

Case Report

Management of a maxillary first molar tooth with unusual mesiobuccal root anatomy

Hany Mohamed Aly Ahmed*, Deepti Saini

School of Dental Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia.

* Corresponding author: hany_endodontist@hotmail.com

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Abstract Sufficient knowledge on the root and root canal anatomy is essential for practicing root canal treatment. The mesiobuccal roots of maxillary molar teeth present an endodontic challenge due to their wide variability and complexity of their internal morphological landmarks. A review on the literature indicates that the prevalence of a third mesiobuccal root canal in the mesiobuccal root of maxillary molar teeth may reach 9%, and the root canal configuration usually is type XV (3-2). These reported data reveal the importance of absolute awareness for this anatomical aberration that requires special attention from dental practitioners while commencing root canal treatment in maxillary molar teeth. Hence, this article aims to report and describe the management of a maxillary first molar tooth with three mesiobuccal root canals, but with an unusual configuration.

Keywords: maxillary molar, mesiobuccal, root, root canal.

Introduction

The increased prevalence of missed roots and root canals is the major cause for root canal treatment failures (Cantatore *et al.*, 2006). Adequate knowledge, good anticipation and clinical thoroughness are essential requirements for practicing successful endodontics (Vertucci, 2005). Maxillary first molar teeth present an endodontic challenge due to their wide internal and external radicular morphological variations, their close relation to the floor of maxillary sinus and superimposition of the zygomatic arch, which may obscure their accurate interpretation and complicate the optimization of their treatment (Cantatore *et al.*, 2006; Cleghorn *et al.*, 2006; Patel *et al.*, 2007).

The root canal anatomy of the mesiobuccal root has been subjected to many research studies and clinical investigations more than any root in the oral cavity (Vertucci and Haddix, 2011).

Whereas the high prevalence of second mesiobuccal root canals has been recorded to reach above 90% (Kulild and Peters, 1990; Stropko, 1999), some *in vitro* and *in vivo* studies mentioned the potential occurrence of a third canal in the mesiobuccal root that can reach 9% (Acosta Vigouroux and Trugeda Bosaans, 1978; Martínez-Berná and Ruiz-Badanelli, 1983; Neaverth *et al.*, 1987; Kulild and Peters, 1990; Rwenyonyi *et al.*, 2007; Baratto Filho *et al.*, 2009; Park *et al.*, 2009; Beljić-Ivanović and Teodorović 2010; Degerness and Bowles 2010; Neelakantan *et al.*, 2010) (Table 1).

Reviewing the reported cases in the literature indicates that the supplemental Sert and Bayirli configuration root canal type XV (3-2) is the most common configuration in the mesiobuccal root enclosing three root canals (Martínez-Berná and Ruiz-Badanelli, 1983; Beatty 1984; Ferguson *et al.*, 2005; Favieri *et al.*, 2006; Garg *et al.*, 2010; Kottoor *et al.*, 2010; Prabu *et*

al., 2010; Kottoor *et al.*, 2011) (Table 2). However, in rare occasions, the three mesiobuccal canals may exist in other configurations such as type VIII (3-3) and type XVI (2-3) (Neaverth *et al.*, 1987; Sert and Bayirli, 2004; Rwenyonyi *et al.*, 2007; Neelakantan *et al.*, 2010). This article aims to describe an unusual root canal configuration in the mesiobuccal root of a maxillary first molar tooth.

Case report

A 37-year-old healthy male patient attended the dental clinic with a chief complaint of severe pain on biting in relation to his maxillary left first molar tooth. The clinical examination revealed

severe pain on percussion on his maxillary first molar, which was restored with an ill-fitting crown with no history of decementation. There was no apparent widening in the periodontal ligament space around the roots (Figure 1a). It was decided to remove the ill-fitting crown to facilitate in reaching the definitive diagnosis. Upon removal of the crown, an excess cement and food impaction were observed beneath the crown margins (Figure 1b). In addition, recurrent caries was noted on the proximal aspect of the tooth. The vitality test with ethyl chloride spray (Walter Ritter, Germany) was negative. The tooth was finally diagnosed as necrotic with acute apical periodontitis and was scheduled for root canal treatment.

Table 1 Review for the percentage of third mesiobuccal canals in the mesiobuccal roots of maxillary first molar teeth (micro-CT: micro-computed tomography, CBCT: Cone-beam computed tomography)

Author/s	Year	Type of study	Percentage
Acosta Vigouroux and Trugeda Bosaans	1978	<i>In vitro</i> study (Visual examination) (n= 134)	3/134 (2.25%)
Martínez-Berná and Ruiz-Badanelli	1983	<i>In vivo</i> study (Clinical investigation) (n= 338)	3/338 (0.88%)
Neaverth <i>et al.</i>	1987	<i>In vivo</i> study (Clinical investigation) (n= 228)	7/228 (3.1%)
Kulild and Peters	1990	<i>In vitro</i> study (Horizontal cross sections) (n=51)	1/51 (1.96%)
Sert and Bayirli	2004	<i>In vitro</i> study (Clearing method) (n= 200)	1/200 (0.5%)
Rwenyonyi <i>et al.</i>	2007	<i>In vitro</i> study (Clearing method) (n= 221)	1/221 (0.5%)
Baratto Filho <i>et al.</i>	2009	<i>Ex vivo</i> study (Operating microscope and radiographic examination) (n= 140)	1/140 (0.72%)
Park <i>et al.</i>	2009	<i>In vitro</i> study (micro-CT) (n= 46)	3/46 (6.5%)
Beljić-Ivanović and Teodorović	2010	<i>In vitro</i> study (Radiographic) (n=200)	18/200 (9%)
Degerness and Bowles	2010	<i>In vitro</i> study (Stereomicroscope) (n= 90)	1/90 (1.1%)
Neelakantan <i>et al.</i>	2010	<i>In vitro</i> study (CBCT) (n= 220)	2/220 (1%)

Table 2 Review of the reported cases for maxillary first molars with three mesiobuccal root canals

Author/s	Year	Root canal configuration
Martínez-Berná and Ruiz-Badanelli	1983	(3 cases) Configuration (3-2)
Beatty	1984	Configuration (3-3)
Ferguson <i>et al.</i>	2005	Configuration (3-2)
Favieri <i>et al.</i>	2006	Configuration (3-2)
Kottoor <i>et al.</i>	2010	Configuration (3-2)
Garg <i>et al.</i>	2010	Configuration (3-2)
Prabu <i>et al.</i>	2010	Configuration (3-2)
Kottoor <i>et al.</i>	2011	Configuration (3-2)
Ayranci <i>et al.</i>	2011	Configuration (3-1)
The present case	2011	Configuration (3-2-1)

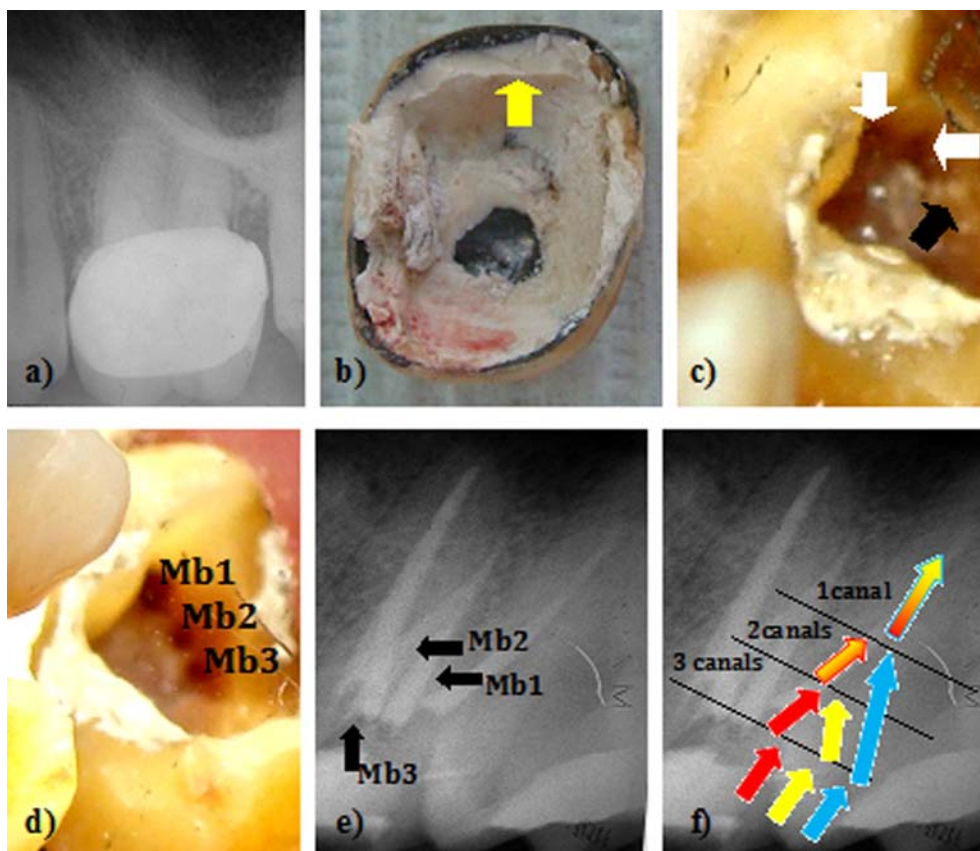


Figure 1 a) Preoperative radiograph. b) Thick layer of cement under-surface of the crown (yellow arrow). c) Photograph showing the Mb1 and Mb2 (white arrows). Mb3 was located under the dentin shelf (black arrow). d) The 3 Mb canal orifices following coronal enlargement. e) Postoperative radiograph. f) 3-2-1 root canal configuration (Blue arrow: Mb1, Yellow arrow: Mb2, Red arrow: Mb3). Mb3 joins Mb2 at the coronal third, and Mb2 joins Mb1 at the middle third ending by one canal.

The access cavity was prepared under prismatic magnifying loupes (4x, Heine, Herrsching, Germany) with the aid of light emitting diode (3S, Heine, Herrsching, Germany). The first mesiobuccal (Mb1), second mesiobuccal (Mb2), disto-buccal (Db) and palatal (P) root canals were located. After coronal flaring, the working length determination was performed using an apex locator (Element Diagnostic Unit, SybronEndo, Orange, California, USA). The Mb1 and Mb2 were joined at the middle third and exit by one apical foramen. Upon further exploration of the pulp chamber floor, a third mesiobuccal canal (Mb3) was located under a dentine shelf palatal to the Mb2 (Figure 1c, 1d). The Mb3 canal was joined to the Mb2 at the coronal third. Hence, the mesiobuccal root was presented with three root canal orifices having the 3-2-1 root canal configuration (Figure 1f). All the canals were mechanically instrumented using K-flexofiles (Maillefer, Dentsply, Switzerland), and then obturated using lateral compaction technique (Figure 1d, 1e). The tooth was temporarily sealed, and the patient was referred for crown fabrication.

Discussion

The root and root canal anatomy show considerable variations and complexities that require special attention while performing root canal therapy (Vertucci, 2005). Ignoring the absolute confidence for the pre-estimated number of roots and/or root canals, assisted vision, thorough preoperative examination and intraoperative exploration are essential for the accurate identification of root and root canal aberrations (England *et al.*, 1991; Buhrey *et al.*, 2002; Cantatore *et al.*, 2006). Whenever indicated, the use of three-dimensional radiographic modalities, such as the cone beam computed tomography (CBCT), can facilitate the detection of some anatomical landmarks that could not be identified during conventional

radiographic examination (Patel, 2009). In addition, Corcoran *et al.* (2007) found that the operator experience can improve the ability to locate additional canals in maxillary molar teeth.

The mesiobuccal root of the maxillary molar teeth shows considerable variations with regard to their root canal anatomy. It seems that the etiology of this morphological heterogeneity is multifactorial in nature. Age accompanied with pulp irritants including caries, trauma and restorative procedures may affect the amount of root canal dentine deposited along the root canal walls, thus causing alteration of the root canal anatomy (Neaverth *et al.*, 1987; Thomas *et al.*, 1993; Lee *et al.*, 2011). In the present case, it was noted that the complex anatomy of the mesiobuccal root was corresponding to a mesially located carious cavity and the patient age was less than 40 which is presumed to have more prevalence for root canal aberrations (Neaverth *et al.*, 1987; Lee *et al.*, 2011).

Despite the common occurrence of the supplemental Sert and Bayirli configuration root canal type XV (3-2) in the mesiobuccal root enclosing three canals, other root canal configurations have been observed. The connection of these canals to form one canal with one apical foramen (3-1) and their complete separation with three independent apical foramina (3-3) have been documented (Neaverth *et al.*, 1987; Baratto Filho *et al.*, 2009). Sert and Bayirli (2004) also observed a new configuration (3-2-1) in the mesiobuccal root of a cleared maxillary first molar. In addition, Rwenyonyi *et al.* (2007) and Neelakantan *et al.* (2010) demonstrated maxillary first molars with one and two orifices in the mesiobuccal root that divided into three canals with three apical foramina, respectively. Interestingly, Verma and Love (2010) investigated, in a micro-computed tomography (micro-CT) study, the morphological features of twenty resected mesiobuccal roots from maxillary first molars and concluded that

the present root canal classifications do not fully reflect their complex anatomy.

In the present case, the mesiobuccal root was identified, by the aid of magnification, with a rare root canal configuration (3-2-1) that was previously observed only in a cleared maxillary first molar tooth (Sert and Bayirli, 2004). Complete deroofting of the pulp chamber, removal of any calcified tissue that may wrap the orifice of an accessory root canal and utilization of supplemental diagnostic aids would facilitate an optimum morphological identification of the root canal system.

Conclusion

The mesiobuccal root canal anatomy of maxillary first molar teeth presents an endodontic challenge due to their considerable morphological variability and complexity. Special attention should be given during their endodontic management to prevent the undesirable consequences when they are left untreated with missed root canals.

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