Case Report

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Management of a mandibular first premolar with two roots and three canals: a case report

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Abstract

INTRODUCTION. The mandibular first premolar presents a diagnostic challenge in endodontics, often referred to as the “endodontist’s enigma”, due to its unpredictable and complex internal morphology. While the typical configuration involves a single root and one canal, significant anatomical aberrations can lead to treatment failure if missed. This report details the non-surgical management of a rare anatomical variant: a mandibular first premolar with two distinct roots and three separate canals.

CASE PRESENTATION. A 25-year-old female patient presented with symptomatic irreversible pulpitis associated with tooth #44. Preoperative radiography indicated an unusual two-rooted anatomy with a low bifurcation. Using a dental operating microscope for access refinement, a careful clinical inspection confirmed the presence of three canals: one lingual and two buccal. Biomechanical preparation was achieved using heat-treated rotary files. The three canals were disinfected using 5.25% sodium hypochlorite and 17% EDTA with ultrasonic activation. Obturation was performed using the single-cone technique combined with a bioceramic sealer for a complete and hermetic seal.

CONCLUSIONS. This successful case underscores that treating extreme anatomical complexity, such as a two-rooted mandibular first premolar with three canals, relies heavily on heigh clinical suspicion and advanced endodontic technology. The meticulous use of the operating microscope, ultrasonic tips, and flexible NiTi files is essential to locate, prepare, and seal all parts of the root canal system, thereby ensuring a predictable clinical outcome.

Keywords: extra canal, deep split, microscope, bioceramic, ultrasonic

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Лечение нижнего первого премоляра с двумя корнями и тремя каналами: клинический случай

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Резюме

ВВЕДЕНИЕ. Нижний первый премоляр представляет диагностическую сложность в эндодонтии и часто называется «загадкой для эндодонтиста» из-за своей непредсказуемой и сложной внутренней морфологии. Хотя типичная конфигурация включает один корень и один канал, значительные анатомические отклонения могут привести к неудаче лечения, если их упустить. В данном отчете описывается нехирургическое лечение редкого анатомического варианта: нижнего первого премоляра с двумя отчетливыми корнями и тремя отдельными каналами.

ОПИСАНИЕ КЛИНИЧЕСКОГО СЛУЧАЯ. Пациентка 25 лет обратилась с симптоматическим необратимым пульпитом, связанным с зубом #44 (44 зуб по международной нумерации). Предоперационная рентгенография указала на необычную двухкорневую анатомию с низким bifurcation (разделением). С использованием дентального операционного микроскопа для уточнения доступа тщательный клинический осмотр подтвердил наличие трех каналов: одного язычного и двух щечных. Биомеханическая подготовка была проведена с применением термообработанных ротационных файлов. Три канала были продезинфицированы с использованием 5,25% гипохлорита натрия и 17% ЭДТА с ультразвуковой активацией. Обтурация (пломбирование) была выполнена по методике одного штифта (single-cone) в сочетании с биокерамическим силером (герметиком) для достижения полной и герметичной обтурации.

ВЫВОДЫ. Этот успешный случай подчеркивает, что лечение крайне сложной анатомии, такой как двухкорневой нижний первый премоляр с тремя каналами, в значительной степени зависит от высокой клинической настороженности и передовых эндодонтических технологий. Тщательное использование операционного микроскопа, ультразвуковых насадок и гибких никель-титановых файлов необходимо для обнаружения, обработки и обтурации всех частей системы корневых каналов, что обеспечивает предсказуемый клинический результат.

Ключевые слова: дополнительный канал, глубокое разделение, микроскоп, биокерамика, ультразвук

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INTRODUCTION

The success of endodontic treatment is fundamentally dependent on a comprehensive understanding of the root canal anatomy. However, human dentition is subject to a wide range of anatomical variations that can present significant challenges during clinical practice. Among these, the mandibular first premolar is well-known for its intricate and unpredictable internal morphology, which has earned it the name of the "Endodontist's enigma", as coined by Slowey [1]. While the most common configuration for this tooth is a single root with a single canal, its predisposition for developing anatomical abnormalities makes it a frequent source of endodontic failure.

The spectrum of morphological variations includes the presence of two or even three canals, as well as the bifurcation of the root into two separate roots. These aberrations, though rare, are critical to identify, as any missing canal can harbor residual bacteria and lead to persistent infection and treatment failure [2].

This article presents a clinical case report of an exceptionally rare anatomical configuration: a mandibular first premolar with two distinct roots and three separate canals. This unusual configuration poses a significant diagnostic and therapeutic challenge, requiring meticulous assessment to achieve a favorable outcome.

CASE REPORT

A 25-year-old female patient, with no history of any systemic diseases, reported to the Department of Conservative Dentistry and Endodontics at Monastir Dental clinic, Tunisia with a chief complaint of spontaneous intermittent pain in the right lower arch. This pain is exacerbated by cold and is predominantly nocturnal. Endo buccal examination revealed the presence of an occlusaldistal caries on tooth 44, which was in a mal position. Transverse percussion on this tooth was painful and axial percussion negative. Radiological examination confirmed the presence of distal Sista 2.3 caries with no periapical image. We also noted that the involved tooth had an unusual anatomy of two roots with a low bifurcation (Fig. 1).

The clinical examination led to a diagnosis of symptomatic irreversible pulpitis in relation to tooth 44 requiring root canal treatment.

In the first visit, we initiated our root canal treatment under local anesthesia and with rubber dam isolation. Access cavity was performed with a round diamond bur and an Endo-Z bur in a high-speed air motor handpiece. As we were dealing with a low bifurcation, we used a DG16 probe to locate the vestibular and lingual canal entrances. Once identified, we moved on to preshaping. The canals were thin and calcified, so we started with an 08K file (GenEndo) irrigated with 17% EDTA

Fig. 1. Preoperative periapical radiograph

Рис. 1. Предоперационная периапикальная рентгенограмма

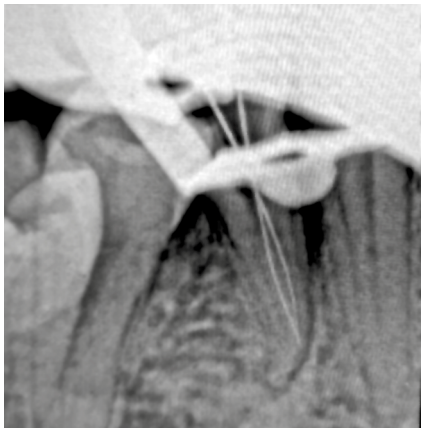

Fig. 2. First working length radiograph

Рис. 2. Первая рентгенограмма для определения рабочей длины

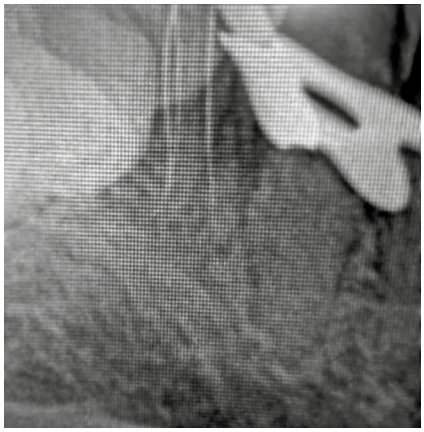

Fig. 3. Second working length radiograph

Рис. 3. Вторая рентгенограмма для определения рабочей длины

(Meta Biomed), followed by a 10°C file (VDW) and a 15K file (GenEndo) irrigated with 5.25% sodium hypochlorite. To determine the working length, we decided to take an X-ray to ensure that we were in two different canals and not in the same one (Fig. 2).

The peroperative radiograph demonstrated two roots with two files appearing to exit at the same apical level which led to the suspicion of a third root canal. While inspecting the pulp floor using a precurved 10K file, one catch was found in slight distobuccal direction. A second peroperative radiograph was taken using three files (Fig. 3). This confirmed the presence of three root canals.

To finish the access cavity, we used an operating microscope and a diamond-tipped endodontic insert to avoid any risk of perforation (Fig. 4).

We performed pre-flaring for this third canal. After establishing manual and mechanical glide path, biomechanical preparation was done using rotary instruments up to 25/04 file (Plex V, Oroodeka). During sequential instrumentation, copious irrigation with 5.25% sodium hypochlorite was frequently renewed. A side vented irrigation needle was effectively used to flush out the debris from the canal system, without pushing it in the periapical region.

The final irrigation procedure was carried out using a sequential protocol of 5.25% NaOCl and 17% EDTA and followed by a rinse with normal saline solution. The irrigation solutions were activated ultrasonically using the UltraX device (Eighteeth) to enhance disinfection, then the canals were dried with paper points. To obturate one canal, we blocked the other two canals with a # 20 spreader fil to maintain canal patency. The obturation was done using the single-cone technique, utilizing a 25/04 gutta-percha cone and bioceramic sealer (BioRoot, Septodent) (Fig. 5, 6).

DISCUSSION

This clinical observation is contextualized by established anatomical studies. Vertucci in 1984 drew up a classification based on root canal configuration that brings together all the possible variations [3] (Fig. 7). According to his research, 74% of mandibular first premolar teeth had a single canal at the apex, 25.5% had two canals, and the remaining 0.5% had three canals [4]. Ingle observed a 12% probability of a second canal and a 0.4% possibility of a third canal in mandibular second premolars, whereas Zillich and Dawson reported an 11.7% occurrence of two canals and a 0.4% occurrence of three canals [5].

A complementary, more modern approach to classifying complex anatomy is the alphanumeric coding system proposed by Ahmed et al. in 2017. This system offers an exhaustive, standardized description of root canal configuration, ideally suited for 3D imaging techniques (CBCT). It combines the FDI tooth number, the number of roots, and a hyphenated sequence detailing the continuous path of canals from the orifice to the apex, thereby eliminating the ambiguities inherent in the older, numerical classifications [6].

Furthermore, racial and ethnic variations have been reported, with some studies suggesting a higher prevalence of extra canals in certain populations. Trope et al. found that Afro-Americans have a higher number of mandibular premolars with extra canals than Caucasians [7]. The former had more than one canal in 32.8% of first premolars and 7.8% of second premolars.

Preoperative assessment plays a critical role in anticipating complex anatomies.

The preoperative periapical radiograph provides valuable assistance in determining the number and shape of roots and canals when taken in at least two orientations: one orthocentric and one eccentric [8; 9]. The fast break phenomenon or the abrupt disappearance of the canal, as shown in the preoperative radiograph of this case, is a suggestive sign of a low bifurcation. Yoshioka et al., indicated the sudden narrowing of the canal system on a parallel radiograph is suggestive of multiple canals [10]. Martinez-Lozano et al. reported that a change of 40° in the horizontal X-ray tube angulation can contribute to the identification of an extra canal in mandibular second premolars [11]. However, this periapical radiograph's two-dimensional nature presents inherent limitations in visualizing intricate three-dimensional structures.

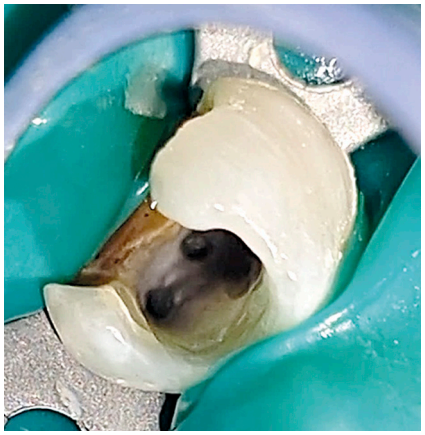

Fig. 4. Access cavity

Рис. 4. Полость доступа

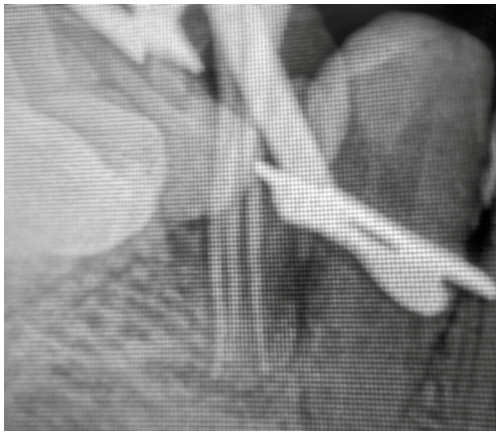

Fig. 5. Master cone radiograph

Рис. 5. Рентгенограмма с мастер-штифтом

Fig. 6. Post-operative radiograph

Рис. 6. Послеоперационная рентгенограмма

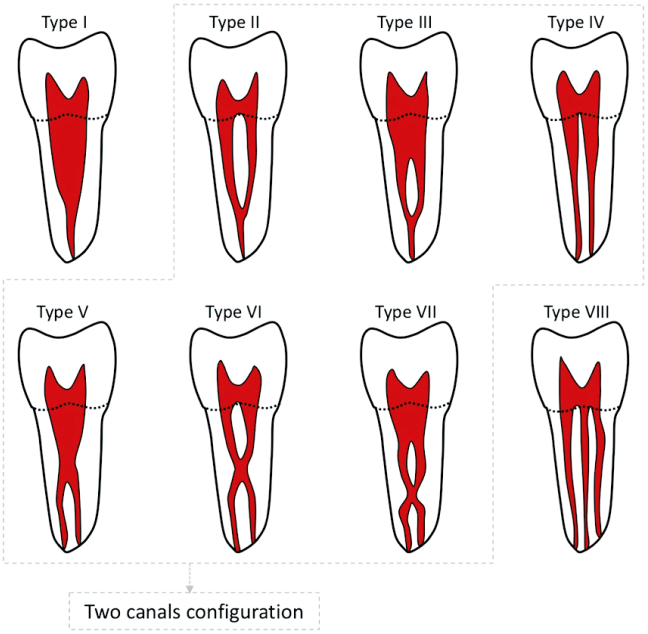

Fig. 7. Vertucci classification (1984) [3]
Рис. 7. Классификация Anthony Vertucci (1984) [3]

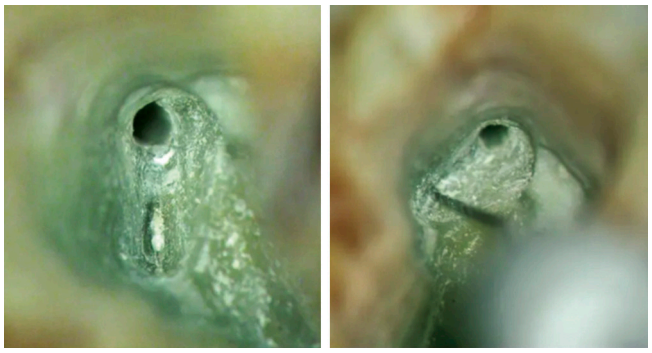

Fig. 8. White line test [14]
Рис. 8. Тест «белой линии» [14]

The advent of cone-beam computed tomography (CBCT) has revolutionized this aspect of endodontics, offering invaluable three-dimensional views, which can reveal unusual root and canal configurations that would otherwise be missed [12].

Following the radiographic findings and a high index of suspicion, clinical inspection of the pulp chamber floor is crucial.

The “dentinal map” and some techniques like the “white line test” (Fig. 8) are powerful adjuncts for locating missing canals [13].

The use of a DG 16 exploratory probe can also provide precise assistance in determining the angle at which the canals depart from the main chamber [2]. If the major canal is in an eccentric position, one or more canals should be suspected and examined on the other side if the pulp chamber is not positioned in the usual buccallingual dimension [8]. This has become possible thanks to the use of an operating microscope. After drying the pulp chamber, the “champagne bubble” test combined with the use of an operating microscope is another effective strategy for locating hard-to-access root canals [13].

In this case, tactile examination with a precurved instrument, was crucial in locating the disto-buccal canal. Access opening was modified using a rounded, diamond-coated ultrasonic tip under microscopic magnification. Ultrasonic inserts are a valuable tool in modern endodontics for locating and identifying obscured or calcified canal orifices, especially in teeth with complex anatomy [15]. Their high-frequency vibration and non-rotational action allow for precise, conservative removal of secondary dentin and pulp stones that might mask the pulp chamber floor. Used in conjunction with an operating microscope, specific inserts can be employed for a controlled “troughing” technique to uncover accessory canals or isthmuses without the risk of procedural errors like stripping or perforation.

Furthermore, the initial exploration and localization of canal entrances are now performed using micro-openers under the microscope. This technique is safer and more efficient than attempting to locate canals with precurved instruments.

Instrumentation of such narrow canals poses further challenges. The use of fine, flexible instruments, particularly heat-treated rotary files, is essential to minimize the risk of procedural errors such as ledging, transportation, or fracture. The sequential approach employed in this case, coupled with copious irrigation with 5.25% sodium hypochlorite and EDTA, was critical for thorough debridement [16].

Crucially, to maximize the biological and chemical efficacy of the irrigants, the solutions were subjected to ultrasonic activation. This mechanical energy input generates acoustic streaming and transient cavitation, mechanisms proven to significantly enhance fluid hydrodynamics. This action promotes deeper penetration and superior exchange of irrigants within complex anatomical features, including isthmuses and lateral canals, which are typically inaccessible to conventional needle irrigation [17].

The established protocol of alternating 5.25% NaOCl for organic tissue dissolution and microbial control with 17% EDTA to effectively chelate and remove the inorganic smear layer and incorporating this activation technique collectively ensures comprehensive disinfection and the removal of both organic and inorganic debris.

For years, warm vertical condensation was the method of choice for obturating complex root canal anatomies, such as deep splits, due to its capacity for three-dimensional filling. However, the recent advent of bioceramic sealers has positioned the single-cone technique as a compelling alternative [18]. This shift is attributed to the bioceramic sealers’ advantageous properties, including biocompatibility, bioactivity, and superior sealing ability.

The low bifurcation in our case complicated the obturation process, mandating a careful single-cone technique with a bioceramic sealer, and maintaining

patency in the other canals to ensure a complete and hermetic seal. The selection of the master gutta-percha cone utilized a 4% taper, as a wider 6% taper can camouflage a clear view of the canal orifices, complicating subsequent procedures. The sealer should be injected precisely into the apical segment using a fine delivery tip and with ultrasonic activation. For the precise and efficient removal of coronal gutta-percha, the Eighteeth Fast Pack heating device was utilized in our case. This ensured that the other canal entrances remained visible.

CONCLUSION

This case report illustrates the successful endodontic management of a rare mandibular first premolar with two roots and three canals.

Successful therapy for such anatomical variations depends on a combination of heightened clinical suspicion, advanced diagnostic imaging (CBCT), and the utilization of magnification for meticulous clinical execution. Diligent application of modern endodontic protocols is necessary to achieve a predictable outcome even in the face of significant anatomical complexity.

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AUTHOR'S CONTRIBUTION

Roua Habbachi – a substantial contribution to the concept or design of the article; the acquisition, analysis, or interpretation of data for the article; drafted the article or revised it critically for important intellectual content; approved the version to be published.

Sana Bagga – a substantial contribution to the concept or design of the article; drafted the article or revised it critically for important intellectual content; approved the version to be published.

Wassim Elleuch – a substantial contribution to the concept or design of the article; drafted the article or revised it critically for important intellectual content; approved the version to be published.

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

ВКЛАД АВТОРОВ

Р. Хаббаччи – внесла существенный вклад в концепцию и дизайн статьи; участвовала в получении, анализе и интерпретации данных; осуществляла подготовку рукописи или ее критическую редакцию с точки зрения важного интеллектуального содержания; одобрила окончательную версию, предназначенную для публикации.

С. Багга – внесла существенный вклад в концепцию и дизайн статьи; участвовала в подготовке рукописи или ее критической редакции с точки зрения важного интеллектуального содержания; одобрила окончательную версию, предназначенную для публикации.

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