Endodontic management of a mandibular second premolar

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Endodontic Management of a Mandibular Second Premolar with Three Roots and Three Root Canals with the Aid of Cone beam Computed Tomography : A Case Report

Abstract:

Aberrations and diversity in the number of root & canal anatomy are most commonly seen especially in the permanent dentition. A thorough understanding and knowledge on the presence of the number of roots, the root canal space configuration and its variations from normalcy mandates the success of an endodontic treatment. Mandibular second molar is usually a single rooted tooth with a single canal. Literature is already abundant with reports of additional canals within the single root of mandibular second premolars, but reports about the incidence or presence of extra roots in these teeth are rare. The incidence of three separate roots with individual distinct root canals with three separate portal of exit are very sparsely reported in literature so far. This case report presents a relatively rare case of a three rooted mandibular second premolar where along with diagnostic radiograph, Cone beam computed tomography (CBCT) was also taken which contributed greatly towards making a confirmatory diagnosis and thereafter performing successful nonsurgical endodontic management.

Key words: Anatomic variations, Cone beam computed tomography, Root canal treatment, Three rooted mandibular second premolar.

INTRODUCTION:

A thorough knowledge and understanding of root canal morphology and anatomy is mandatory for achieving high levels of predictable success in

endodontic treatment. The ultimate objective of endodontic treatment is thorough chemical and mechanical debridement of the entire root canal system, followed by a hermetic obturation and a final permanent coronal restoration to prevent microleakage. For a successful root canal treatment, extensive knowledge about the occurrence of abberent or unusual internal and external root canal morphologies becomes a prerequisite.

Unsuccessful endodontic treatment result commonly due to the failure in recognizing the variations in root or root canal anatomy. Hence, it is crucial that the clinician be well aware of the commonest possible aberrations or variations of the tooth being treated. Hoen and Pink (1) in their study on teeth requiring reâ€‘ treatment, found a 42% incidence of missed roots or canals which emphasises the importance of locating all the canals during a nonsurgical endodontic therapy. Numerous factors contribute to the aberrations found in the number of root or the root canal space configuration of permanent teeth like age, gender and ethnic background of the population studied. Slowey (2) has indicated that mandibular premolars probably because of exhibiting a high frequency of complex internal anatomy and variable root canal morphology are considered to be one of the most difficult teeth to treated endodontically.

The mandibular second premolar is usually a single rooted tooth with a single root canal system. Its already been well documented in various textbooks about the normal root and canal configuration of mandibular second premolar but there is a great deal of information already been reported in the literature with respect to the incidence of anomalies in the root and canal configuration. Literature reviews reveals extensive diversities

and variations in the root canal space morphology of mandibular second premolars. From 400 examined lower premolars, Vertucci et al.(3) reported that 97. 5% of second premolars had one root canal at the apex , 2. 5% only had two root canals of the teeth studied; the incidence of three root canals were scarce. In extensive review by Cleghorn et. al (4), eight anatomic studies were analysed(3, 5-11)which included 4019 teeth to analyse the presence of number of roots for the mandibular second premolar. About 99. 6% of teeth had a single root. Only 0. 3% of the teeth had two roots. Three-rooted teeth were extremely rare and it was only 0. 1%. This shows the rarity of incidence of three separate roots

Although uncommon, possible root canal morphological anomalies are reported in the literature. Goswami et al (12) reported mandibular premolar with two roots and two canals , Borna et al (13) reported three cases of mandibular second premolar with three canals , Mokhtari , Niknami and Zand (14) very recently reported a two rooted taurodont second premolar with three canals. Bram and Fleisher (15), Wong (16) reported cases with four canals in a single root, Alâ€‘ Fouzan (17); Tzanetakis et al (18) have published cases with two roots and four canals. Sachdeva et al (19), reported a case of four rooted mandibular second premolar with four root canals using spiral computed tomography as a diagnostic tool.

Since very rare in incidence of about 0. 1%, only very few case reports have been documented in the literature so far by Fischer and Evans (20) and Rödig and Hülsmann (21) where only periapical radiographs were used for diagnosis and treating these cases. This shows the rarity of three separate roots with three separate root canals. No case reports were published till

date with three separate roots and three separate canals in patients of Indian origin.

This case report presents a nonsurgical endodontic management of a left mandibular second premolar with three separate roots with three distinct separate root canals, with the aid of cone-beam computed tomography (CBCT) as a diagnostic tool.

Case Report

A 28-year-old male patient presented with a chief complaint of severe sensitivity and intermittent pain in tooth no. 35 (mandibular left second premolar) of 3 weeks duration. Dental history revealed that the patient underwent a temporary restoration in 35 by a general dentist two months earlier, but the patient complained of dull persisting pain from then which had increased in intensity since past three weeks. The patient also gives history of short bouts of sensitivity which lingers for a while to hot and cold food stuffs in the involved tooth. On clinical examination, there was a fractured temporary restoration in 35, with clinically evident secondary caries around the margins of the restoration. No periodontal pockets or sinus opening were present in relation to 35. The involved tooth was severely tender on percussion. Radiographic evaluation (IOPA) 35 revealed a complex root configuration which was unusual. There was an additional root and the presence of an extra root was indicated by the crossing of the translucent lines defining the pulp space and periodontal ligaments. Vague outlines of only two roots could be identified with radiopaque filling material in close proximity with the mesial pulp horn.(figure 1)Evidence of secondary caries

beneath the restoration with pulpal involvement was evident with periodontal ligament space widening and loss of lamina dura. Pulp vitality testing was done using electric pulp tester (EPT) which yielded a response only at a higher current level in comparison with the adjacent and contralateral teeth which were clinically normal. EPT was supplemented with cold testing which showed no response in relation to 35.

Since the anatomic make up of the root canal system of the involved tooth was quite unusual, additional radiographs taken at different angulations revealed the presence of more than two distinct roots, (in extreme distal angulations)(figure 2)but, the confirmation of the number of roots or root canals could not be made with the help of intraoral periapical radiographs alone. Hence, to comprehend this aberrant and rare complex root anatomy and canal space configuration of the tooth in all three-dimensions, computed imaging with the a Cone Beam Computed Tomography was planned. Patient was informed about the treatment plan and after obtaining the informed consent a CBCT image of the left mandible was taken by using the Promax3D (Planmeca, Finland). A three-dimensional computed tomographic image of the left mandible was obtained. The tooth of interest was specifically focused, and the morphology was obtained in all three planes such as transverse, axial, and sagittal sections. The axial CBCT image revealed presence of three distinct and separate roots with three distinct root canals (mesiobuccal, distobuccal, palatal) with no evidence of fusion of the roots or root canals at any level.

Correlating the clinical and radiographic findings of the patient, the final diagnosis of acute apical periodontitis with irreversible pulpitis was made

and multiple visit endodontic therapy was planned. The treatment protocol was well elaborated to the patient and after his informed consent, the second premolar was anaesthetized by inferior alveolar nerve block of the left side with 2% lidocaine (Lignox A, Warren Indoco) solution. The tooth was isolated using rubber dam and to gain an adequate access to all the canals, the conventional endodontic access cavity was modified to be wider mesiodistally and buccolingually using a Endo access bur (No. 2) and an endo tapered safe-end bur (SS white). Extensive opening of the pulp chamber was done to enable easy location of the canals. Due to the unusually long coronal pulp chamber, orifice location was difficult as direct visualisation of the floor of the chamber with naked eye was practically impossible. After careful inspection, three canal orifices were located under an operating microscope of magnification (16X). The basic modification in the shape of the access cavity was to include both the buccal and the palatal canals, by extending the cavity buccolingualy, which made the shape of the access cavity to appear as a triangle with rounded corners. Whereas the conventional access for a second premolar is ovoid in shape. The root canal configuration consists of three separate roots with three individual canals from the floor of the pulp chamber, terminating at three individual foraminas. Three canals located were mesiobuccal, distobuccal, palatal. Working length was estimated with the use of electronic apex locator (Root ZX, J. Morita Inc.), and later the same was confirmed with the working length radiograph. Manual glide path of all the three canals was first established using 10k and 15 K-file (Dentsply Maillefer, Ballaigues, Switzerland). Coronal flaring of the orifice was done using SX file of the ProTaper rotary system (Dentsply Maillefer, Switzerland) and X-Smart endomotor (Dentsply Maillefer,

Switzerland). Instrumentation was done using rotary ProTaper (Dentsply Maillefer, Ballaigues, Switzerland) nickel–titanium (NiTi) instruments and shaping was completed upto the finishing file F2 in MB, DB canals and F3 in Palatal canal of 35. The master cone was checked radiographically for the correct working length. Only new nickel–titanium (NiTi) rortary files were used in this case to instrument the canals and the rotary system was used only after establishing the manual glide path upto No 20K file to reduce the risk of fracture of the instrument.

All the three canals were irrigated continuously with abundant volume of 5. 25% sodium hypochlorite (NaOCl) solution during cleaning and shaping using a leur lock hypodermic syringe with a side vented needle. After completion of the biomechanical preparation, for the effective disruption and removal of the smear layer and plugs a final flushing was performed by alternating 17% ethylenediaminetetraacetic acid (EDTA) and 5. 25% NaOCl solution. Sterile protaper paper points (Dentsply, Maillefer, Switzerland) was used to completely dry the canals and non settable calcium hydroxide paste (Apexcal, Ivoclar vivadent, India) was given as an intracanal medicament. The access cavity was restored temporarily with Cavit (3M ESPE, Germany). The patient was asked to report after a week for review. The tooth became completely asymptomatic at a week follow up. Non settable calcium hydroxide paste was flushed and removed from the canal and a final rinse of 2 % chlorhexidine for a minute was done and manual dynamic agitation of the final rinse was done with the master cones of the respected canals for effective penetration of 2 % chlorhexidine into dentinal tubules and to break the vapour lock. The canals were then dried with sterile protaper paper

points (Dentsply, Maillefer, Switzerland) and all the canals were then obturated with No. F2 & F3 protaper GP points and AH plus sealer. The final radiographs showed three well-obturated root canals ending at the radiographic apex. The access cavity was temporarily filled with Cavit (3M ESPE AG, Seefeld, Germany) to avoid leakage. After a months review, the patient was found to be completely asymptomatic. Final permanent coronal seal was given with silver amalgam. Full coverage restoration was given in both 35 and 36 and the final radiograph shows radiographic success after a year

Discussion :

Undoubtedly its a biggest endodontic challenge to diagnose and manage extra roots or complex root canals in the mandibular pre molars. In order to best achieve this, the clinician must have profound knowledge of the basic root canal anatomy and its possible aberrations and variations. It has been well documented in the literature that inability to clean and shape a canal or to miss a root completely has been shown to be one of the major cause of failure in non surgical endodontic therapy [1, 22] . The clinical importance of this fact has already been proved by a study at the University of Washington which assessed the outcomes of the endodontic therapy, in which the failure rates for the mandibular first and second premolars were 11. 45% and 4. 54% respectively [23] showing a direct correlation between the complex root canal anatomy of these premolars and success of the endodontic theraphy.

A wide array of case reports and reviews have already been documented in the literature with respect to the multiple root canals in mandibular second

premolar, and many of these cases included three or four root canals within a second premolar [24, 25] and even fiveâ€‘ canalled mandibular second premolar [26] , but all these case reports had only one or two roots with multiple canals in it. In literature there are only very few reports on the variations in the numbers of roots that occur in mandibular second premolar [27] .

Incidence of three separate roots with three separate root canals is only about 0. 1%, and it has been very sparsely reported in the literature. The clinician should always employ meticulous care in diagnosing these aberrations prior to initiation of the endodontic therapy because in retreatment of the failed cases the anatomic landmarks would have either been completely eliminated or altered by access opening which would possibly reduce the reliability of using these morphological landmarks as a road map in locating the canals [26] . Missing these extra root or canals during non surgical endodontic theraphy can often result in acute mid treartment flareâ€‘ ups during treatment and or subsequent failure of endodontic therapy. There are reports in the literature of acute mid treatment flare-ups in mandibular second premolars with associated parasthesia of the mental and inferior alveolar nerves [28] .

Determining the number of roots in the preoperative radiographs is possible to a certain extent with the help of parallel radiographs with either mesial or distal angulation. Radiographs yield only two-dimensional images of three-dimensional objects, thus resulting in superimposition of vital structures in the resultant image. Therefore, they are of rather limited use and value in

complex root canal anatomy cases. In the present case, the preoperative radiographs gave us a clear picture of multi rooted anatomical complexity in the roots of the both first and second premolar, but there was still a suspicion with the second premolar as there was a vague outline seen behind the second root. Since these two dimensional radiographs provided only limited information, and on the basis of the results of previous studies by La *et al.* and Kottoor *et al.* , Cone beam computed tomography of the involved tooth was planned to obtain a confirmatory diagnosis. [29-31]

For this reason, it was decided to complete the endodontic treatment under the operating microscope. Efforts were made to focus at the level where root canals were separated. This point is very significant because it seems that the case difficulty is determined directly by the location of this level. The more apically the furcation area is located, the more difficult is the case. In the present case, this area was located at the level of 16 mm. The operating microscope aided in focusing precisely at this level. In addition, a clear optical field was obtained with the aid of high illumination (xenon light).

The CBCT images in this study revealed three separate roots (two buccal and one palatal) with three distinct root canals. Each of the root canals had separate apical orifice or portal of exits. Although the vague outlines of the three roots could be observed on the radiograph, only after angulated radiographs, the confirmatory diagnosis of three separate roots with three separate canals could only be made with the help of CBCT.