Endodontic Management of Maxillary and Mandibular Premolars with aberrant root canal anatomy: A Report of Two Cases

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ABSTRACT
Understanding the morphological and structural variations of the tooth is a primary determining factor in predicting the success of endodontic treatment. The complexity of the root canal system of ‘seemingly simple’ premolar teeth has been underestimated. Two rare cases of aberrant root canal anatomy of maxillary and mandibular premolars are presented and appropriate diagnostic and treatment modifications necessary to achieve success in these complex cases are discussed.

Keywords: Root canal anatomy, Maxillary first premolar, Mandibular second premolar, Three canals

Introduction
Barrett has rightly stated, “Of all the phases of anatomic study in the human system, one of the most complex is that of pulp cavity morphology”.¹ Roots and root canals can vary in number, size, shape, divisions, fusions, directions and stages of development.² In order to achieve successful and predictable endodontic therapy, the clinician should have a sound and thorough knowledge of the internal anatomy of the pulp chamber and root canal system along with associated variations. Anatomic aberrations present an additional challenge for clinicians. The ability to diagnose and treat these aberrations is of paramount importance and has a direct impact on the success of root canal treatment.³ Hoen and Pink reported a 42% incidence of missed roots or canals, necessitating re-treatment.⁴ All endodontic procedures, including cavity outline form, canal access, localization of canal orifices, shaping and cleaning of the root canal system, and 3-dimensional obturation must reflect the root canal system anatomy in toto.

Premolars often have simple anatomy, but if variations exist then these teeth may present very complex morphology making it challenging for the clinician to treat them effectively. In maxillary premolars two canals exiting in one or two roots is the norm, whereas mandibular premolars usually present as a single root with a single canal. A review of the literature however reveals varied complex root canal configurations, among which the 3-rooted premolar is a rare oddity.⁵ The frequency of three canals in maxillary first premolars is reported to be quite low, ranging between 0.5 to 6%.⁹ Vertucci and Gegauff studied 400 maxillary first premolars and reported 5% to have three canals- 0.5% were three canals in a single root, 0.5% were two canals in one root and one canal in a second root, and 4% were one canal in each of three separate roots.¹² Carns and Skidmore found 6% and Rozyl et al found 9% maxillary first premolars to have three canals.¹¹ In mandibular premolars, Zilich and Dawson reported a 11.7% occurrence of two canals and 0.4% of three canals.¹³ Vertucci reported a 2.5% incidence of a second canal in his series of studies. Trope et al found the incidence of three canals in black individuals to be 7.8% and in white to be 2.8%.¹⁴ Clegborn et al. reported the incidence of one canal as 91.0% and two or more canals as 9.0% in mandibular second premolars.⁸

This article describes the successful endodontic management of two such aberrant maxillary and mandibular premolars.

Case 1
A 30-year-old male patient reported to the Department of Conservative Dentistry and Endodontics complaining of spontaneous pain in the maxillary right quadrant since 1 week. His medical history was non-contributory. The pain was aggravated on biting and lying down. Clinical examination revealed a deep carious cavity in 14 involving the pulp. The tooth was tender on percussion and responsive to cold vitality test. A provisional diagnosis of symptomatic irreversible pulpitis with apical periodontitis was made and non-surgical endodontic treatment was planned. A careful assessment of the periapical radiograph revealed the presence of an extra root. (Fig 1a) Additional radiographic images were obtained at mesial and distal angulations. The tooth was anesthetized with local anesthesia (LIGNOX 2%) and isolated under the rubber dam. Access was gained using Cavity access set (Endo Z Access Kit, Dentsply Tulsa). In view of the aberrant canal anatomy, modified T-shaped access...
cavity preparation was done to explore the two closely located buccal orifices. After careful examination under surgical operating microscope (Evolution XR6 Dental Microscope Seiler St. Louis, Missouri), three separate root canal orifices were identified in relation with tooth 14 (Mesiolingual, Mesiobuccal and Distal). The root canals were explored with DG 16 explorer (Hu Friedy, USA). Patency of the canal was checked with # 10 K-file. The working length was determined with ProPex II (Dentsply) and confirmed with radiography (Fig 1b) The glide path was prepared with Rotary Path files. [013(2%), 016(2%) and 019(2%)] and orifice enlargement was done using ProTaper SX (Dentsply, Maillefer, Switzerland). Canal shaping was done with ProTaper NEXT Rotary instruments (X1 and X2; Dentsply Maillefer) as per the manufacturer’s instructions using 17% of Ethylenediaminetetraacetic acid (Glyde, Dentsply) as lubricant and 5.2% of sodium hypochlorite as irrigant. EndoActivator (Dentsply) was used with 17% aqueous EDTA (Dent Wash; Prime Dental PVT Ltd, India) for one minute in the canal for removal of smear layer followed by a final flush with 3ml of sodium hypochlorite solution. Canals were dried with sterile absorbent paper points. The master cone radiograph was taken (Fig 1c) and the root canals were obturated using X2 ProTaper NEXT Gutta-percha (Dentsply Maillefer) and AH Plus resin sealer (Dentsply). The post obturation radiograph showed a dense filling in 3 roots and the patient was asymptomatic at the 1 year recall. (Fig 1d)
Case 2
A 23-year-old male patient was referred to the Department of Conservative Dentistry and Endodontics with a chief complaint of intermittent pain in the mandibular right quadrant. The pain aggravated on consumption of cold beverages and sweet foodstuffs. There was no relevant medical history. Clinical examination revealed deep occlusal caries in relation to 45. The tooth showed a painful response to vitality tests and normal response to percussion test. Radiographic examination revealed normal periodontium and the presence of an additional root. (Fig 2a) Canal outlines were vague suggesting possible complex anatomy. Additional mesial and distal angled radiographs were obtained. A provisional diagnosis of symptomatic irreversible pulpitis was made and non-surgical endodontic treatment was planned. After administration of local anesthesia, the tooth was isolated under a rubber dam. Access preparation was done and two canal orifices were easily located. Visualization under surgical operating microscope and staining with methylene blue allowed the detection of a minute third canal orifice (Mesiobuccal) and the two main canals (Distobuccal and Lingual) already located.

Working length was established with the use of an apex locator and confirmed by a radio-visualization. (Fig 2b) The canal patency was established using #10 K-file and glide path was prepared with rotary Path Files. Further shaping was done with Hyflex CM rotary files (Coltene / Whaledent Switzerland) upto a final size of #0.04/40 in lingual canal and #0.04/30 in mesiobuccal and distobuccal canals. Canals were irrigated and obturated in a similar way as that of case-1. At the one year recall the tooth remained asymptomatic. (Fig 2c and Fig 2d)
Discussion

Anatomic variations in roots and root canals pose a diagnostic and therapeutic challenge to the endodontist. Incomplete removal of pathogens from incompletely treated or untreated root canals is the principle cause of persistent periradicular pathosis. For complete shaping and cleaning of all the canals, clinicians should be familiar with the anatomy of the teeth and their associated variations.

The ‘small size’ and ‘intricate anatomy’ of premolar teeth presenting with variations transforms these ‘seemingly simple’ cases to ‘enigmatic’ ones. In fact, Slowey has called the mandibular first premolar an ‘endodontist’s enigma’. Maxillary premolars with an additional root mimic adjacent molars and have been referred to as ‘mini molars’ or ‘radiculous’ teeth. In these case reports the maxillary premolar presented with Vertucci’s type VIII canal anatomy and the mandibular premolar presented with type IX of modified Vertucci’s classification of root canal anatomy.

It is difficult to locate extra roots and canals on the 2-dimensional pre-operative periapical radiograph; therefore, Walton suggested the use of additional radiographs at 30 degree mesial and distal angulations. Vertucci reported two signs for detecting an extra canal on radiographs. A) If the middle third of the root has a mesiodistal distance equal to or greater than the cervical third of the root. This might indicate that there are two buccal roots or two root canals in a single-wide buccal root in a maxillary first premolar and B) Rapid disappearance of the continuity of radiolucent image of the root canal on the radiograph.

The presence of an eccentric orifice other than in its normal buccopalatal location leads to the suspicion of the presence of an extra canal in the tooth. Other diagnostic measures include visualization of canal bleeding points, examination of the pulp chamber floor with a sharp endodontic explorer, tracing the dentinal map, troughing along grooves and access cavity refinement with ultrasonic tips, staining the chamber floor with 1% methylene blue dye, the sodium hypochlorite champagne bubble test. Advanced diagnostic methods like Cone-Beam Computed Tomography and Spiral Computed Tomography permit 3-D visualization of hidden root canal anatomy. According to Karapinar-Kazandag et al., the powerful magnification and illumination presented by the dental operating microscope are invaluable in the detection of extra canal orifices. In mandibular second premolars, the bifurcation or trifurcation is generally present at mid root level which can be successfully managed with the help of the operating microscope.

In the above cases, rotary PathFile instruments were used to maintain the original anatomy of the root canal and easy catheterization before introduction of the rotary instruments to shape the canal. In the presence of complex dental anatomy, ProTaper Next and Hyflex CM permitted adequate shaping procedures with predictable outcomes and lower risk of iatrogenic errors like ledge formation or perforations.

Conclusion

Successful diagnosis and management of complex anatomy in maxillary and mandibular premolars has been described. Thorough knowledge of root canal anatomy and possible variations is a basic prerequisite for successful endodontic therapy. Microscopic visualization and access cavity modification may be necessary to permit identification and stress-free entry to complex canal anatomy.

References: