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Aberrations in Root Canal Morphology: A Case Series

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ABSTRACT

A clear understanding of the anatomy and morphology of root canals is an essential pre-requisite for carrying out a successful endodontic treatment. One of the major causes of failure of root canal treatment is complexity of the anatomy of pulp canal space. Variations in root canal morphology presents constant challenges for the clinician. With the advent of magnification and other diagnostic and treatment adjuvants, searching for and treating root canals has become easier and more predictable. This article presents case series emphasizing on the significance of thorough knowledge regarding root canal morphology and the associated anatomical aberrations.

Keywords: Root canal aberrations; Angulated IOPAR's; Mandibular molar; Mandibular Central Incisor; Mandibular Canine.

INTRODUCTION

An efficient chemo-mechanical preparation and a good hermetic seal with a three-dimensional obturation are the prerequisites for a successful root canal treatment. The wide range of studies conducted on root canal morphology, from the early work of Hess and Zurcherl[1] to various recent authors, demonstrating anatomic complexities of the root canal systems, have all emphasized on the fact that a root with tapering canal and a single foramen is an exception rather than a rule. Root canal variation can be identified with intra oral peri-apical (IOPA) radiograph, magnifying optical loupes, surgical operating microscopes, endodontic endoscopes and Cone Beam Computed Tomography [2] (CBCT). This article describes endodontic management with morphological variations in anatomy of mandibular incisor and molars.

DOCUMENTED CASES

CASE 1: A 35-years old male patient reported with severe attrition in relation to mandibular central incisor teeth. The teeth were tender on percussion. The IOPAR showed a loss of lamina dura and widening of PDL along with presence of one canal. Another angulated IOPA was taken which confirmed presence of 2 canals (Fig 1 (a)). Root canal treatment (RCT) was planned with respect to tooth 41 and 42.

The tooth was anaesthetised using 2% Lignocaine with 1: 80 000 adrenaline (Lignox, Indoco Remedies Ltd, India) and isolated using rubber dam. Access opening was prepared with Endo Access burs and refined with Endo Z bur (Dentsply Maillefer, Switzerland) in an oval shape with larger labio-lingual extension under

rubber dam isolation (Fig 1 (b, f)). The teeth when endodontically explored with help of DG-16, were found to have two separate canal orifices extending into two canals. Working length was determined for all the canals using electronic apex locator (EAL) (Root ZX mini, J Morita, USA) and was confirmed radiographically. (Fig 1(c,g)).Shaping and cleaning of root canals were performed and, 41and 42 were prepared with rotary instruments (ProTaper Universal, Dentsply, Maillefer, Switzerland) upto the size of F2 for both the canals (Fig 1 (d, h)). 5.25% sodium hypochlorite (Prime Dental Products Private Limited, Thane, Maharashtra, India) and 17% liquid EDTA (Prevest Denpro, Jammu, India) were used for irrigation alternating with saline. The canals were dried with absorbent points and obturation was done with gutta-percha (GP) (F2 cone for 41 and 42) by single cone obturation technique using AH Plus sealer (Dentsply, Maillefer, Ballaigues, Switzerland) (Fig 1 (e, i)). The access cavities were restored with composite (Dentsply, Maillefer, Switzerland) restoration.

figure 1:(a) preoperat radiograph

(b) Clinical image #42 with 2 canal orifices

(c) Working length

(d) Master cone

(e) Post-obturation

(f) Clinical image #41 with 2 canal orifices

(g) Working length

(h) Master cone

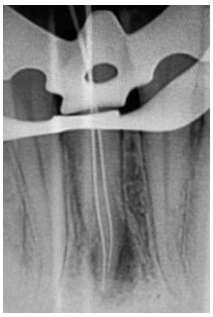
(i) Post obturation

CASE 2: A 24-year-old man with chief complaint of pain in lower left front tooth. The radiographic examination revealed loss of lamina dura and periapical radiolucency with 31(Fig 2 (a)). IOPA taken at different angulation, confirmed presence of 2 canals. The tooth was anaesthetised using 2% Lignocaine with 1: 80 000 adrenaline (Lignox, Indoco Remedies Ltd, India) and isolated using rubber dam. Following access cavity preparation with Endo access (Dentsply, Maillefer, Switzerland) and Endo

Z bur (Dentsply, Maillefer, Switzerland) (Fig 2 (b)). Exploration of the pulp chamber using DG-16 explorer, indicated the presence of another root canal orifice. Working length was determined by EAL (Root ZX mini, J Morita, USA) and verified radiographically (Fig 2 (c)). Root canal preparation was carried out using rotary instrumentation (ProTaper Universal, Dentsply, Maillefer, Switzerland) upto size of F1 (Fig 2 (d)). 5.25% sodium hypochlorite (Prime Dental Products Private Limited, Thane, Maharashtra, India) and 17% liquid EDTA (Prevest Denpro, Jammu, India) were used as irrigants along with saline. The root canals were obturated using GP F2 cone and AH Plus root canal sealer (Dentsply, Maillefer, Ballaigues, Switzerland) with single cone obturation technique. The postoperative radiograph showed two root canals with separate apical foramina (Vertucci's type IV) with respect to 31(Fig 2 (e)). Later on access cavity was restored with composite restoration.

figure 2: (a) Pre-operative radiograph

(b) Access cavity preparation



(c) Working length

(d) Master cone

(e) Post-obturation

CASE 3: A 46-year-old female presented with chief complaint of dislodged restoration lower front tooth region. Upon clinical examination the tooth had no coronal restoration and was positive to both percussion and palpation. IOPA revealed tooth (#43) has one root with two canals joining apically (Vertucci's type II). The tooth was anaesthetised using 2% Lignocaine with 1: 80 000 adrenaline (Lignox, Indoco Remedies Ltd, India) and isolated using rubber dam. Access opening was done with Endo access (Dentsply, Maillefer, Switzerland) and Endo Z bur (Dentsply, Maillefer, Switzerland),the access cavity was extended lingually to expose the second canal, both the buccal and lingual canals were located. The working length was determined with EAL and confirmed radiographically (Fig 3 (a)). Both the buccal and lingual canals were instrumented to an apical size #35 in the

buccal canal and lingual canal, followed by step-back instrumentation in both canals up to size #60 k file (Fig 3 (b)) using 5.25% sodium hypochlorite(Prime Dental Products Private Limited, Thane, Maharashtra, India)and 17% liquid EDTA (PrevestDenpro, Jammu, India) for cleaning and shaping procedure. Both canals were dried with absorbent points and then were obturated with GP cone of size 35(0.2 taper) and AH Plus sealer (Dentsply, Maillefer, Ballaigues, Switzerland) by cold lateral condensation technique. The post endodontic restoration was done with composite (Dentsply, Maillefer, Switzerland) (Fig 3 (c)).

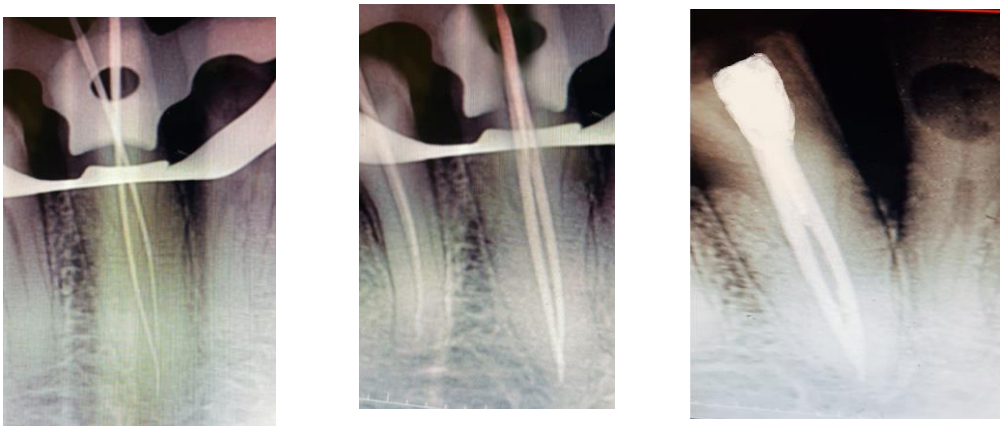


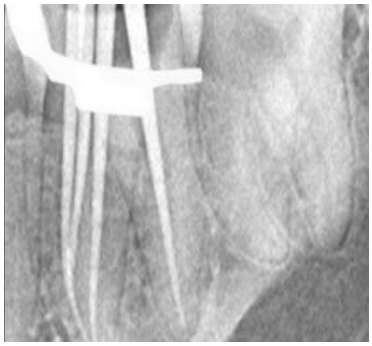
figure 3: (a) Working length **(b) Master cone** **(c) Post-obturation**

CASE 4: A 25-year-old male patient with a chief complaint of pain in a right lower back tooth for the past one week. Clinical examination revealed the presence of deep caries involving the pulp. The radiographic examination revealed loss of Lamina Dura and Widening of PDL. The tooth was anesthetised using 2% Lignocaine with 1: 80 000 adrenaline (Lignox, Indoco Remedies Ltd, India) and isolated using rubber dam. Access Opening was done and working length was established. The canals were negotiated using a size 10 K file (Dentsply, Maillefer, Switzerland). Four canals were initially located, two mesial and two distal. Bleeding spot was identified between the MB and ML orifices. Angulated IOPA revealed presence of additional canal. A total of, five distinct orifices were identified: Mesially three (MB, middle mesial, ML) and distally two (distobuccal, distolingual) (Fig 4 (b)). The working length was determined using EAL and confirmed radiographically (Fig 4 (c)). Shaping and cleaning was carried out by NiTi rotary instrument (ProTaper Universal, Dentsply, Maillefer, Switzerland) in a manner as all the canals were wide including the MMC. All the 3 mesial canals were prepared to size of F3 and distal till F4 (Fig 4 (d)). Irrigation was carried out using 5.25 %sodium hypochlorite solution (Prime Dental Products Private Limited, Thane, Maharashtra, India) and 17% liquid EDTA (Prevest Denpro, Jammu, India) alternating with saline. Canals were dried using paper points and obturation was done by single cone obturation technique using F3 and F4 GP cones and AH Plus sealer (Dentsply, Maillefer, Ballaigues, Switzerland). Post-obturation radiograph revealed that MMC merged with the Mesiolingual canal (Pomeranz's Type III) at the middle third region. The access cavity was restored using a composite restoration (Dentsply, Maillefer, Switzerland) (Fig 4 (e)).

figure 4: (a) Pre-operative

(b) Access cavity prepration

(c) Working length



(d)Master cone

(e) Post-obturation

CASE 5: A 32-year-old female patient reported with pain in the left lower back tooth region. Intraoral examination revealed Class I dental caries #36, with positive percussion test. The radiographic examination revealed widening of PDL space and loss of lamina dura. IOPAs at different horizontal angulations revealed the presence of an extra root between mesial and distal roots and, following the SLOB rule, it was confirmed that the extra root was located in the lingual aspect (Radix Entomolaris-RE). Access cavity was prepared using with Endo access bur and Endo Z bur (Dentsply Maillefer, Switzerland). After de-roofing of the pulp chamber, two mesial canal orifices and one distal orifice were located (Fig 5 (a)). The orifice of the RE was located at the lingual aspect to the orifice of the distal root canal. The working length was determined electronically with EAL (Root ZX Mini, J Morita, USA) and confirmed radiographically (Fig 5 (b)). The root canals were instrumented using 10 K-file to create a glide path for the rotary instrumentation (ProTaper Universal, Dentsply, Maillefer, Switzerland), Root canal was prepared upto F2 size (Fig 5 (c)). During cleaning and shaping, the root canals were irrigated with copious amounts of 5.25% sodium hypochlorite solution (Prime Dental Products Private Limited, Thane, Maharashtra, India) and 17% liquid EDTA (Prevest Denpro, Jammu, India) alternating with saline. The root canals were medicated with a calcium hydroxide dressing and the access cavity was temporarily sealed with temporary restoration. Intracanal medicament was removed a week later and the root canals were irrigated with copious amount of saline and dried with absorbent points.

The selected GP cones (F2) were coated with AH Plus sealer (Dentsply, Maillefer, Ballaigues, Switzerland) and placed in the canal and obturated by single cone obturation technique. The access cavity was restored using a composite restoration

(Dentsply, Maillefer, Switzerland) (Fig 5 (d)).

figure 5: (a) Access cavity preparation

(b) Working length

(c) Master cone

(d) Post-obturation

DISCUSSION

Root canal system present high levels of diversities and complexities. Recognizing the number of root canals, root canal shape, morphology and apical anatomy helps to achieve the best outcome of root canal therapy[3,4,].Use of angulated IOPAR'S[5] and DG-16[6] helps in exploration and location of the canals. The inability to detect and locate all the root canals could result in failure of endodontic treatment, which may require endodontic retreatment in future. Thus, thorough knowledge of root canal morphology is an essential prerequisite for a successful treatment.

1. **Mandibular incisors:** These teeth usually have one canal and one foramen. Research supported that 5-2.5% of mandibular incisors have two canals with one foramen (Vertucci's type II) and in them more than 1% have two separate identifiable apical foramina (Vertucci's type IV/V) [7].
2. **Mandibular Canine:** In general, the usual morphology involves one canal and one foramen. However, the incidence of two canals in single root varies around 1-15% and occurrence of two roots and two canals is a rare entity ranging from 1-5% [8].
3. **Mandibular first molar:** These teeth usually have two roots, mesial and distal; with three root canals i.e. mesiobuccal, mesiolingual and distal. In most cases the mesial root has two root canals, ending in two distinct apical foramina or sometimes, these merge together at the root tip to end in one foramen [9,10]. The distal root typically has one root canal, although if the orifice is particularly narrow and round, a second distal canal may be present. A number of anatomical variations have been described in the mandibular first molar including the presence of three mesial/distal (middle mesial/middle distal) canals. Canal located between the mesiobuccal and mesiolingual canals, is called the middle mesial canal.

The MMCs were classified by Pomeranz et al. (1981) [11,12] into: -

(i) Fin type
(ii) Confluent type
(iii)Independent type.

Azim *et al*. (2015) reported a high incidence of confluent type (78.5 %) of MMC, followed by fin-type (12 %) and independent type (9.5 %). Nosrat *et al*. (2015) reported that about 46.7 % of the MMC are confluent type, 33.3 % are fin-type, and 20 % of the canals are independent [13].
Karapinar- Kazandag *et al*. (2010) demonstrated that all MMCs were confluent [14], with no canal terminating as fin or independent type.
According to Fabra-Campos, (1989), about 1.7 % of MMC merged with the MB canal, mainly in the apical thirds of the root canal. 1.6 % merged with ML canals. Versiani *et al*. (2016) demonstrated that about 20.8 % of the MMC joined the MB canal, and 16.7 % joined to ML canal [15].

CONCLUSION

A successful management protocol depends upon clinician's ability and knowledge to establish a definitive diagnosis. Use of advanced technologies such as loupes, dental operating microscope (DOM) and CBCT can further enhance knowledge, detection of aberrations and planned management in such cases. As it is very well said that, "what we cannot see, we cannot negotiate and what we cannot negotiate we fail to prepare".

Declaration by Authors

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