

Mandibular second premolar with three root canals: a case report.

Kazem F. Hosny¹, DDS, Roula S. Abiad², BDS, M.Sc., D.D.Sc., MAAE

Abstract

• **Introduction:** Mandibular second premolars with three canals and separate foramina are very rare. A review of the literature has revealed that human mandibular premolar tooth can have an extremely complex root and root canal morphology; however, incidence of both multiple roots and multiple canals in mandibular second premolar is lower than that found in mandibular first premolar.

• **Aim:** To report and discuss endodontic management for an unusual occurrence of three canals with three separate foramina in mandibular second premolar.

• **Materials and methods:** Description of the root canal anatomy and management for a case of mandibular premolar with three root canals for an 18 year old African American male patient, where pulp chamber floor revealed one lingual and two buccal orifices at the same level. This report was clinically and radiographically based.

• **Conclusion:** The complex nature of root and root canal morphology of mandibular premolars has been underestimated, which resulted in unknown endodontic failures in many clinical cases. Proper diagnosis and orientation with the root canal anatomy is mandatory for successful treatment.

INTRODUCTION

To achieve a successful root canal treatment, a thorough knowledge of root and root canal morphology as well as possible variation in anatomy of the root canal system is of utmost importance^{1,2}. This is followed by negotiation, cleaning and shaping, and obturation of the entire canal system in three dimensions^{3,4}.

Failure to recognize the presence of an additional root canal may result in unsuccessful treatment and may be the origin of acute flare ups during and after treatment⁶.

Normal root and root canal anatomy of mandibular premolars are well documented in numerous textbooks, but there is a great deal of variation in the reporting of the incidence of anomalies^{4,5,7-14}.

Slowey³ indicated that due to the variations in canal anatomy, mandibular premolars are the most difficult

teeth to treat endodontically; they have a high flare up and failure rate¹.

Mandibular premolars have gained a reputation for having aberrant anatomy. Different studies have looked at the morphology of mandibular premolars over the years and reported a fairly high percentage of these teeth to have more than one canal^{1,2,15}.

Occurrence of three canals with three separate apices (type V, Vertucci) in mandibular premolars is very rare¹⁶.

In a classic anatomical study, Zillich and Dowson¹⁷ showed the occurrence of three canals in mandibular second premolars to be 0.4%, while Vertucci¹⁸ reported it as zero %.

Clinically reported cases showing the presence of three separate roots for the same tooth are very few and far between^{1,15,19,20,21,22,23}.

Our report addresses a case of nonsurgical endodontic management of mandibular second premolar with three separate roots and root canals with three foramina.

1. General Dentistry and Endodontics, Fresno, California, USA.

2. Assistant Dean, Assistant Professor of Endodontics, and Director of Endodontic Division, Beirut Arab University Faculty of Dentistry, Beirut, Lebanon

MATERIALS AND METHODS

An 18 year old African American male patient was referred to the endodontic clinic in Concord, California, USA, with chief complaint of severe shooting pain related to lower left side of his face over a period of one week. Patient also complained of episodes of sensitivity to hot and cold foods in mandibular left second premolar tooth.

On clinical examination, patient's oral hygiene was found to be fair. Deep carious lesions were observed in teeth # 19 and 20. Tooth #20 had a very deep cavity showing pulpal involvement and was tender on percussion. The crown of mandibular second premolar on contralateral side showed no unusual anatomy in terms of number of cusps and dimension suggestive of any anomaly. Electric pulp test (Sybron Endo, USA) and heat test with a gutta-percha stick gave a lingering response. There was no evidence of swelling or sinus tract.

Preoperative periapical radiograph revealed slight widening of the periodontal ligament space at the periapical area related to the mandibular second premolar and thickening of the lamina dura, with deep occluso-distal cavity reaching the pulp space area (Fig. 1).

Radiograph also showed the presence of two roots with a shadow of a third root in between the first two.

Based on clinical and radiographic evidences, a diagnosis of irreversible pulpitis was made.

Access was gained to the pulp chamber after administration of local analgesia (2% lidocaine with 1:80,000 adrenaline) under rubber dam isolation using 557 bur and endo Z bur. To gain sufficient access to canals, conventional access opening was modified into one that was wider mesiodistally. Radiographically, the mid-root diameter appeared to be almost equal to the crown diameter. Tactile examination of the walls of major canals was implemented with a small precurved pathfinder file (Dentsply, Maillefer, USA) which was slowly pushed down each wall of the major canal, probing for a catch. A slight catch may signify the orifice of an additional canal especially in the case of the buccal and lingual walls because these are the unseen dimensions on the radiograph. Three separate orifices were located: two buccaly, and one lingually. Patency was ascertained with a small size 10 K-file (Dentsply, Maillefer, USA). The working length

radiograph was taken (Fig. 2). Canals were cleaned and shaped sequentially with ProTaper files (Dentsply, Maillefer, USA), irrigated using 6% sodium hypochlorite and a final rinse of saline. Canals were dried with paper points (Dentsply, Maillefer, USA), cotton was placed in pulp chamber and Cavite (3M ESPE, St. Paul, MN, USA) was used to close access cavity. At second appointment, canals were obturated with F2 ProTaper gutta-percha cones (Dentsply, Maillefer, USA) using AH Plus sealer (Dentsply, Maillefer, USA), Calamus dual (Dentsply, Tulsa dental, USA) used for vertical compaction technique with the use of Buchanan hand pluggers (Sybronendo, USA) (Fig. 3).

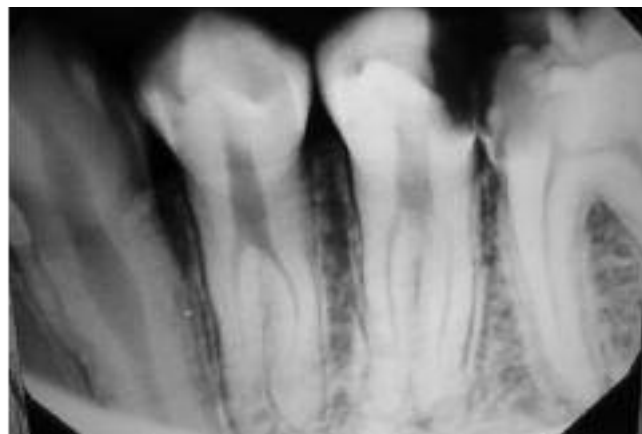


Fig. 1. Preoperative radiograph: the tip of the third (lingual) root was identified in between the two buccal roots.



Fig. 2. Working length.

DISCUSSION

The complex nature of the root and root canal morphology of the mandibular premolars has been underestimated¹.

Since 1979, Slowey³ reported that root canals are frequently left untreated because clinicians often fail to identify their presence, particularly in teeth that have anatomical variations or additional root canals, before root canal treatment is performed. Therefore, clinicians should be aware of the configuration of pulp space of the tooth is to be treated^{2, 25, 26}.

Anatomical variations of mandibular premolars are well documented in literature both in terms of anatomic studies and clinically reported cases^{6, 26-31}, and reports have shown that mandibular premolars are possibly the most difficult teeth to treat endodontically due to wide variation in root canal morphology³⁴.

Failure to recognize presence of an additional root canal may result in unsuccessful treatment and may be the origin of flare ups during and after treatment².

Incidence of number of roots and number of canals reported in anatomic studies greatly varies in literature. Root morphology and canal morphology of mandibular premolars can be extremely complex and highly variable³.

Factors that can contribute to differences observed in various anatomic studies have been previously reported³³, and these factors include ethnicity, age, gender, unintentional bias in the selection of clinical examples of patients or teeth (specialty endodontic practice v/s general dental practice), as well as study design (*in vitro* v/s *in vivo*)³.

Based on race, and since our patient was African American, a study by Trope and co-workers³⁴ compared the number of roots and number of canals in mandibular premolars between African American and white patients: the African American group had an incidence of two or more roots in the mandibular second premolar tooth at 4.8% of the time compared with a 1.5% incidence in the white patient group. Although the incidence of multiple roots was greater in the African American patients compared to white patients in both mandibular first and second premolars, the differences were statistically significant only for mandibular first premolar.



Fig. 3.
Obturation of
the three canals.

Ethnic differences in internal canal morphology were also found in this study but were not statistically significant. The African American group had an incidence of two or more canals at 7.8% of the time, whereas the white group had an incidence of 2.8%^{1, 34}.

However, based on gender distribution, two studies compared differences for number of roots or canals in a known population¹. A study by Serman and Hasselgren³⁵ reported the incidence of two canals and two roots for mandibular first and second premolars: authors found gender differences with respect to the number of canals and roots in an analysis of radiographic surveys of 547 patients. The distribution of men (252 patients) and women (295 patients) was approximately equal and in their study, more men exhibited multiple roots and/or canals (29 men v/s 15 women) in the mandibular second premolar. Also, Sert and Bayirli³⁶ assessed canal morphology in 100 Turkish male and 100 Turkish female patients: male (43%) exhibited two or more canals much more frequently than female patients (15%).

Incidence of mandibular premolars with more than one canal or root is likely to be greater than that reported/found because of hidden images radiographically. The Washington study⁴⁴ which assessed the results of endodontic therapy of mandibular premolars showed that the failure rate in mandibular second premolar as 4.54%³⁷. This may be due the extreme variations in root canal morphology of mandibular premolar teeth compared with the standard description of one root and one canal and therefore

poses an endodontic challenge to clinicians.

Root canal morphology of mandibular premolars can be highly variable and complex and it is often a challenging task to carry out successful endodontic therapy with such teeth. Therefore, the primary step in root canal treatment is the identification of the internal morphology of canal system as precisely as possible^{19,23}. Gulabivala and co-workers³⁸ concluded that broad, flat roots are much more likely to contain multiple canals and intercanal ramifications. In such cases, and to obtain predictable results, high-quality pre-operative radiographs should be available at different horizontal angulations and carefully evaluated to detect the presence of extra root canal.

CONCLUSIONS

A thorough knowledge of root canal anatomy and its variations, careful interpretation of peri-apical radiographs, close clinical inspection of the floor of the pulp chamber and proper modification of access opening along with adequate magnification, all are essential for successful treatment outcome.

The following clues from diagnostic information and techniques might help clinicians to detect additional root(s) and canal(s):¹

High-quality pre-operative radiographs should be obtained at different horizontal angulations, 15° to 40°, either mesial or distal from horizontal long axis of the root, and they are necessary to accurately diagnose number of roots and canals in premolars.

Yoshioka and co-workers³⁹ have indicated that sudden narrowing of the canal system on a parallel radiograph suggests canal system multiplicity.

A general guideline is that if the mid-root image diameter appears equal or greater than the crown image diameter, then the tooth most likely has a variation in root canal configuration⁴⁰.

Presence of additional canal should be suspected whenever an instrument demonstrates an eccentric direction on deeper penetration into the canal, termed directional control, or if the working length file appears off center in the radiograph⁴¹.

Use of magnification has been demonstrated to improve the clinician's ability to visualize and access canals⁴².

Advent of 3D imaging such as Cone Beam

Computed Tomography (CBCT) and (the more recent) tuned aperture computed tomography would be very beneficial and should have been used in such rare cases for effective evaluation of root canal morphology, as this may facilitate and enhance visualization of the area of interest⁴³. However, the high cost, accessibility and availability to patient and extra radiation as compared to standard radiographic methods makes its routine use limited.

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Correspond with:

Roula Abiad

roulaabiad@yahoo.com

abiadroula@gmail.com