

RESEARCH AND REVIEWS: JOURNAL OF DENTAL SCIENCES

Management of Complex Root Canal Anatomy of Maxillary Central Incisor with Calcified Canal.

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Case Report

Received: 28/05/2014

Revised : 19/06/2014

Accepted: 21/06/2014

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Keywords: Root canal, maxillary central incisor, 3D reconstruction, tomography.

ABSTRACT

A 22 year old male patient reported with history of trauma and discolored maxillary central incisor which was non-vital upon pulp testing. Root canal treatment was planned. Access opening was performed with standard access cavity preparation set. No canal was located upon access opening initially it seemed to be calcified canal. Further access was made by the munge discovery bur #1 and #2 for locating the canal. Ultrasonic tips were used to locate canal orifice. Then finally access was gained to the canal. The main canal was located and the access was further modified to locate the additional canal. Using a surgical operating microscop under $\times 3$ magnifications the additional canal was located lingual to the main canal and the working length was determined. Chemo-mechanical preparation was done by the Crown-Down technique with K-File system. Tooth was obturated by using lateral condensation technique with AH plus sealer. A postoperative spiral CT examination was carried out to study and confirm the unusual root canal morphology of the tooth. It was concluded that tooth had two root canals with vertucci type V pattern.

INTRODUCTION

The success of endodontic treatment closely depends on complete knowledge of the complexity and variety of internal/external dental anatomy in order to identify, clean, shape and obturate the whole root canals [1]. Maxillary central incisor is considered to be the least difficult tooth for root canal treatment. It is generally considered as tooth with a single root and single root canal. One of the main objective of the endodontic treatment is to prevent or treat apical periodontitis by removing bacterial colonies and necrotic material from the root canal system [2]. This is carried out by chemomechanical instrumentation, using files, irrigants and intracanal medicaments. The space created following cleaning and shaping is obturated with a biocompatible filling material that is intended to seal the entire root canal system, thus preventing the ingress of microorganisms [3]. However, endodontic treatment can fail for many reasons, such as diagnostic errors, persistence of the infection in the root canal system, errors in debridement and shaping of the root canal systems, instrument fractures, calcifications, poor restorations and extra roots or canals if not detected are a major reason for failure [4,5,6,7]. The internal anatomy of the tooth can present a number of variations; these are extremely rare and in most cases are associated with anomalous tooth development such as gemination, fusion, dens invaginatus or presence of supernumerary root [8,9]. Maxillary central incisor has one root and one canal in 100% of cases [10,11], but recently a few cases of dual - rooted maxillary central incisor have been reported in literature. It is important that dentists consider the existence of anatomical variations of root canal systems, and that these variations can also be found in the maxillary central incisors. The incidence of an additional canal in the maxillary central incisor is 0.6% [12].

This case report highlights the clinical significance and management of a rare case of maxillary central incisor having two canals with vertucci canal pattern type V [13]. The case presented was

combination of calcified canal with surprise package of two canals. It was challenging to locate the canal in the calcified tooth and then managing very rare condition of two canals in maxillary central incisors. The case was later studied by spiral computed tomography which also confirmed our findings. The 3D reconstruction was also done by the data obtained from the spiral computed tomography scan to get an over view of root canal morphology of such a tooth.

Case Report

A 22 year old male patient reported to the department of endodontics, Karnavati School of Dentistry with complaint of discolored maxillary central incisor. On clinical examination, left maxillary central incisor did not exhibit any morphological variation and no signs of trauma to the tooth. There was absence of dental caries, periodontal probing and mobility was within physiologic limits. On pulp testing it was found non-vital. The tooth did not respond to both electric (Parkell Electronics, Farmingdale, USA) and thermal pulp testing. Preoperative radiograph revealed the presence of a single root with no visible root canal space in left maxillary central incisor compared other teeth. (Figure 1.) Periodontal ligament space widening around the apex was observed. Hence a provisional diagnosis of pulpal necrosis with periapical radiolucency was made. It was hence decided to perform root canal treatment under microscope. Before endodontic procedure oral prophylaxis was done with ultra-sonic scaler. Access cavity preparation was performed with access cavity preparation set (Dentsply-Maillefer, Rio de Janeiro, RJ, Brazil). No canal was located upon access opening initially; it seemed to be calcified canal. Further access was made by the munce discovery bur (Curtecy, CJM engineering) #1 and #2 for locating the canal. Ultrasonic tips (BUC 1) were used to locate canal orifice. Then finally access was gained to the canal. After that procedure, a compensatory finishing was carried out with a high-speed Endo-Z stainless steel bur (Maillefer-Dentsply, Switzerland) to improve the exploration of canals. The main canal was located and the access was further modified to locate the additional canal. Using a surgical operating microscope (Seiler Revelation, St. Louis, MO, USA) under $\times 8$ magnification the additional canal was located, lingual to the main canal in the midroot region of the root canal. The canals were explored (a lingual and a buccal one) and the working length was determined. After this procedure, the working length measurement was carried out and chemomechanical preparation was done by the Crown-Down technique with K-File system (Dentsply-Maillefer, Rio de Janeiro, RJ, Brazil). For irrigation 3% sodium hypochlorite and 17% EDTA were used. Tooth was obturated by using lateral condensation technique with AH Plus sealer (Dentsply, Rio de Janeiro, RJ, Brazil). (Figure 2.) A postoperative spiral computed tomography (Siemens, 64 slices, Germany) examination was carried out to confirm the obturation. The patient was observed for 3 months through clinical and radiographic examination and the tooth remained asymptomatic. In spiral computed tomography examination (Figure 3.) in panoramic view it was clearly revealed that there are two different obturated root canals in left maxillary central incisor. Cross sectional view clearly showed two different obturated canal in left maxillary central incisor. (Figure 4.) Another cross sectional views showed a main root canal dividing at the isthmus area and forming two separate canals with different path. (Figure 5, 6, 7). 3D representation of the data was also done to study the morphology of such teeth which clearly showed two different root canal tips of left maxillary central incisor. (Figure 8, 9) Hence we can say that such internal morphology is in with conjunction with external tooth morphology.

Figure 1



Figure 2



Figure 3

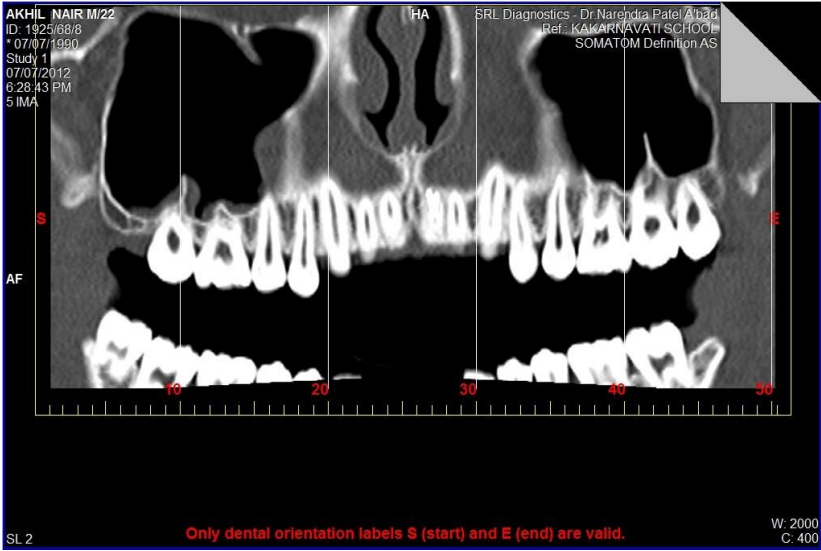


Figure 4



Figure 5

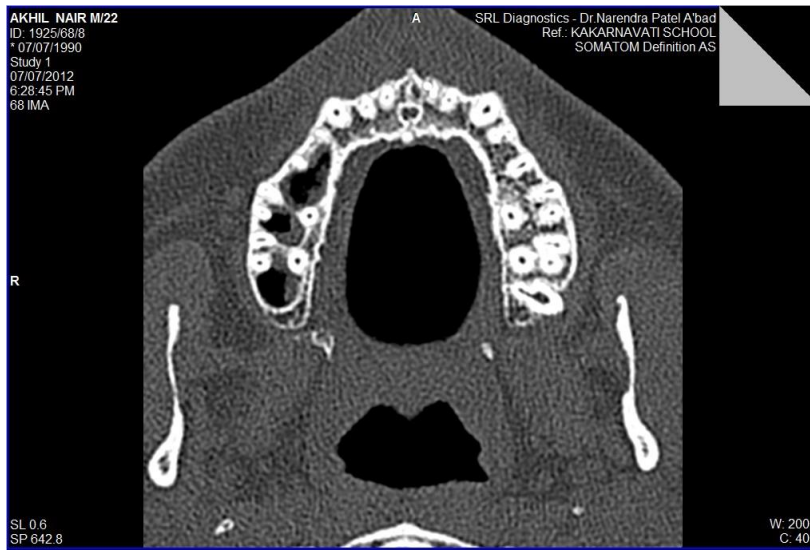


Figure 6



Figure 7



Figure 8



Figure 9



DISCUSSION

The exact mechanism of pulp canal calcification is unknown. Theoretically it may be because of sympathetic/parasympathetic blood flow to odontoblasts is altered, resulting in uncontrolled reparative dentin. Another theory is that hemorrhage and blood clot formation in the pulp after injury is a nidus for calcification if pulp remains vital [14]. Calcification replaces cellular components of the pulp and may hinder the blood supply of pulp. In the coronal pulp, calcification usually takes form of discrete-concentric appearance, while in radicular pulp, calcification tends to be diffuse. Pulp canal obliteration occurs commonly following traumatic injuries to teeth. Approximately 4-24% of traumatized teeth develop varying degrees of pulpal obliteration that is characterized by the apparent loss of the pulp space radiographically and a yellow discoloration of the clinical crown. These teeth provide an endodontic treatment challenge; the critical management decision being whether to treat these teeth endodontically immediately upon detection of the pulpal obliteration or to wait until symptoms or signs of pulp and or periapical disease occur.

Pulp canal obliteration occurs commonly as a result of trauma and usually affects the anterior teeth of young adults. Holcomb & Gregory examined 882 servicemen and found that 34 of them had a total of 41 anterior teeth exhibiting partial or total obliteration of the pulp spaces, representing an incidence of 4%. Over a 4-year period, only 3 of the 41 teeth (7%) developed periapical rarefactions on radiographs.

In a study by Robertson et al., 82 concussed, subluxated, extruded, laterally luxated and intruded permanent incisors presenting with pulp canal obliteration were followed for a period of 7–22 years (mean 16 years). Radiographic periapical bone lesions suggestive of pulp necrosis and infection developed in seven teeth (9%); the incidence of pulpal necrosis in teeth with pulp canal obliteration increased over time [15].

Maxillary central incisors are generally considered to have one root and one canal. Vertucci [13] has reported that maxillary central incisor presents single root and single canal in 100% of the cases. There were few case reports describing an additional canal in the maxillary central incisor [16,17,18]. However, some of the cases that have been mentioned were germination or fusion teeth [19,20]. The maxillary central incisor with more than one root is a rare condition. Only few case reports have been mentioned in the literature. Patterson [21], Heling [22], and Mader and Konzelman [23] observed two-rooted maxillary central incisors in routine radiographic examinations. Sinai and Lustbader [24] reported a case manifesting both two roots and two canals that was managed with an apexogenesis procedure. Michanowicz et al. [25] performed apical surgery on a two-rooted maxillary central incisor, but radiographs suggested the possibility of germination. Lambruschini and Camps [26] managed a two-rooted maxillary incisor with nonsurgical endodontic retreatment. In 2003, Genovese and Marsico [27] reported a maxillary central incisor with two roots treated with endodontic retreatment. Periradicular surgery was performed to eliminate excess filling. Gonzalez-Plata and Gonzalez-Plata [28] presented a case of two-rooted maxillary incisor.

In the present case, we noted the uncommon morphology of two-rooted maxillary central incisor in the initial evaluation. Nonsurgical endodontic treatment was performed carefully. If root canal treatment is required, teeth with pulpal obliteration fall into the high difficulty category of the American Association of Endodontists Case Assessment criteria (American Association of Endodontists 2010). This is evidenced by numerous case reports in the literature that highlight the difficulties encountered when treating such teeth [14].

Missed canals are a common cause of root canal treatment failure as they often harbor bacteria and related irritants contributing to clinical symptoms [29]. Current concepts suggest that the number of bacterial species in an infected root canals may vary from one to more than 12 and the number of bacterial cells from $<10^2$ to $>10^8$ per sample [30].

If one encounter such kind of root canal morphology and because of unawareness of how to treat such case, there will be treatment failure because of missed canal and improper cleaning. We have presented the complete step by step treatment protocols in this report. The thorough knowledge and preparedness can help dentist to treat such unusual morphological and anatomical variation in a tooth successfully.

CONCLUSION

Successful management of calcified canal was attributed to multiple angled radiographs and the use of magnification with surgical operating microscope. Spiral computed tomography confirmed presence of two root canals with type V vertucci pattern. 3D reconstruction of the data confirmed the relation between internal and external morphology. Therefore, precise exploration is essential prior to root canal treatment in order to avoid missing alternative root canals.

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