

Clinical Features and Endodontic Treatment of Two-Rooted Mandibular Canines: Report of Four Cases

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SUMMARY

Introduction Predictable endodontic treatment depends on the dentist's knowledge about root canal morphology and its possible anatomic variations. The majority of mandibular canines have one root and root canal, but 15% may have two canals and a smaller number may have two distinct roots. The following clinical reports describe endodontic treatment of mandibular canines with two roots and two root canals.

Outline of Cases Four clinical case reports are presented to exemplify anatomical variation in the human mandibular canine. Detailed analysis of the preoperative radiographs and careful examination of the pulp chamber floor detected the presence of two root canal orifices in all canines. Working length was determined with an electronic apex locator and biomechanical preparation was carried out by using engine driven BioRaCe Ni-Ti rotary instruments in a crown-down manner, followed by copious irrigation with 1% sodium hypochlorite. Definitive obturation was performed using cold lateral condensation with gutta-percha cones and Top Seal paste. The treatment outcome was evaluated using postoperative radiographs.

Conclusion Endodontists should be aware of anatomical variations of the treated teeth, and should never presume that canal systems are simple.

Keywords: anatomy; endodontics; mandibular canine; two roots

INTRODUCTION

A comprehensive knowledge of the external and internal anatomy of teeth is essential to ensure predictable endodontic treatment [1]. Mandibular canines are teeth with one root and one root canal occurring in a very high rate of cases [2]. However, several investigators have reported the presence of anatomical variations associated with mandibular canines. Pineda and Kuttler [3], Green [4] and Vertucci [5] reported that the occurrence of mandibular canines with one root and two root canals is about 15%. The occurrence rate of mandibular canines with two roots and two canals ranges from 1.7% up to 5% of all examined canines [6, 7]. Laurichesse et al. [8] reported the presence of two distinct roots and two root canals in only 1% of analyzed canines. Despite the low occurrence, endodontists should be aware of possible variations in the number of roots and root canals of mandibular canines.

The following clinical reports describe endodontic treatment of four mandibular canines with two roots and two root canals.

CASE REPORTS

Case 1

A 42-year-old male patient was referred to the Dental Clinic of Vojvodina, due to spontaneous, severe pain in the mandibular region on the left side. A history of the condition was

recorded and a clinical examination and diagnostic tests were performed, ending with a diagnosis of irreversible pulpitis of tooth 33. Endodontic treatment was proposed to the patient. After the patient's consent, the treatment started with preoperative radiography. Careful analysis of the radiograph revealed a two-rooted canine with root bifurcation at the apical third of the root according to Sharma et al. [9] and recently Versiani et al. [10], as shown in Figure 1a.

After applying local anesthesia, a rubber dam was placed. An access cavity preparation, modified to take into account the two canals, was performed and the coronal orifice of the main root canal was found. During the exploration of the root canal with a No.15 K-file (FKG Dentaire S.A., Chaux-de-Fonds, Switzerland), the presence of two branches of the root was confirmed, (buccal and lingual, as based on external tooth anatomy). A working length was determined radiographically (with no rubber dam and clamp on the tooth while taking the radiograph) for both canals (Figure 1b) and confirmed electronically. Both canals were prepared in a crown-down manner according to the sequences for working with the engine driven BioRaCe Ni-Ti rotary instruments (FKG Dentaire S.A., Chaux-de-Fonds, Switzerland); BR1 15/0.05, BR2 25/0.04, BR3 25/0.06 and BR4 35/0.04 at the end of preparation. Copious irrigation with 1% sodium hypochlorite solution, followed by saline solution (0.9%), was performed after each step of the instrumentation. Paper points were used to dry

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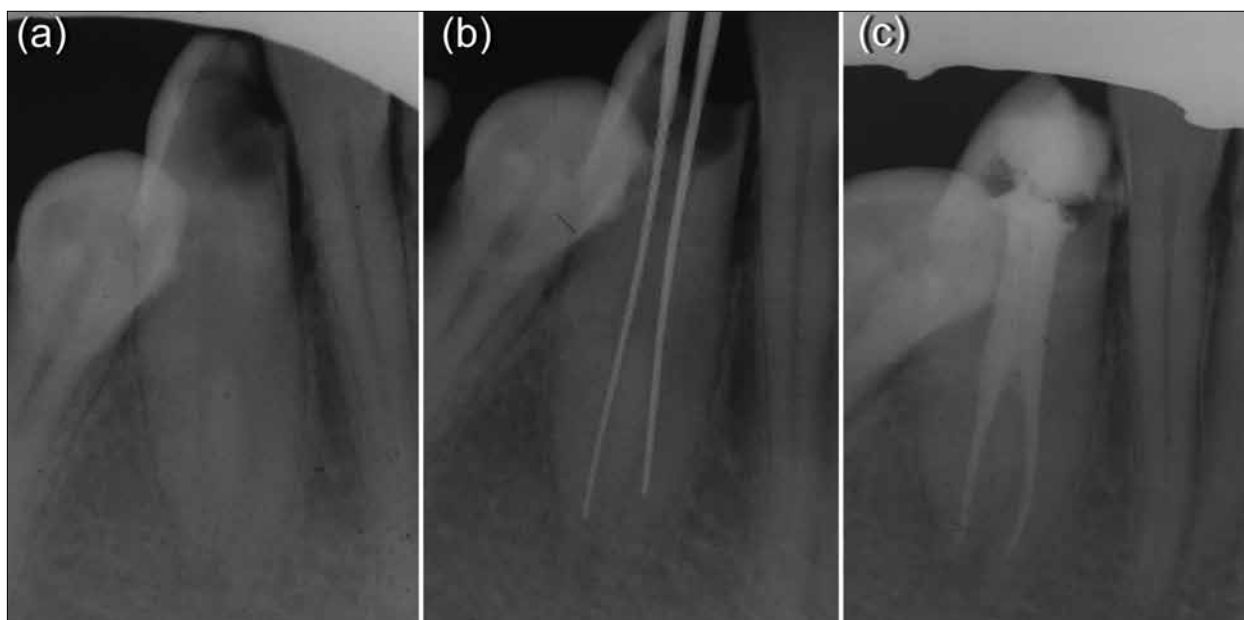


Figure 1. Case 1: (a) Preoperative radiograph of tooth 33 indicating two roots; (b) diagnostic length files placed into both root canals; (c) final obturation of the root canals using lateral compaction of gutta-percha.

the canal. Top Seal paste (Dentsply Maillefer, Ballaigues, Switzerland) was placed in the canal using a No.15 NiTi K-file (FKG Dentaire S.A., Chaux-de-Fonds, Switzerland) with a counter-clockwise motion. A master gutta-percha cone 35/0.06 (FKG Dentaire S.A., Chaux-de-Fonds, Switzerland) and accessory gutta-percha cones were laterally compacted into the root canal. Excess gutta-percha was removed with a heat-carrier and the remaining gutta-percha was vertically compacted. The access cavity was temporary sealed with IRM Ivory (Dentsply/DeTrey, Konstanz, Germany). The postoperative radiograph showed two well-obtured root canals, ending at the electronically located apices (Figure 1c).

Case 2

A 38-year-old female patient was referred to the Dental Clinic, with a chief complaint of slight unspecific pain in the mandibular region on the left side which had lasted for two months. Clinical examination and diagnostic tests revealed slight percutory and palpatory sensitivity of tooth 33, which was part of a fixed prosthesis. Careful analysis of preoperative radiographs revealed a periradicular radiolucency and a periodontal pocket associated with the left mandibular canine. Radiographs also indicated the presence of two roots and two root canals, of which only one was previously endodontically treated (Figure 2a). Upon clinical examination, the treatment options were presented to the patient, including the removal of the fixed prosthesis, followed by endodontic and periodontal therapy of the left mandibular canine. After the patient's consent, the fixed prosthesis was removed and endodontic treatment was initiated with the administration of local anesthesia and placing a rubber dam. An access cavity was prepared to preserve as much of the coronal part of the tooth as possible, but to provide unobstructed instrumentation of

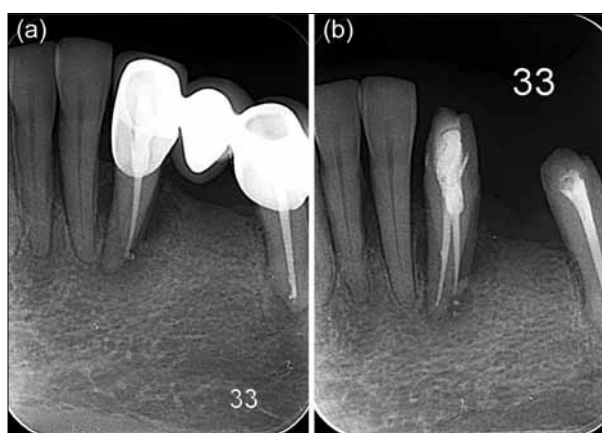


Figure 2. Case 2: (a) Preoperative radiograph of tooth 33 indicating the presence of two roots, one of which was previously endodontically treated, as well as a periradicular radiolucency; (b) final obturation of the mandibular left canine with two roots and two canals.

both canals. The root canals were separated in the coronal third, which made the treatment relatively easier. The remnants of the existing root canal filling were removed using engine driven rotary re-treatment files (ProTaper Universal Retreatment Kit, Dentsply/Maillefer, Ballaigues, Switzerland) and the X-Smart endomotor (Dentsply/Maillefer, Ballaigues, Switzerland) with the speed of 800 rpm. A working length for both root canals was determined electronically. Both canals were then instrumented using a crown-down technique and obtured as described previously (Figure 2b).

Case 3

A 44-year-old female patient was referred to the Dental Clinic, because of spontaneous, sharp pain in the mandibular region on the left side, which lasted for about ten days. The patient could not localize the pain, but a clinical

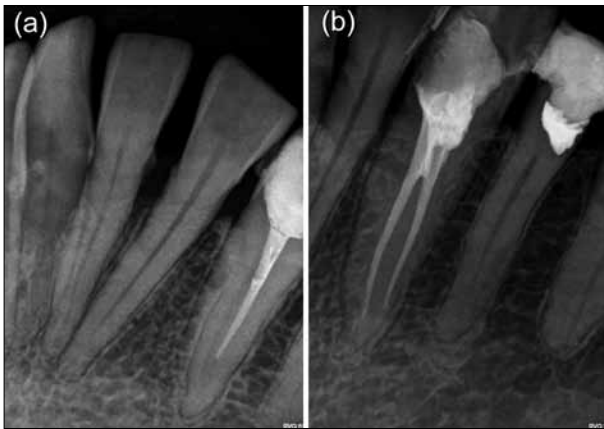


Figure 3. Case 3: (a) Preoperative radiograph of tooth 33 shows the presence of two roots, one of which has an inadequate root canal fill; (b) final obturation of the mandibular left canine using cold lateral compaction of gutta-percha.

examination and clinical diagnostic tests revealed highly expressed percutory sensitivity associated with the left mandibular canine; pain was particularly expressed to the cold test, and electrical pulp test showed decreased values. Preoperative radiographs showed the presence of two separated roots of the left mandibular canine, one of which was previously endodontically treated, while the other one was not treated at all (Figure 3a). Previous endodontic therapy was not successful as the remnants of the pulp tissue were inflamed and gave the symptoms of acute pulpitis. After the administration of local anesthesia and isolation with a rubber dam, an access cavity was prepared and modified to take into account the two canals, both buccal and lingual. The existing canal filling material was removed from the root canal which had been previously treated, as described in Case 2, using engine driven rotary re-treatment files. Both root canals were explored with No. 10 K files (FKG Dentaire S.A., Chaux-de-Fonds,

Switzerland), and the working length determination, irrigation, instrumentation and obturation were performed as described previously (Figure 3b).

Case 4

A 46-year-old female patient was referred to the Dental Clinic because of intense, throbbing pain in the periradicular region of the right mandibular canine, which lasted for two days. The tooth was highly sensitive to pressure, percussion and palpation, the electric pulp test was negative, and radiograph examination revealed a periapical radiolucency associated with tooth 43 and the presence of two roots (Figure 4a).

The diagnosis of chronic apical periodontitis was established. Drainage of the unanaesthetized tooth was performed using a round diamond bur, the roof of the pulp chamber was removed and the release of exudates provided the patient with immediate relief. After two days, the patient had no more subjective symptoms and endodontic therapy was continued. The root canals were separated in the coronal third, which made the endodontic treatment easier. After obtaining a dry operating field, the canal orifices were extended using the #2 Gates-Glidden bur, the working length was determined electronically and instrumentation was done using a crown-down technique, as described previously. Irrigation was performed using 1% sodium hypochlorite solution and medication was performed using calcium-hydroxide paste (Septodont, Saint Maure des Fosses Cedex, France) for seven days. Final obturation was performed as described previously with gutta-percha cones (FKG Dentaire S.A., Chaux-de-Fonds, Switzerland) and Top Seal paste (Dentsply Maillefer, Ballaigues, Switzerland) using the cold lateral condensation technique. The postoperative radiograph showed two well-

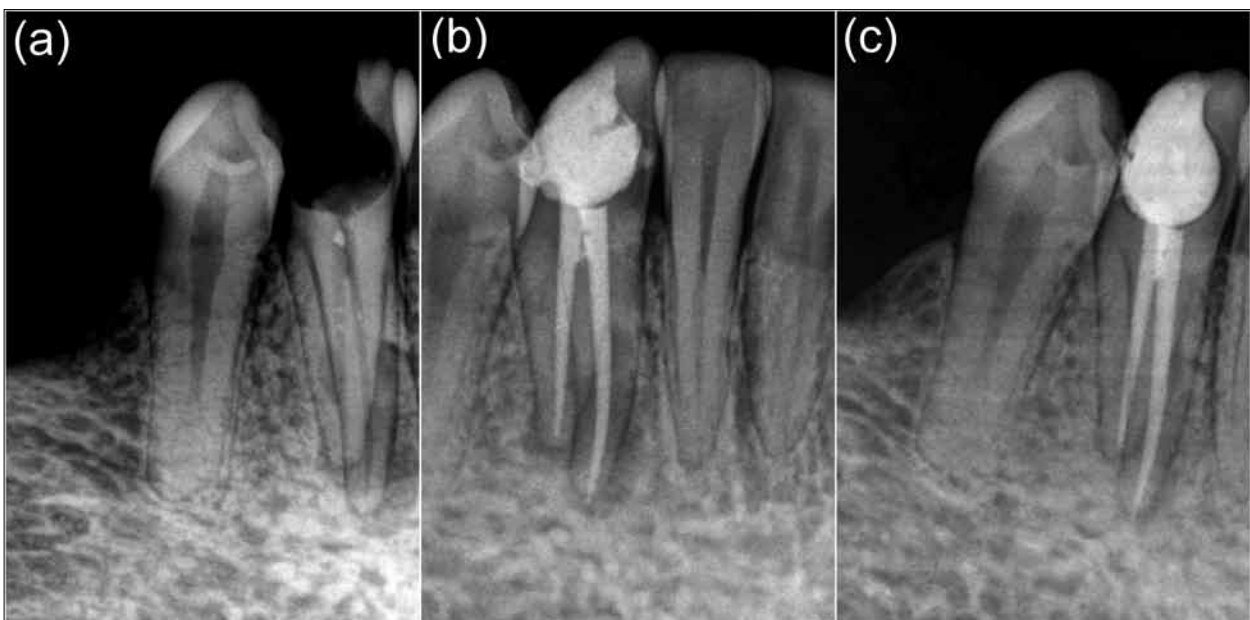


Figure 4. Case 4: (a) Preoperative radiograph examination revealing periapical radiolucency and the presence of two roots; (b) final obturation of both root canals in the mandibular right canine using cold lateral compaction of gutta-percha; (c) a 6-month postoperative radiograph showing the progression of hard tissue healing in the periapical region.

obtured root canals (Figure 4b). At a 6-month recall, the patient was asymptomatic and a 6-months postoperative radiograph showed progression of hard tissue healing in the periapical region (Figure 4c).

DISCUSSION

Clinicians should never assume that a given tooth will contain a specific number of canals [11]. Endodontists should be aware of the possibility of additional root canals, which must be detected; otherwise treatment failure is extremely possible [12, 13].

Only three case reports of endodontic treatment of mandibular canines with two roots have been reported [11, 14]. Heling et al. [15] presented a case report of a mandibular canine with two roots and three root canals, while Holtzman [16] reported a case of root canal treatment of a mandibular canine with three root canals.

Over the past four years of clinical practice of the current authors, the percentage of endodontically treated mandibular canines with rare anatomical variations was 2.5% (4/161). All of these clinical cases are presented in this article.

The endodontic treatment of mandibular canines with two roots and two distinct canals requires accurate diagnosis based on the medical and dental history of the patient, clinical examination, careful analysis of preoperative, diagnostic radiographs from different angles and a detailed plan of therapy [17].

High quality, preoperative radiographs taken from different angulations, and their correct interpretation, are an indispensable factor for identifying all significant details and clarifying uncertainties. If the mandibular canine has two roots, they are positioned buccally and lingually. The superposition of roots and canals on radiographs, especially in the presence of agonist teeth, can cause that the clinician easily overlooks the existence of additional roots/canals. In these current cases, radiographs from different angles usually indicated two clearly visible buccal and lingual roots. A careful analysis of the continuity of the periodontal ligament can infer the presence of an extra root or canal. Clinicians should observe the direction of a root canal and if sudden interruption of its continuity exists, it can indicate branching of the canal [18].

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A careful examination of the pulp chamber floor and manual exploration of the root canal system with an appropriate endodontic file is the reliable way to identify the exact configuration of the root canal system. Using augmentative equipment, such as magnifying loupes or an endodontic microscope is very helpful during the diagnosis of the canal system. The practice of extending the access cavity bucco-lingually is mandatory to find extra and/or hidden canals. If the endodontic instrument is inclined too buccally or lingually and cannot be removed from the canal in an opposite direction, the eventual presence of two canals might be indicated [19]. With regards to the root canals, engine-driven, rotary, endodontic instruments made of Ni-Ti alloys are capable of achieving faster and easier root canal preparation with a predictable treatment outcome, even in complicated root canal systems [20].

According to Sharma et al. [9] and recently Versiani et al. [10], the second root/canal of the mandibular canine can branch from the apical, middle (as described in Case 1) or coronal thirds (Cases 2, 3 and 4). If a branching of root/canal is located more apically, the case is more difficult to diagnose and treat [21].

When one of the lower anterior teeth has a complicated canal system, a detailed analysis of external and internal anatomy of the surrounding teeth and the eventual detection of similar cases is required.

Despite the fact that mandibular canines are usually composed of a single root and a single root canal, it is very important for clinicians to consider all the possible tooth anatomy variations (external and internal) and to have an individual approach to each endodontic therapy. Careful and detailed clinical and radiograph examination are an essential factor in detecting morphological variations. Only obturation of the entire root canal system can provide predictable and long-term clinical success.

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Клиничке одлике и ендодонтско лечење мандибуларног очњака са два корена: приказ четири случаја

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КРАТАК САДРЖАЈ

Увод За постизање успешног и предвидљивог ендодонтског лечења неопходно је поседовати знање о морфологији каналног система зуба и његовим могућим анатомским варијацијама. Очњаци у доњој вилици углавном имају један корен и један канал, али у 15% случајева се јављају два канала, а само код малог броја постоје и два одвојена корена. Следећи прикази болесника описују ендодонтско лечење очњака са два канала и два корена у доњој вилици.

Приказ болесника Детаљном анализом рендгенског снимка пре интервенције и пажљивим прегледом дна коморе пулпе установљено је постојање два улаза у канале корена код свих лечених очњака. Радна дужина је одређена електродонтометријском методом, а биомеханичка препарација канала је извршена никл-титанијумским машинским инструментима пуне ротације применом тзв. *crown-down* технике. Препарација канала је била праћена обилним испирањем канала корена помоћу једнопроцентног раствора натријум-хипохлорита. Коначна оптурација је извршена гутаперка поенима и пастом *Top Seal* методом хладне латералне компакције, након чега је постоперационим рендгенским снимком потврђена успешност ендодонтског лечења.

Закључак Приликом примене ендодонтског тремана треба индивидуално приступити сваком болеснику и увек имати на уму могућност постојања анатомских варијација каналног система зуба.

Кључне речи: анатомија; ендодонција; очњак у доњој вилици; два корена

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