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Identifying Anatomical Anomaly - A Four Rooted Maxillary Second Molar Case Report

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Abstract

This article underscores the importance of understanding the root canal anatomy of maxillary second molars for successful endodontic treatment, particularly when faced with unusual root canal configurations. This anatomical variation is rare and presents a unique challenge for endodontic treatment. The case highlights the importance of recognizing and adapting to atypical root canal anatomy for successful treatment outcomes.

Keywords: Maxillary second molar, two palatal roots, four roots, root variations

Introduction

Anatomical variations can occur in any tooth, and maxillary second molars are no exception to this possibility. Recognizing root canal anatomy and any variations is crucial for improving the success rate of endodontic treatments. Typically, the maxillary second

molar has three roots and three distinct canals. However, in 14–94% of cases, a second mesio-buccal canal (MB2) is present [1].

Christie et al. documented 16 cases of maxillary molars with two palatal roots observed over 40 years of clinical practice, i.e., once in every 3 years. Christie et al. in 1991 have proposed a classification system describing three types (I-III) of four rooted maxillary second molar abnormalities, based on root separation level and their divergences. Maxillary molars of Type I exhibit two widely divergent palatal roots, often elongated and complex in shape, with buccal roots that resemble cow's horns and show less divergence. Radiographs of these teeth typically show four distinct root apices. Type II molars have a quadrifurcated root structure, with the roots being shorter, aligned parallel, and having both facial and lingual root morphology, along with blunt apices. Type III molars display a constricted root structure, where the mesiobuccal, mesiopalatal, and distopalatal canals are encased within a network of dentin, sometimes with the distobuccal root appearing as a separate entity that may even deviate in the distobuccal direction.[2] Variations in maxillary second molar with four separate roots and four separate canals including two palatal roots were the least frequent with an occurrence rate of 0.4-1.4% respectively [2,3].

This case report describes an unusual presentation of a maxillary second molar exhibiting two buccal and two independent palatal roots, along with its endodontic management.

Case Report

A 33 year old male patient with no systemic condition presented to the department of Conservative dentistry and Endodontics with a chief complaint of pain in upper right back tooth region since 20 days. The pain was sharp and continuous, exacerbated by mastication and the patient reported a history of nocturnal pain. Clinical inspection revealed deep mesio-occlusal caries. Upon vitality testing with cold test using Endo Frost, (Coltene//Whaledent, USA) tooth showed delayed response and periodontal probing was also within the normal range. Radiographic examination revealed carious lesion on mesial aspect of the suspected tooth involving the pulp and had considerable anatomic change in its root structure indicating the existence of a supernumerary root (Figure1). For better understanding of the anatomy and accurate location, 3D imaging by means of CBCT was done (Figure 2). There was evidence of periodontal ligament widening and loss of lamina dura. Based on clinical and radiographic evaluation, provisional diagnosis was chronic irreversible pulpitis with symptomatic apical periodontitis and the endodontic treatment was planned for tooth 17.

After local anesthesia with buccal infiltration of 2% lidocaine with 1:80,000 epinephrine and isolation with rubber dam (Coltene/Whaledent, USA). Caries was removed and access cavity was prepared using Endo access bur (Mani. Inc. Japan). Pre-endodontic buildup was done with composite (Ivoclar Vivadent Tetric N - Ceram Bulk fill). Clinical examination with DG -16 endodontic explorer revealed 4 canals. One canal in Palatal root, one canal in Mesiobuccal (MB) root, One canal in Distobuccal (DB) root and one canal in Palato-Distobuccal root (P-DBR) (Figure 3). According to new anatomically based nomenclature for roots and root canals for maxillary molars. The proposed formula of root and root canal for maxillary molars having additional root is XPR, where X = Anatomical position of additional canal in respect to its respective principle canal (palatal to distobuccal root), P = Principle root (distobuccal root - DB), R = Suffix “R” added for

supernumerary root [4]. Therefore, Palato - Distobuccal Root (P-DBR). The Root ZX mini (J. Morita, Kyoto, Japan) apex locator was used to measure the working length and confirmed with the radiograph (Figure 4).The canal was first equipped with # 10 and #15 stainless steel files. (Mani. Inc, Japan).The cleaning and shaping of four root canals was performed employing crown-down technique, utilising rotary Nickel - Titanium files. The apical preparation was enlarged to 04/30 (Endo star E3 Azure, Poldent Co. Ltd., Warsaw, Poland). 17% aqueous Ethylenediaminetetraaceticacid (EDTA) (Dent Wash, Prime Dental Products Pvt. Ltd, India) was used as a lubricant for the files. The root canal was frequently flushed with a solution of 5.25% sodium hypochlorite (Hypochlor, Safe Endo, India) followed by normal saline and was agitated using sonic endo irrigator (API, India). The intracanal medicament of calcium hydroxide paste (RC Cal; Prime Dental Products, India) was then administered. The patient was scheduled for a follow-up after one week, during which the tooth remained asymptomatic. The root canals were cleaned in the next session using a 5.25% sodium hypochlorite solution. Then master cone were selected and a radiograph was taken to confirm the extent of the cones (Figure 5). After confirming the master cone selection the canals were flooded with 17% aqueous EDTA (Dent Wash, Prime Dental Products Pvt. Ltd, India) for a minute to assure removal of the smear layer prior obturation. A final rinse with 5 ml of 5.25% sodium hypochlorite was done. The root canals were then dried with sterile paper points and the obturation was completed with cold lateral condensation using AH-Plus (De Trey-Dentsply, Konstanz, Germany) as the sealer. A post obturation radiograph was taken to confirm the quality of obturation (Figure 6). The tooth was then rebuilt using a packable resin composite restoration (Ivoclar Vivadent Tetric N - Ceram Bulk fill) (Figure 6).

Figure 1(a): Pre operative radiograph

Figure 1(b): Pre operative clinical picture

Figure 2: CBCT image demonstrating the presence of four distinct roots.

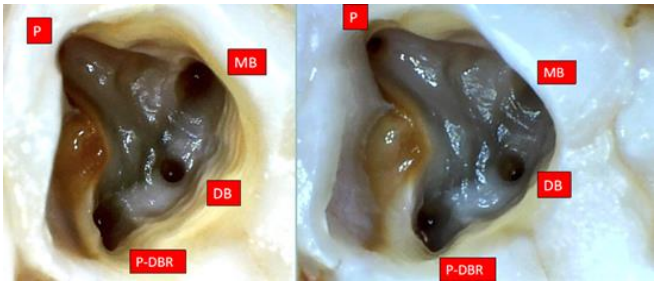

Figure 3: Access opening showing four orifices

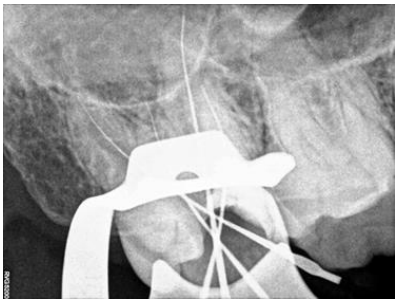

Figure 4: Working length determination

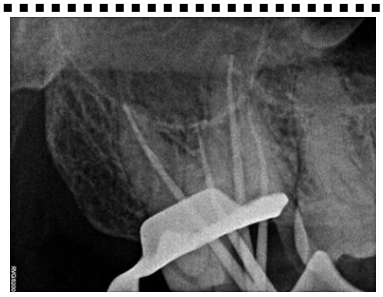

Figure 5: Master cone selection

Figure 6(a): Post obturation radiograph

Figure 6(b): Post obturation restoration with composite resin

Discussion

Maxillary second molars often possess a tri-radicular configuration, with three distinct roots and three corresponding root canals. Peikoff et al. in an article in 1996 carried out retrospective study and classified the anatomical root and canal variants for maxillary second molar into six categories.[1] Three separate roots and three separate canals (56.9%).[2]Three separate roots and four canals (two in mesiobuccalroot) (22.7%).[3] Three roots and canals where mesiobuccal and distobuccal canals combine to form a common buccal with a separate palatal (9%).[4] Two separate roots with a single canal in each (6.9%).[5] One main root and canal (3.1%).[6] Four separate roots and four separate canals including two palatal (1.4%)[5]. However, Versiani et al. (2012), using micro-CT to study four-rooted maxillary second molars, challenged the feasibility of Christie's configuration due to the possibility of root fusions occurring at different levels[6]. As a result, they proposed a revised classification introducing a new Type III, characterized by short, less divergent palatal roots and widely divergent buccal roots. Additionally, Christie's original Types II and III were merged [7]. Another classification approach for this rare anatomical anomaly involved naming the additional palatal root as radix mesiolingualis or radix distolingualis, based on its positional relationship to the prominent portion of the crown [8]. Furthermore, Carlsen and Alexandersen described maxillary molars with three buccal roots, identifying the additional root as radix paramolaris [9]. According to Versiani's configuration of canal orifices in four-rooted maxillary second molars, the orifices were classified in relation to the pulpal chamber floor as Type A (irregular quadrilateral-shaped), Type B (trapezoid-shaped), Type C (lozengeshaped), and Type D (kite shaped) [6]. This case presented with a type A configuration (Figure 3).

Operating microscopes and traditional radiography are primary techniques used in clinical practice to assess tooth anatomy. Recently, CBCT imaging has provided valuable insights into root canal morphology [10]. The advantage over the conventional radiograph it being the three-dimensional image and also allows the operator to look at multiple slices of tooth roots and their root canal systems [11].While various anatomical variations can be effectively identified using radiographic imaging, caution must be exercised when interpreting root positions, as radiographs may not always accurately reflect their true spatial orientation[12]. Radiographic interpretation of the second maxillary molar root anatomy presents complications because of

superimposition of roots on each other or adjacent bony structures[13]. Morphological differences can sometimes be difficult to interpret radiographically; therefore, it is essential to prioritise the use of an endodontic microscope in conjunction with an electronic apex locator for improved diagnostic accuracy [14]. Existing literature indicates that maxillary second molars have a higher degree of variability in terms of root numbers and morphology when compared to first molars [15].

In terms of clinical implications, the findings highlight a significant advancement in aligning narrow and standardized concepts related to root and canal morphology. This is particularly important, as the failure to identify additional roots or canals with atypical anatomy is a common cause of unsuccessful endodontic therapy [16].

Conclusion

The root canal anatomy of the maxillary second molar can present with significant variations, and clinicians should remain vigilant for these unusual anatomical configurations. However, in the pursuit of locating additional canals, care must be taken not to unnecessarily compromise tooth structure. When conventional radiographs fail to clearly depict the root canal system, three-dimensional computed tomography (CT) imaging serves as an excellent diagnostic tool, offering superior visualization for the successful management of complex cases.

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