CASE REPORT

Endodontic management of taurodontism with a complex root canal anatomy in mandibular posterior teeth

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SUMMARY

One of the biggest challenges in endodontic treatment is to comprehensively understand the variation of tooth root canal anatomy. To a large degree, the anatomy and furcation distribution of teeth, which vary from nationality and ethnic groups, will influence the clinical diagnosis, treatment plan and even prognosis. Taurodontism, as one of anatomic variation in tooth structures, is relatively hard to be seen in dental clinics. Two special cases of taurodontism with varied root canal anatomies in mandibular second premolar and first molar are reported in this paper.

BACKGROUND

The success of endodontic therapy depends on preparation, disinfection and three-dimensional hermetic sealing of all root canals.¹ Therefore, it is of importance for clinicians to have a clear and comprehensive overview of the root canal anatomy before the endodontic treatment. So far, endodontic cases have shown various internal root canal anatomies, as previous classified by Vertucci.²

The mandibular first molars typically have well-defined three canals and two roots. The success of endodontic treatment on these teeth rate is around 81.48%. The rates of missed or untreated root canal(s) are 86% in distal root and 14% in mesial root, unusually depending on root canal anatomy.^{3–4} The anatomic configuration of roots and canals of first mandibular molar varies from nationality or ethnic groups. The major variation of mandibular first molar has three separate roots or additional roots. The frequency of three separate root is less than 5% in Caucasian; however, in Chinese, Eskimo and American-Indian populations, the prevalence of three separate root occurs from 5% to more than 40%.⁵ It is reported that the incidence rate of additional roots is 22.7% in a Japanese population,⁶ 15% in a Hong Kong population,⁷ 0.5%–2.06% in a Turkish population for the mandibular first molars.⁸

Mandibular second premolars have a single root with a canal. However, these teeth can show different root canal anatomy according to populations, such as mandibular first molars. Studies have indicated high level of endodontic failures and flare-ups due to complexity and diversity of root canal configurations in mandibular premolars.⁹ The incidences of mandibular second premolars with

two and more canals are 30%–39.5% and 1.2%–29%, respectively.^{10–11} However, two to four root variations are rarely reported in the literature.^{12–13} Bulut *et al*¹⁴ stated that the one root with a canal is the most common case in mandibular second premolar, which is at a high ratio of 98.9%, two separate root with two canals at 2% and three roots not yet found in the Turkish population. Similarly, Ok *et al*¹⁵ reported that the incidence of one root canal is 98.5%, two canals are 1.3% and three canals are 0.2% in the Turkish population.

Taurodontism is recognised as a relatively rare morphoanatomical anomaly in the shape of the tooth, whose body is enlarged and the roots of teeth are reduced in size.¹⁶ It is reported that the pathogenesis of taurodontic root formation is due to a delay in the calcification of pulp chamber floor, or an alteration in Hertwig's epithelial root sheath or disrupted development homeostasis.¹⁷ It is generally hard to have a complete and thorough observation on taurodontism. To the best of our knowledge, very few case reports were presented about taurodontism with a clear overview of complex root canal anatomy in the PubMed database. Therefore, this report presents two cases of taurodontism with an anatomical variation in the root canal system, the proper diagnosis way and their treatment.

CASE PRESENTATION

Case I

A 27-year-old male patient was admitted to the Department of Endodontic, Ankara University for a routine dental examination.

Clinical examination revealed that the left lower premolar tooth had a mesial carious. Tooth was not sensitive to percussion and palpation. However, this tooth did not show any response to the vitality test (electric pulp test) compared with the control tooth (right lower premolar). Patient's medical history was unremarkable.

Radiological examination showed periapical lesion and lamina dura was not continued in the apical area. However, periapical radiograph suggested anomalies as taurodontism (figure 1A). The pulp chamber is extremely large with a greater apico-occlusal height than normal and lacks the usual constriction at the cervical region of the teeth with exceedingly short roots. Soft tissue examination showed that there was no fistula and swelling.

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Figure 1 Radiographic examination and treatment results of case I: (A) initial radiography; (B) root canal orifices; (C) root canal filling.

A diagnosis of chronic apical periodontitis was made. Multi-visit root canal treatment was then planned.

Case II

Another 19-year-old male patient was admitted to the same clinic with the chief complaint of a spontaneous pain which kept him awake at night.

By clinical examination, there was a deep decay in the mandibular right first permanent molar's mesial side, which was tender to percussion. Nevertheless, it has no palpation sensitivity. Medical history of patient was unremarkable.

The radiological examination revealed a mesio-occlusal radiolucency and a large coronal pulp space. In addition, normal periodontal ligament space around three roots and lamina dura were determined (figure 2A). Based on the clinical and radiographic findings, a diagnosis of symptomatic irreversible pulpitis with a taurodontism was made. The one-visit root canal treatment was planned.

TREATMENT

Case I

The endodontic access cavity was opened by diamond fissure bur (Endo-Z, Dentsply Maillefer, Ballaigues, Switzerland) and then the tooth was isolated by rubber dam. Three root canal openings were found (figure 1B). The root canals were explored with #15 K-file (Dentsply Maillefer, Ballaigues, Switzerland). The working length was established electronically with an apex locator (Propex Pixi, Dentsply Maillefer). This length was confirmed by periapical radiography. Root canals were prepared with nickel titanium rotary instruments (ProTaper, Dentsply Maillefer) according to manufacturer suggestions. The finishing file was performed by using F3. Instrumentation and irrigation with 2mL 5.25% sodium hypochlorite (NaOCl) were applied into the root canals. The final rinse was performed with 1 min ethylenediaminetetraacetic acid (EDTA), 5mL NaOCl and distilled water, respectively. Root canals were then dried with

paper points. Then, calcium hydroxide paste was performed into the root canals using lentulo. The endodontic access cavity was sealed temporally (Cavit, 3M ESPE).

Case II

The patient was anaesthetised after an inferior alveolar nerve block using Ultracaine DS Fort (4% articaine with epinephrine 1/100 000, Hoechst-Marion Roussel, Frankfurt, Germany) followed by rubber dam application. The endodontic access cavity was prepared by diamond fissure bur same as in case I. Three root canal orifices were found and then working lengths were established electronically by an apex locator (Propex Pixi, Dentsply Maillefer) with #15 K files (Dentsply Maillefer). The lengths were later confirmed by periapical radiography. K files were put into the root canals to improve straight line access. The nickel titanium rotary files (Race, FKG Dentaire SA, Switzerland) were then used for the root canal preparation. The finishing file was 0.04 taper and apical size was #30. The following steps, including instrumentation, irrigation, final rinse and root canal drying were performed in the same way as in case I.

OUTCOME AND FOLLOW-UP

Case I

Two weeks later, the patient was recalled. His tooth has no clinical symptoms for further root canal filling. The temporary filling material was removed and tooth was isolated by rubber dam. The root canals were irrigated with NaOCl and calcium hydroxide paste was removed with #30 H-file (Dentsply Maillefer) into the root canals. The final rinse was performed for 1 min with 17% EDTA, 5mL NaOCl and 5mL distilled water, respectively. The root canals were dried with paper points. The root canals were obturated with F3 single cone and AH Plus sealer using single cone technique (figure 1C). Then, composite resin was used for the permanent filling material.

Case II

All root canals were filled by AH Plus and gutta-percha with lateral compaction (figure 2B). Finally, the composite resin was employed as the permanent filling material.

Figure 2 Radiographic examination and treatment results of case II: (A) initial radiography; (B) root canal filling.

DISCUSSION

The untreated or missing root canals, which are likely to harbour micro-organism, usually result in endodontic failure. In the meantime, micro-organisms proliferate and move to the apical area from inside of the root canal(s), further causing apical periodontitis. Therefore, these roots or root canals are the important factors of endodontic treatment.¹⁸ In addition, teeth with a dental anomaly are usually a challenge to endodontic treatment

Learning points

- Taurodontism is a relatively rare condition in dental clinic, which is especially difficult for the location and negotiation of canal configurations. This condition would complicate cleaning and shaping procedures, compromise the treatment and reduce the likelihood of a successful outcome.
- Proper angulation and interpretation of periapical radiographs may help to identify chamber and root anatomy. In short, when clinicians suspect additional root canal or different root canal anatomy, they could at least take a multiangle radiography; cone beam CT could offer better radiographic images if available.
- The magnification devices such as loupes or endodontic operation microscope are highly recommended.

by clinicians. Taurodontism is one of the dental anomalies, first described by Gorjanovic-Kramberger.¹⁶ The characteristic of taurodontism includes an extremely large coronal pulp chamber space with short roots. The endodontic treatment of taurodontism is difficult for the clinicians due to their indecisive root canal orifices and the extraordinary root canal system.

In the present report, two cases showed abnormal root canal anatomy with taurodontism. The radiographs were taken from different angles to check the suspected additional tooth roots. The loupes were used during root canal treatment procedures in order to see root canal orifices more clearly. With the popularity of dental cone beam CT (CBCT), which may offer three-dimensional information on the hard tissue changes at a relatively low-dose exposure, the root canal anatomy could be better visualised. However, the CBCT imaging is unavailable for these two cases out of economic considerations.

The increasing reports dealing with anatomical variations of teeth emphasise the clinical requirements by carefully inspecting the pulp chamber floor and locating possible accessory canal orifices. A thorough understanding of tooth and root canal morphology, angulated two-dimensional radiographs and exploring the root canals under magnification tools are essential prerequisites for a successful treatment outcome in endodontics.

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