CASE REPORT

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Endodontic Treatment of Premolar Teeth with Different Root Canal Anatomy: Two Case Reports and Literature Review

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Abstract

Thorough knowledge of the anatomy and morphology of the root canal system is necessary for successful endodontic treatment. Lack of information about anatomic variations and their properties in different teeth has been shown as being one of the main causes of endodontic treatment failure. Therefore, in our study, we reported on cases using cone-beam computed tomography for the diagnosis of teeth with different root canal structures and operation microscopes in order to enhance effective treatment.

Keywords: Cone-beam computed tomography, dental operating microscope, root canal anatomy

INTRODUCTION

Successful root canal treatment requires a thorough knowledge of both the internal and external anatomy of a tooth. Therefore, the aim of root canal treatment is the shaping and cleaning of pulp spaces and its complete filling with an inert filling material.[1] If a proper root canal shaping procedure is not performed, the treatment prognosis will be poor. Endodontic treatment failure is usually characterized by the presence of post-treatment apical periodontitis, which may be persistent, emergent or recurrent. Major causes of post-treatment disease failure are the inability to locate and debride all canals in the root canal system or the improper obturation of root canals.[2] The success of endodontic therapy depends on the through elimination of the infected pulp tissue and microorganisms, and the complete three-dimensional sealing of the root canal space.[3] Results of retrospective studies have shown that root canals do not only consist of a conical shaped single canal and a single apical foramen, but also multiple teeth openings and apical endings, lateral canals, deltas, accessory canals and other variations. Vertucci examined these types of variations in a root canal anatomy classification in 2005.[4]

The endodontic treatment of teeth showing anatomical variations is more complex than teeth presenting with well-known anatomy. At the same time, this complexity can be overcome by appropriately preparing the endodontic access gap, which allows radiographs to be carefully examined and fully understood before the treatment procedure is performed. However, two-dimensional radiography is inadequate for the diagnosis of extra root canals or root morphology.[5] For these reasons, different imaging techniques and equipment to be used during treatment have been developed recently. Some of these are cone-beam computed tomography (CBCT), micro computed tomography, and the dental operating microscope. CBCT has been increasingly used for dentistry because of its higher correctness compared to two-dimensional radiographs when evaluating the possible presence of pathologies or different types of anatomical variations in teeth. CBCT is a non-invasive and three-dimensional technique which produces images which allow for the measurement and analysis of teeth and other maxillofacial tissues without detriment to samples, which may be considered an advantage over techniques such as histology and scanning electron microscopy.[6] In this way, it has clinical benefits by improving the quality in endodontic treatment. The primary example of this was the addition of the surgical microscope to the endodontic treatment procedure, which is considered to be a useful aid in improving clinicians' ability to detect root canals, especially in teeth with accessory roots.[7]

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CASE PRESENTATIONS

Case 1

A 23-year-old male patient presented to the faculty of dentistry department of endodontics with severe pain in the upper right area. It was discovered that there was no systemic disorder in the anamnesis taken from the patient and there was a long-term, throbbing pain complaint which had started spontaneously in the right second premolar tooth of the maxilla. As a result of the clinical examination, the patient was observed to have deep caries on the distal surface of the tooth. In the percussion and palpation test, it was determined that there was no pain or mobility in the tooth. In the electric pulp test, it was noted that the relevant tooth responded earlier and was more vital than the symmetrical tooth. Sinus tract and swelling were not observed in the soft tissues. Radiological examination revealed no periapical pathology in the roots of the tooth and lamina dura (Figure 1). The patient was diagnosed with pulpitis and root canal treatment was planned. The patient was informed about all procedures and an informed consent form was signed.

The tooth was anesthetized with infiltrative nerve block by using ultracaine DS Fort (4% articaine with epinephrine 1/100,000, Hoechst Marion Roussel, Frankfurt, Germany). After preparing an access cavity to the relevant tooth, a rubber-dam was placed for isolation. The pulpal floor was carefully examined with a magnification loupe (2.5x), and three canals were identified. After careful examination, another root canal was found in the buccal root. Accordingly, the pulpal floor revealed in total four canal orifices; three root canals in the buccal roots and one root canal in the palatal root (Figure 2). After all these processes, the root canal lengths were determined using an apex locator with type #15 K file (Dentsply Maillefer, Ballaigues, Sweden). Following working length determination, cleaning and shaping procedures were performed using the ProTaper Universal rotary system (Dentsply-Maillefer, Ballaigues, Switzerland) using the step-down technique to size #F1 in the buccal canals and size #F2 in the palatal canal. Copious irrigation was carried out with 5% NaOCl during instrumentation. After the instrumentation process, the last irrigation was performed with 17% EDTA saline and 5% NaOCl. The root canals were dried with absorbent points, and congruous Protaper Gutta-percha points were placed. Radiologically, the Gutta-percha points were checked and then the root canals were obturated using a resin-based sealer (Dia-Proseal, Diadent) (Figure 3) and the relevant tooth was restored with composite. At the postoperative follow-up of the patient 3 months later, no symptoms were observed.

Case 2

A 21-year-old male patient presented to the faculty of dentistry department of endodontics with severe pain in the posterior mandibular area. The patient had no systemic disease. In the clinical and radiological examination, deep caries was detected in the mandibular right second premolar tooth. In the percussion and palpation test, it was determined that there was no pain or mobility in the tooth. Positive response was

Figure 1. Case 1 preoperative radiographic figure.

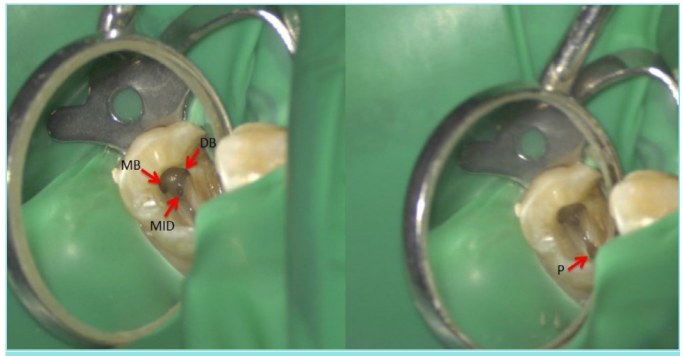

Figure 2. Case 1 intraoral figure.

MB: Mesiobuccal canal, DB: Distobuccal canal, MID: Mid canal, P: Palatine canal

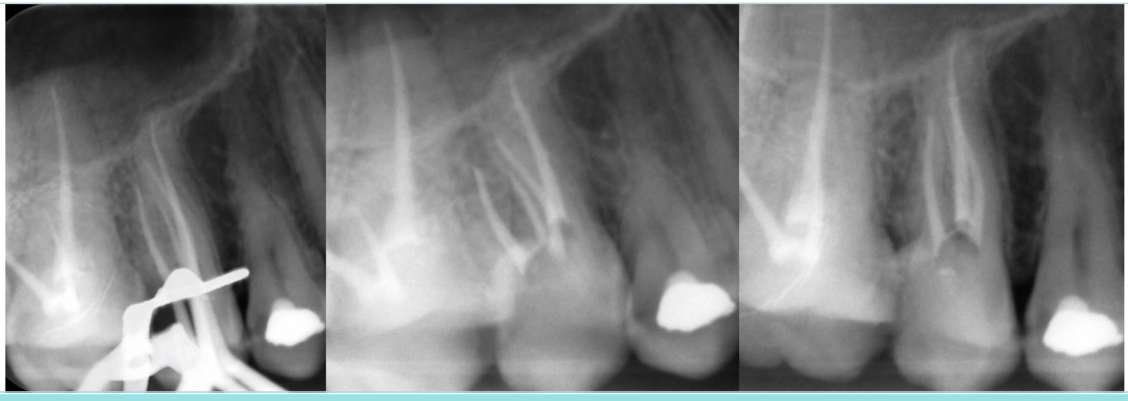

Figure 3. Case 1 intraoperative and postoperative figure.

received in the vitality test (cold test). A diagnosis of irreversible pulpitis was made and root canal treatment was planned. A striking point was observed on the radiography, namely that it was thought that the root canal was divided into several canals in the middle third area of the root. The patient was informed about all procedures and an informed consent form was signed.

Local anesthesia of the patient's right inferior alveolar nerve block was applied with ultracaine DS fort (4% articaine with epinephrine 1/100,000, Hoechst Marion Roussel, Frankfurt, Germany). The caries on the distal surface of the tooth was cleaned and the endodontic access cavity preparation was performed. After pulpal extirpation, the patient was recommended for CBCT imaging for evaluation of the root canal morphology. The patient was recalled for a second appointment. According to a review of the CBCT results, it was found that the root canal was divided into 4 different canals starting from the middle third of the root (Figure 4). The tooth was isolated with a rubber-dam (Figure 5). Access to the root canals was achieved with K files #8 and #10. When the files were positioned, radiographs were taken for evaluation. The root canal working lengths were determined using an apex locator with a type #10 K file (Dentsply Maillefer, Ballaigues, Sweden). The root canals were instrumented to size F1 using ProTaper Universal nickel titanium rotary instruments (Dentsply Maillefer, Ballaigues, Switzerland). The root canals were irrigated with 5% NaOCl during instrumentations. After the canals were dried with paper points, the root canals were filled using the lateral condensation technique with resin-based sealer/Gutta-percha points (Dia-Proseal, Diadent) and the root canal treatment was completed (Figure 6). As a result of the postoperative follow-up of the patient after 3 months, no symptoms were observed.

DISCUSSION

Extensive knowledge of the root canal configuration and variety is essential for the long-term success of endodontic therapy. Hoen and Pink[8] reported that the incidence of cases requiring retreatment due to overlooked roots or canals is 42%. Endodontic success in teeth with a number and morphology of canals that are unusual found requires a correct diagnosis and careful clinical radiographic inspection. Before starting treatment, the tooth should be evaluated due to the possibility of having different morphological variations. Periapical radiographs should be evaluated carefully as they can provide information about morphological variations in teeth. Accurate evaluation of pre-operative radiographs is essential to detect extra roots/canals.[9] However, as in our study, periapical radiography may be inadequate. Therefore CBCT should be used in those patients with different tooth morphology.

To date, single, double, and three rooted maxillary second premolars have been identified, with the number of canals ranging from one to three according to different grades of classifications. On the other hand, four canal maxillary second premolars reports are very rare. Leonardo et al.[10] reported that the inability to detect, locate, negotiate and instrument the canals in multi-rooted teeth plays a significant part in the failure to execute any of the above-said factors and will lead to endodontic failure.[11] Considering these, in our study, three different roots and four different root canals were detected in the first right upper second premolar tooth.

The mandibular second premolar is one of the most difficult teeth for endodontic treatment because of the multiple variations in the

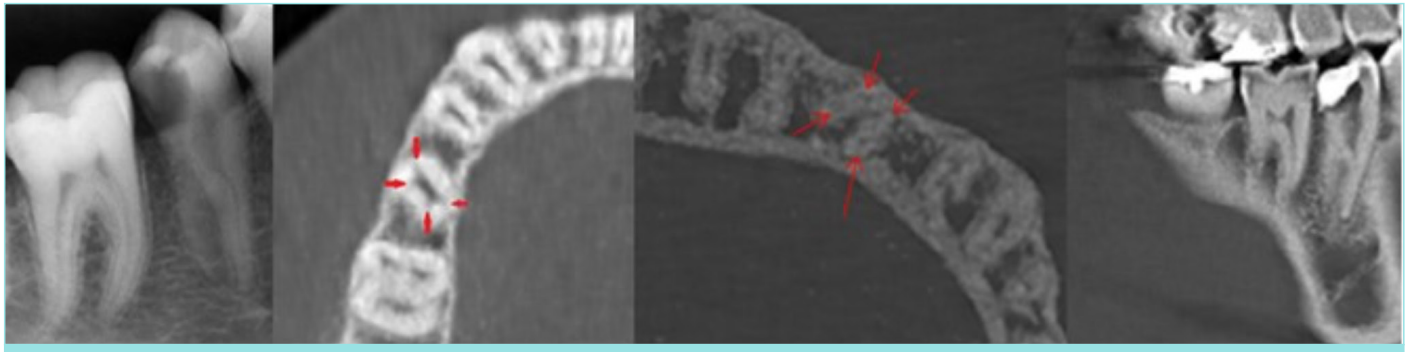

Figure 4. Case 2 preoperative and cone-beam computed tomography figure.

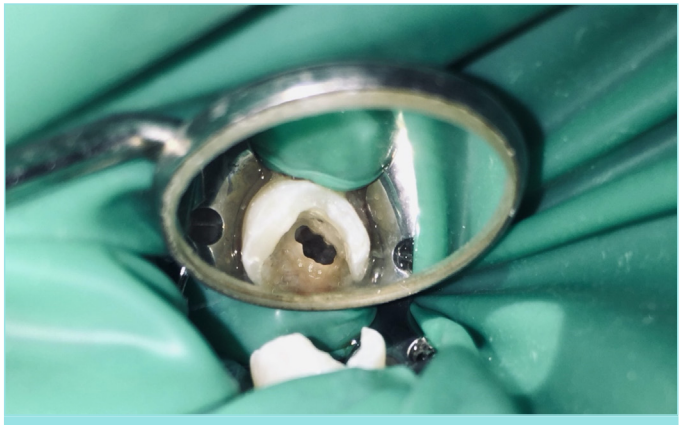

Figure 5. Case 2 intraoral figure.

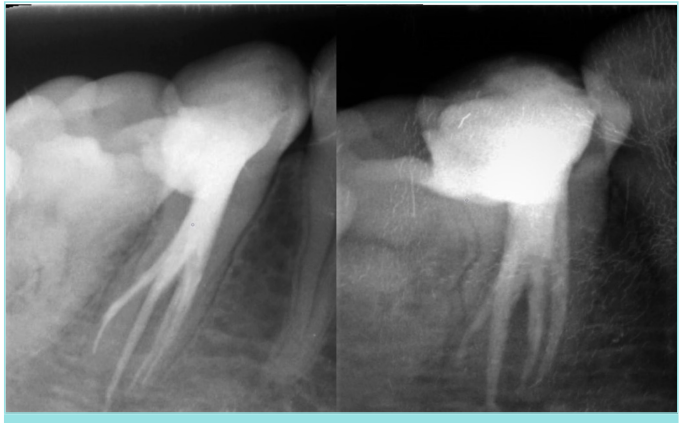

Figure 6. Case 2 postoperative figure.

morphology of its root canal system. Rahimi et al.[12] stated that the incidence of lateral canal (38.7%) and apical delta (4.38%) in mandibular premolars was high. However, the frequency of 3 or 4 canals in lower premolar teeth is rare. In our study, it was found that in case 2, there were two roots and four canals in the right lower 2nd premolar tooth separated in the middle third. CBCT was used in order to understand this anatomical confusion.

Llena et al.[13] reported that mandibular second premolar canal configurations according to the Vertucci criteria are 90.6% type 1, 1.8% type 2, 7.5% type 5, and 0.0% type 6. As a result, most teeth were reported to be type 1 followed by type 5. One first premolar tooth showed a root canal configuration which was not included in Vertucci's classification (one canal in the coronal third of the root, three canals in the middle third, and a single canal in the apical third). In that study, the other reported result was that morphological variation was significantly higher in the first molars than in the second molars.[13]

New technological tools, such as dental study microscopy, greatly enhance the viewing area of root canal holes, allowing the work area to be enlarged and illuminated to a greater extent. Considering these advantages, de Carvalho and Zuolo[14] explained the importance of microscopes, which can significantly improve the prognosis of treatment.[15] In order for the root canal treatment to be successful, a dental microscope was used for the detection of extra canals and the appropriate chemomechanical preparation.

Knowledge of the relevant tooth's root canal anatomy and its variations from the normal is important for the success of root canal treatment. A detailed interpretation of radiographs coupled with accessibility and inspection of the pulpal floor under magnification can play an important role in the root canal treatment of complex root canal anatomy in endodontics.

MAIN POINTS

- Knowledge and understanding of the complexity in root canal anatomy is an important factor for the success of endodontic treatment.
- Today, the effect of magnification on endodontic treatment procedures is an indisputable fact. Therefore, it is advantageous to use dental operation microscopes in the clinic.
- Endodontic diagnosis using cone-beam computed tomography provides 3D imaging which provides a better understanding of complex situations.

ETHICS

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: A.Ö., S.S., Design: A.Ö., S.S., Supervision: F.S., B.Ç., Data Collection and/or Processing: A.Ö., S.S., Analysis and/or Interpretation: F.S., A.Ö., S.S., B.Ç., Literature Search: A.Ö., S.S., Writing: F.S., A.Ö., S.S., B.Ç.

DISCLOSURES

Conflict of Interest: The authors have no conflicts of interest to declare.

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