal restoration with composite resin that can be possible reason for the pain. Neither fistulae nor edema was observed. Periodontal probing did not reveal significant pocket depths. Electric pulp test was positive – 18 μ A, which was confusing.

Volume 3 Issue 12, December 2014

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The preoperative periapical radiograph showed a small area of thickened periodontal ligament around the palatal root apex (Fig.1).



Figure 1: Preoperative radiograph on tooth 26

Radiographic examination disclosed an unusual anatomical configuration of the roots, suggesting that two roots might be present. The mesiobuccal and the palatal root were easily detected but distobuccal root was not evident. Careful assessment of pretreatment radiographs may indicate potential challenges to canal identification.

At the first session after local anesthesia (2% Articaine with 1:100 000 epinephrine) the operative field was isolated with a rubber dam. After the removal of the composite restoration an old communication to the pulp chamber was found. The removal of the pulp chamber tectum revealed a darkly colored and unpleasantly scented pulp tissue. The pulp chamber was irrigated with 5.25% sodium hypochlorite and 17% EDTA. Examination of the chamber floor with an endodontic explorer (DG-16) and micro opener, revealed only three canal orifices – mesiobuccal canal (**MB₁**), second mesiobuccal canal (**MB₂**) and palatal canal (**P**). When observe the pulp chamber floor the “color map” should be read careful – the floor is dark and walls are light (Fig.2).

Orifices found at the junction. In the time of observation we hadn't find a groove in distal direction from **MB₁** orifice and in buccal direction from palatal orifice. The internal anatomy of two rooted first maxillary molars is related to external crown anatomy – distobuccal cusp is pressed and very small. Exploration of the buccal gingival area presence a lack of furcation between MB and DB root.

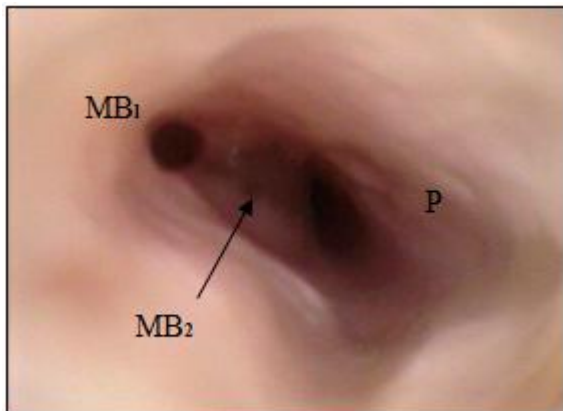


Figure 2: Preoperative radiograph on tooth 26

Ultrasonic diamond tips and small head burs (Muller Burs) are ideal to gently remove ridge of dentine covering the **MB₂** canal orifice. Small sized files 'C-Pilot files' (# 006, 008 and 010) are required to initially negotiate these narrow and curved canals. The **MB₂** orifice was found nearly on the imaginary line between the **MB₁** and **P** orifice, and about 1.5 mm palatal to the **MB₁** orifice (Fig.2,3).

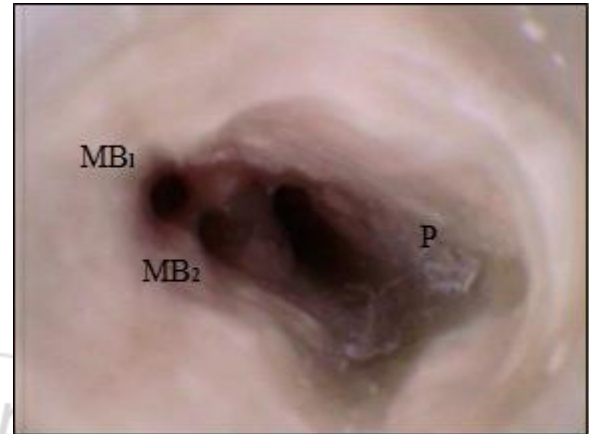


Figure 3: **MB₂** orifice was found nearly on the imaginary line between the **MB₁** and **P** orifice.

All canals were easily negotiated, and the working length was determined by using electronic apex locator Raypex 5 (VDW, Germany) and the determined working length was confirmed with radiographs, because of initial pathological apical root resorption (Fig.4). Shape, dimension and position of the root apex are continuously altered. Thus, the exact location of the apical foramen remains difficult to determine. The accuracy of electronic measurement of root canal length not affected by root resorption less than one third of root length in primary molar teeth [1].



Figure 4: Radiographic determination working length.

The root canals were cleaned and shaped using crown-down technique. The radiographs with two different angulations showed that the instrument in the buccal root canal was well centered (Fig.5). Therefore it was thought that the buccal root had two canals in mesiobuccal root. Apical preparations in the **MB₁** and **MB₂** canals were enlarged to a master file size of #040, and in the palatal canal to size of #060.



Figure 5: Radiographic determination working length-angulation with 30°.



Figure 7: Radiographic determination working length.

The use of magnification enhanced the ability to detect the MB₂ canals, although the difference was not statistically significant. The MB₂ canals could not be detected in 16.5% of the teeth, mainly because of pulpal calcification [29]. However, as the operator became more experienced, scheduled sufficient clinical time and used specific instruments adapted for microendodontics, MB₂ canals were located in 93.0% of first molars and 60.4% in second molars [31].

At greater magnification, the groove shows two orifices of similar size, separated by a bridge of dentine (Fig.3). The canals were flushed with 17% EDTA for 3 min under continuous stirring with a file, rinsed, dried and filled with a paste prepared with calcium hydroxide /Ca(OH)₂/, which was used as an intracanal medication. At a second-day recall, the patient was clinically comfortable. After 10 days, the canals were emptied, copiously flushed with 5,25 % sodium hypochlorite under stirring with a #15 K-file (Dentsply), followed by rinsing with citric acid and sterile saline, dried with paper points and obturate definitive. Main gutta-percha cones were selected for each canal and all canals were filled using the gutta-percha and sealer AH Plus (Dentsply Maillefer, Switzerland). A final radiograph was taken to confirm the completeness and extension of root fillings (Fig.6).



Figure 6: A final radiograph

The pulp floor was polished with powder (sodium bicarbonate - average grain size ~40µm) using air-polishing device - Prophyflex (KaVo) for better bonding procedure (Fig.7).

The tooth was restored with composite resin – Artemis (Ivoclar Vivadent, Schaan, Leichtenstein).

The canal system in MB root was classified in Vertucci's second class. It was considered that the canal morphology was bilateral (Fig.8). There are many variations in canal number and configuration in maxillary molars [24]. After six – month follow-up period, the patient was asymptomatic (Fig.9).



Figure 8: Radiograph of tooth 16.



Figure 9: Radiograph after 6 month follow-up.

3. Discussion

A detailed understanding of the complexity of root canal systems and careful interpretation of preoperative

radiographs is imperative to ensure successful root canal preparation. However radiographs are two dimensional images of a three-dimensional object. The clinician must be aware of this limitation during radiographic interpretation [16]. Pécora et al. (1992) affirms that one of the main reasons for the failure of root canal therapy is the lack of sufficient knowledge concerning the anatomy of teeth, both internal and external [23] In our knowledge in contemporary endodontic literature there isn't a paper about that unusual anatomic variations a lack of distobuccal root.

Anatomical variations, especially extra canals and roots, should always be kept in mind when treating teeth endodontically. The incidence of missed canals among retreated teeth was reported to be as high as 42% [13]. Canals if left uncleaned may harbour microorganisms which have been reported to be a major cause for treatment failure [19, 32].

Conservative or small access cavity preparations are not recommended because some missed canals can lead to root canal therapy failure. Modification of the access cavity (to a rhomboidal shape) to include a trench preparation from the mesiobuccal canal to a mesiopalatal direction, where the ML canal orifice may be typically found, increases the frequency of MB₂ canal orifice detection. Baldassari-Cruz et al. [2] related that different access cavity shapes increase the frequency of locating the MB₂ canal in the mesiobuccal root of the first maxillary molar.

However, the discovery of this variant indicates that maxillary first molars may have more unusual anatomy than the traditionally expected 3,4 or 5 canals in MB root [26, 28, 33], two DB canals [14, 17] and two even three P canals [6, 30, 37], especially in the case of an unusually massive coronal morphology. Over 95% of maxillary first molars had three roots and 3.9% had two roots. The incidence of fusion of any two or three roots was approximately 5.2%. Conical and C-shaped roots and canals were rarely found (0.12%). This data was published in review on the canal morphology of the mesiobuccal root with a total of 8399 teeth from 34 studies [7]. Therefore, careful examination with radiograph from different angles and magnification should be done to avoid the missing of canals.

Seven point two percent of the cases displayed an infundibulum at the deepest part of the floor including two canals. In 21.4% of cases, these had two clearly separated orifices, while in 71.4% they displayed a groove at whose ends both orifices were located [25]. It is known that failure to find and treat the second canal may modify the long-term prognosis of treatment [35, 36]. This case highlights the importance of radiographic examination, especially preoperative radiography, for success in endodontic therapy.

The importance of current knowledge of pulp space anatomy and frequent variations as well as gaining straight line endodontic access cannot be over-emphasized. Ultimately poor access cavity design could lead to inadequate detection, cleaning, shaping and obturation compromising successful outcome.

Unlike mandibular second molars, a root canal system with C shape root canal system may occasionally occur. Such a configuration for a maxillary first molar tooth has been reported in a limited number of cases [8, 9, 20]. A fusion of the distobuccal and palatal root in maxillary first molar tooth was reported in their study.

The use of a magnifier is one important instrument that can aid in locating extra canals [3]. In this case the initial radiograph suggested only two roots – MB and P, not buccal and palatal, like premolar configuration [10], not a fusion of two buccal roots [18]. Pecora et al. [22] Evaluated 140 first molar teeth and reported that fusion was observed 7.9% in buccal roots, 5% in lingual and distobuccal roots and 0.7% in all of the roots. Sabala et al. [27] Reported that fused buccal roots can be seen only in 0.4% cases. They discovered that aberrations occurred under 1% of the cases and that 90% of such aberrations were bilateral.

Only by correct clinical examination and interpretation of radiographic images help the clinician to detect such variations and make him to be aware of them before and during endodontic procedures [12]. When a preoperative radiograph reveals atypical toothshape with unusual contour, further radiographs should be taken with a different angulation to confirm any unusual anatomical features [11].

4. Conclusion

In conclusion, knowledge of root canal configuration and its variations, use of magnification lens and radiographs are all important aids that are needed for successful endodontic treatment.

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