



Challenging anatomy: Successful management of a mandibular central incisor with two canals

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Abstract

The presence of two canals in a mandibular central incisor represents a rare and complex challenge for dentists. This case report describes the management of a patient with a mandibular central incisor exhibiting two distinct root canals. It emphasizes the importance of understanding canal anatomy to avoid endodontic failures and highlights the difficulties associated with identifying and negotiating uncommon anatomical variations. The low incidence of this anatomical variant underscores the necessity for adequate preparation and a targeted approach in managing such cases.

Keywords: canals; central incisor; endodontic treatment; root canal

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Сложная анатомия: успешное лечение центрального нижнего резца с двумя каналами

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Резюме

Наличие двух каналов в центральном резце нижней челюсти представляет собой редкую и сложную задачу для стоматологов. В данном клиническом случае описано лечение пациента с центральным резцом нижней челюсти, имеющим два отдельных корневых канала. Подчеркивается важность понимания анатомии корневых каналов для предотвращения эндодонтических неудач, а также акцентируется внимание на сложностях, связанных с выявлением и прохождением редких анатомических вариаций. Низкая распространенность данной анатомической особенности подчеркивает необходимость надлежащей подготовки и целенаправленного подхода к лечению подобных случаев.

Ключевые слова: каналы; центральный резец; эндодонтическое лечение; корневой канал

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INTRODUCTION

The presence of two canals in mandibular incisors is a rare anatomical variation that poses significant challenges for dental professionals. While many practitioners may be familiar with the typical morphology of these teeth, the existence of additional canals often goes unnoticed, leading to misdiagnosis and inadequate treatment. In endodontics, one of the primary reasons for treatment failure is the inability to recognize these anatomical variations. Missing canals contribute significantly to the rate of endodontic failure, as they may harbor persistent infections or lead to complications post-treatment. Hence, missing untreated canals account for 12.2% and 17.4%, respectively, of the cases of periapical lesions in the central and lateral mandibular incisors [1; 2].

The scientific literature indicates that the prevalence of two root canals in mandibular incisors is 21.9% and 26.0% in the central and lateral incisor, respectively. The outcomes vary according to geographic location, ethnicity, age, and gender [3].

Hence, the implications of failing to identify such variations are profound. As a result, a comprehensive understanding of root canal anatomy is crucial for successful endodontic outcomes. This case report will illustrate the importance of meticulous diagnosis and treatment planning in managing a mandibular central incisor with two canals, underscoring the necessity for dental practitioners to enhance their skills in recognizing and addressing uncommon anatomical presentations.

CASE REPORT

A 64-year-old male patient, with no significant medical history, known allergies, or medication use, presented to the dental clinic with discomfort in the mandibular incisor region. The patient was identified as a bruxist, presenting significant wear on the incisal surfaces of his teeth. Clinical and radiographic evaluations, including intraoral radiographs, cold sensitivity tests, and percussion and palpation tests, revealed that all four man-

dibular incisors were necrotic. A cone-beam computed tomography (CBCT) scan was performed to further assess the anatomy, confirming the presence of two canals in tooth 41, which were already partially visible in the initial intraoral radiograph (Fig. 1).

The patient was informed of the need for root canal treatment on all four mandibular incisors and signed the informed consent. Local anesthesia with lidocaine was administered, and the treatment was carried out under rubber dam isolation to maintain a sterile field.

An access cavity was prepared, and after locating the first canal, the second canal was identified following the buccolingual expansion of the cavity. This was achieved using an ultrasonic tip, combined with 3.3x magnification loupes, which allowed more delicate movements and better visualization of the canal anatomy (Fig. 2).

The working length for both canals was determined to be 19 mm using an apex locator and confirmed with an intraoral periapical radiograph. A No. 6 K-file was used to check the working length and ensure canal patency (Fig. 3). The canals were manually instrumented up to a No. 20 K-file. During the initial manual instrumentation, EDTA gel was applied to the manual K-files to improve glide path creation and facilitate smoother instrumentation.

Following this, rotary instrumentation was performed with Proglider® (Dentsply Maillefer, Ballaigues, Switzerland) and Protaper Next® F1 and F2 files (Dentsply Maillefer, Ballaigues, Switzerland). Throughout both manual and rotary instrumentation, 5.25% sodium hypochlorite (NaOCl) was used after each file change to eliminate organic debris and disinfect the canals. The sodium hypochlorite was delivered using syringes with side-vented tips to ensure effective and controlled irrigation within the canals.

After completion of instrumentation, the final irrigation was carried out with 20% citric acid to remove remaining inorganic debris, particularly considering the necrotic status of the tooth.

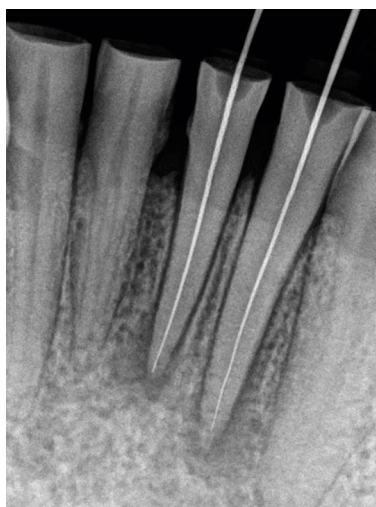


Fig. 1. Initial radiograph

Рис. 1. Исходная рентгенограмма

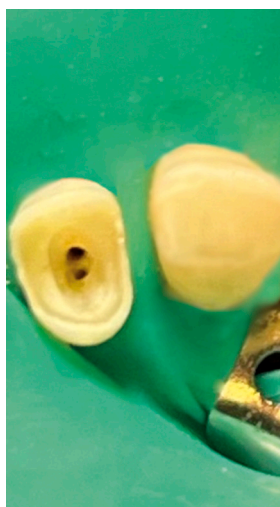


Fig. 2. Visualization of the two root canals

Рис. 2. Визуализация двух корневых каналов

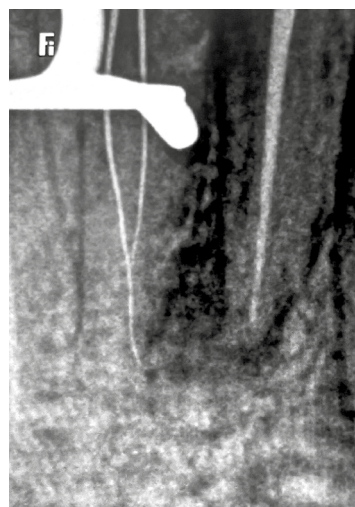


Fig. 3. Radiographic Assessment of Conductometry

Рис. 3. Рентгенологическая оценка кондуктометрии

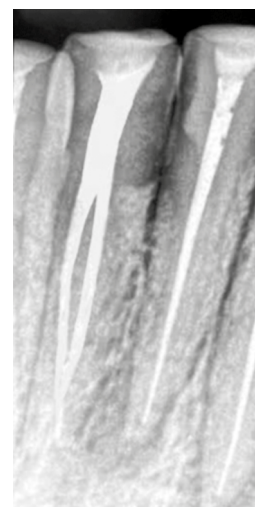


Fig. 4. Final radiograph

Рис. 4. Финальная рентгенограмма

The two canals were sealed using thermoplastic condensation with 25.04 gutta-percha cones and an epoxy resin-based sealer, without eugenol. A final composite restoration was placed. The final radiograph can be seen in Fig. 4.

DISCUSSION

The management of a mandibular central incisor with two root canals presents a unique challenge, requiring a precise understanding of root canal morphology. While mandibular central incisors typically have a single canal, the prevalence of two canals is documented to be around 21.9% for the central incisor. Recognizing these variations is crucial to preventing endodontic failure, as undetected and untreated canals remain a primary cause of residual infection and retreatment cases [1; 3].

In this case, the traditional periapical radiograph was essential in detecting a peculiar anatomical feature that suggested the presence of an additional canal. The optimized angulation of the radiograph was critical, as it allowed visualization of the atypical anatomy. It is well known that slight changes in radiographic angulation can reveal or obscure crucial details [2]. However, while radiographs provided valuable initial information, the cone-beam computed tomography (CBCT) was pivotal in confirming the diagnosis. CBCT scans offer three-dimensional imaging, which is superior to two-dimensional radiographs for detecting and mapping intricate canal configurations. Numerous studies have shown that CBCT significantly enhances diagnostic accuracy, especially in detecting additional or calcified canals [4; 5].

Although in this case, the traditional radiograph revealed the presence of two canals, CBCT was indispensable for confirming their full morphology and providing precise measurements of working lengths and canal curvature. This is critical, as accurate assessment of the canal anatomy allows for comprehensive treatment planning. Without CBCT, there is a higher risk of missing critical details, particularly in complex cases like this, where anatomical variations exist [5–7]. Additionally, CBCT helps avoid procedural errors, such as under- or over-instrumentation, which are common causes of endodontic failures. Therefore, even though traditional radiography can sometimes reveal these anatomical variations, CBCT remains a necessary adjunct for full confirmation.

The use of magnification, in this case, was also crucial. The 3.3x magnification loupes allowed enhanced visibility during the procedure, aiding in the identification and treatment of the second canal. Magnification tools, whether loupes or dental microscopes, are invaluable in detecting narrow, calcified, or additional canals that might otherwise go unnoticed. Several studies have shown that the use of magnification improves the detection of complex canal anatomy and reduces the incidence of missed canals, which is a leading cause of endodontic failure [7].

Furthermore, irrigation is a key aspect of successful root canal treatment, particularly in cases involving necrotic teeth like this one. NaOCl was employed for its

potent antimicrobial properties and its ability to dissolve organic tissue. The use of NaOCl between each instrument change ensured continuous disinfection throughout the procedure. Irrigation was delivered through side-vented tips, which help prevent irrigant extrusion beyond the apex, making the process safer and more effective. Citric acid at 20% concentration was used in this case to dissolve inorganic material, particularly useful in necrotic cases to ensure complete canal debridement. Recent literature supports this combined approach of NaOCl and citric acid or EDTA, particularly when working in necrotic or highly infected canals [8].

The mechanical preparation of the canals was achieved using ProGlider® and ProTaper Next® (Dentsply Maillefer, Ballaigues, Switzerland) rotary files, which are known for their flexibility and ability to shape complex canal morphologies while maintaining the original anatomy. The ProGlider® file was particularly useful for glide path preparation, and ProTaper Next® was effective for canal shaping, achieving optimal canal cleanliness without unnecessary removal of tooth structure. These systems are supported by a growing body of evidence that highlights their efficiency in shaping complex canal anatomies and reducing the incidence of canal transportation [9].

One of the most significant reasons for endodontic failure is the incomplete treatment of anatomical variations. Numerous studies confirm that missed canals represent a high proportion of retreatment cases, underscoring the importance of thorough canal identification [10; 11]. In this case, the combination of advanced imaging (CBCT), magnification, effective irrigation protocols, and mechanical preparation with modern instrumentation systems minimized the risk of missing a canal and ensured the success of the treatment.

In conclusion, successful management of mandibular incisors with two canals requires the clinician to be aware of anatomical variations and to utilize all available diagnostic and treatment tools. CBCT and magnification are essential for detecting and confirming the presence of multiple canals, while meticulous instrumentation and irrigation protocols are critical for eliminating infection and achieving long-term treatment success.

CONCLUSION

This case report illustrates the successful management of a mandibular central incisor exhibiting two canals, a rare anatomical variation that can complicate endodontic treatment. The integration of advanced diagnostic tools, including optimized radiographic techniques and cone-beam computed tomography (CBCT), was essential in identifying the complex canal morphology. Additionally, the use of magnification facilitated thorough canal exploration and preparation, while effective irrigation protocols ensured optimal disinfection. This case underscores the importance of understanding and recognizing anatomical variations to minimize the risk of endodontic failure. Continuous education and the adoption of modern endodontic techniques are vital for improving treatment outcomes and ensuring long-term success in complex cases.

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Fulvia Galletti – a substantial contribution to the concept or design of the article; drafted the article or revised it critically for important intellectual content

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Ankita Mathur – drafted the article or revised it critically for important intellectual content; approved the version to be published.

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