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Case Report

Cone Beam Computed Tomography-Assisted Non-Surgical Endodontic Management of Type V Root Canal Configuration in Permanent Maxillary First Molar - A Rare Case Report

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Abstract

Knowledge of tooth anatomy, cleaning-shaping, adequate irrigation and three-dimensional obturation are paramount to achieve endodontic success. However, the clinicians should also be aware of the possibility of anatomical variations such as the occurrence of more or less number of roots, root canals and unusual canal configurations. The aim of this article is to present the diagnosis of single rooted maxillary first molar having the rare Type V root canal anatomy with its successful endodontic management using cone beam computed tomography imaging.

Keywords: Anatomical Variation; Cone Beam Computed Tomography; Maxillary First Molar; Single Canal; Type V Canal Configuration

Abbreviations

CBCT: Cone Beam Computed Tomography; MB: Mesiobuccal; DB-Distobuccal; P: Palatal; IOPA: Intraoral Periapical; SIP: Symptomatic Irreversible Pulpitis; GG Drills: Gates-Glidden Drills; NaOCl: Sodium Hypochlorite; GP: Gutta-Percha; VC: Vertical Compaction; HERS: Hertwig's Epithelial Root Sheath

Introduction

It has been well documented that, the knowledge of tooth anatomy along with its variation, thorough cleaning-shaping, copious irrigation with agitation and three-dimensional obturation of root canals are vital for successful endodontic treatment outcome. Diversions in the usual root canal morphology often complicate the routine endodontic procedure and failure may occur if one was unable to diagnose and treat such variations promptly. Anatomical variations are commonly seen in third molars, mandibular premolars, permanent maxillary first molars as well as permanent mandibular second molars. The complexities of the root canal system in maxillary first molar have often presented a constant challenge to the clinician. Permanent maxillary first molars usually show three roots and four root canals. The majority of the mesiobuccal (MB) roots have two canals and a single canal is present in the palatal (P) and the distobuccal (DB) root. Literature has shown a wide range of diversions in maxillary first molars in the form of the number of roots, canals and root canal anastomosis which is often complex and highly variable.

Vertucci has done the extensive work to identify the root canal anatomy of teeth and classified the canal configurations into various types; ranging from Type I to Type VIII [1]. In the permanent maxillary first molars, MB canal often exhibits Vertucci's Type IV canal configuration followed by Type I or Type II type canal configuration respectively. In P and DB roots, Type I canal configuration is observed in the majority of the cases. Cases of single, conical root or exhibiting C-shaped canal configuration in the maxillary first molars have been reported in the literature as a rare entity [2,3]. The presence of single rooted maxillary first molar with a single canal which bifurcates in the apical third of the root and exiting through two separate apical foramina (Vertucci's

Type - V configuration) has not been reported yet. To identify such anatomical variation, the advance imaging tool such as cone beam computed tomography (CBCT) proved to be the helpful diagnostic tool in providing a three-dimensional image of the tooth, unlike the conventional radiographs [4]. The presented case report describes the diagnosis and successful non-surgical endodontic management of the rare case of a single rooted permanent maxillary first molar exhibiting Vertucci's Type V root canal configuration.

Case Report

A 24-years-old healthy, an apprehensive female patient residing in a rural area; reported to the Department of Conservative Dentistry and Endodontics with the complaint of pain in tooth #26, since a week. The pain was spontaneous, throbbing and radiating to the left temple region. Clinical examination showed deep disto-proximal caries in tooth #26 with sound periodontal support. Thermal and electrical pulp tests exhibited an increase response in tooth #26 as compared to the control teeth. Intraoral periapical radiograph (IOPA) of tooth #26 revealed deep disto-proximal caries involving the pulp with a single root having a single wide canal (Figure 1).

Figure 1: IOPA radiograph of tooth #26 showing a single root with a single wide canal.

To confirm the presence of such a rare anatomic variation, a CBCT scan was advised after obtaining the patient's informed consent. The CBCT scan of tooth #26 showed the presence of single root with a single canal exiting from the pulp chamber to the middle third of the root and then bifurcates in the apical third (Figure 2 a, b, c). Cross section images showed that the canal was bifurcating and exiting through two apical foramina exhibiting Vertucci's Type V canal configuration (Figure 3 a, b). Based on the clinical and radiographic findings, tooth #26 was diagnosed with symptomatic irreversible pulpitis (SIP) exhibiting Vertucci's Type V canal anatomy. IOPA of tooth #16 was also advised to check the bilateral frequency of a single canal but it revealed absence of anatomic variation. The patient has advised the root canal treatment in tooth #26 after obtaining her informed consent.

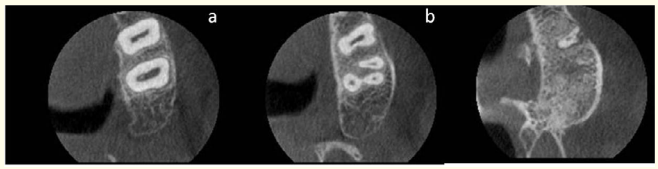

Figure 2 (a, b, c): The CBCT scans of tooth #26 at coronal (a), middle (b) and apical (c) thirds of the root.

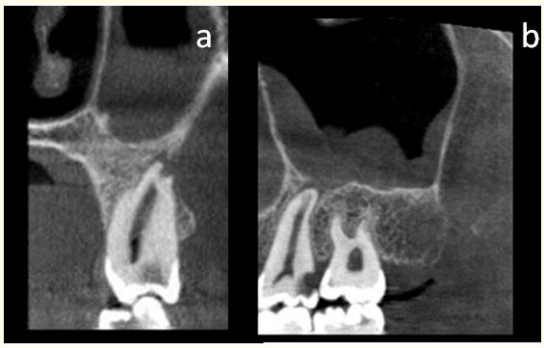

Figure 3 (a, b): Cross section scan images of tooth #26 showed the canal was bifurcating and exiting through two apical foramina showing Vertucci's Type V canal configuration.

After securing local anaesthesia, the tooth #26 was isolated under rubber dam. Access cavity was prepared which showed a wide, single root canal orifice. As the patient was very apprehensive to the dental procedures and had a severe gag reflex, working length was measured using an electronic apex locator (Root ZX II™, Morita, Tokyo, Japan). The root canal was cleaned and shaped in a Crown-down technique using hand files followed by Protaper Gold NiTi rotary files. The root canal was flared coronally till the level of the bifurcation with Gates-Glidden (GG) drills. Apically bifurcated

canals were prepared with hand files till no.#20 K-file. Then the bifurcating canals were prepared separately using Protaper gold files up to the finishing file F2 (Dentsply, Maillefer, Switzerland). During the entire root canal preparation, copious irrigation with Endo-activator agitation was done using 3% warm sodium hypochlorite (NaOCl) solution (Prime Dental, India) and distilled water was used sequentially. Final rinsing of the canal was done with distilled water and canals were dried with corresponding size absorbent Protaper paper points (Dentsply, Maillefer, Switzerland).

A radiograph was advised by placing F2 gutta-percha (GP) master cones to confirm its course and extension (Figure 4a). The root canal was obturated using selected GP with AH plus endodontic sealer (AH PLUS™; Dentsply) by warm vertical compaction (VC) technique. One cone at a time was placed in the canal and seared off at the level of bifurcation and compacted vertically. Similarly, the second cone was also placed in the canal and compacted. The remaining portion of the canal was backfilled using VC of thermo-plasticized GP. An immediate postoperative radiograph was advised after coronal sealing with intermediate restoration (Figure 4b). In the subsequent visit after a week; when the patient was asymptomatic the post-endodontic restoration was advised followed by full coverage restoration. Unfortunately, the patient did not report for the follow up visits as she moved to her native place.

Figure 4 (a, b): Master cone IOPA and immediate post-obturation IOPA radiograph of tooth #26.

Discussion

Successful endodontic treatment depends on various aspects such as knowledge of root canal anatomy, correct diagnosis, exploration of all canals, thorough cleaning-shaping, agitated copious irrigation and three-dimensional obturation of the entire root canal system. Root canal anatomy is the only factor which is beyond the control of the clinician. The variation as well as complexity in root canal configuration make the treatment more difficult and affect the treatment outcome. Root canal variations are commonly observed in third molars and mandibular premolars but maxillary first molars and mandibular second molars also exhibit a variety of anatomical diversions. In the literature, a wide range of diversion have mentioned in the root and root canal morphology of the permanent maxillary first molar. The variability of root canal anatomy in multirooted teeth presents a constant challenge to endodontic diagnosis as well as the treatment [5].

Anatomical variation and development of root and root canal system have pivoted on the activity of Hertwig's epithelial root sheath (HERS). When HERS grows horizontally it may give rise to single collar-shaped or two-three tongue-like extensions. A single extension resulted into a single-rooted tooth whereas; multiple extensions lead to the formation of a multirooted tooth. The variations observed in the root canal anatomy of the permanent teeth may be influenced by factors such as ethnicity, age and gender of the particular population [6]. Various studies have reported the high incidence of three rooted permanent maxillary first molars namely; the mesiobuccal, distobuccal and palatal roots. In the Burmese population, authors reported that all 90 (100%) maxillary first molars had 3 roots [7]. In another study, it was observed that out of 140 permanent maxillary first molars, three roots were detected in 86.4% teeth, 7.9% showed fused buccal roots, 5% exhibited fused lingual and distobuccal roots while only 0.7% teeth showed a fusion of all the roots [8]. Very few cases have been reported that describe the unusual cases of maxillary molars with a single root and single root canal configuration [9,10]. In another study authors have reported a wide variation in the root and root canal morphology of permanent maxillary molars using CBCT in the Indian population and compared it with the Caucasian and the Mongoloid traits [11]. The rare, atypical case of seven maxillary and mandibular molars with the single root and single canal in the patient diagnosed with CBCT has also been reported [12].

Permanent maxillary first molars often have an additional root canal i.e. MB2 canal, in its mesiobuccal root and seen in the range of 56.8% - 80.9% of the cases [13]. In other recent study using CBCT as a diagnostic tool, three separated roots were observed of the maxillary first molars in 100% of cases while MB2 canals were detected in 59.8% of cases. The MB root showed Type I in 40.2%, Type II in 22.4%, and Type IV canal configuration in 37.3% of the cases [14]. However, the extra canals are more common than

having less number of canals in maxillary first molars. The clinician should always explore all the canals using magnification, multi-angulated radiographs or CBCT scan than totally depending on the clinical picture alone.

In the presented case, the permanent maxillary first molar has a single root with one root canal. The single canal starts from the pulp chamber and bifurcating at the apical third and exiting through two separate apical foramina (Vertucci's type V configuration i.e. 1-2 configuration). One case of a mandibular first premolar with C-shaped canal having Vertucci Type V canal configuration was reported in the literature [15]. This type of Vertucci's configuration in a single-rooted maxillary first molar has not been documented in the literature so far.

In Endodontics, to evaluate the unusual tooth morphology and root canal configuration, conventional intra-oral periapical radiographs (IOPA) play an indispensable role. However, the radiographs have inherent shortcomings such as showing a two-dimensional image (2D) of a three-dimensional object (3D), superimposition and require more radiation dose than the digital radio-visiography (RVG). To overcome these disadvantages, the newer diagnostic aids such as spiral computed tomography and CBCT have been evolved and used effectively in the field of endodontics due to their accuracy and 3D reconstructive ability. CBCT in endodontics helps to identify anatomic variations in the root and root canals such as additional roots or canals, fused roots, C-shaped canal configuration and other complex root canal anatomy, identification of horizontal/vertical fracture lines in the root as well as in the management of internal and external resorption cases [4].

In the cases where canal bifurcates at the middle or the apical third as observed in our case; the chemo-mechanical preparation, cleansing and obturation are critical due to difficulty in the access and the visibility. Pre-flaring of the canals with GG drills provides an easier access to the apically dividing canals for further cleaning and shaping. Active irrigation with sonic or ultrasonic agitation using warm sodium hypochlorite showed to be very efficient; especially in the inaccessible areas of root canal like isthmus and intricacies to dissolve the pulp tissue. Similarly, the filling of the root canal space in such complex cases the warm vertical compaction method is advisable to achieve 3D seal by compact obturation.

Conclusion

The clinician should be well aware of the tooth anatomy and anatomical variations in the root canals and must be prepared to manage any aberrant morphology. The occurrence of a single canal in the maxillary permanent first molar is a rarity and the advanced technology like CBCT has proven to be an effective tool in the diagnosis of anatomic variations which would result in favourable treatment outcome for the patient.

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