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Endodontic Management Of A Mandibular Second Molar With C-Shaped Canal Configuration: A Case Report

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Abstract

Anatomical variations in root canal morphology, especially in mandibular molars, pose ongoing challenges in endodontic diagnosis and treatment. Among these, mandibular second molars frequently demonstrate root fusion, leading to complex and atypical canal configurations. One such notable variation is the C-shaped root canal system, which presents as a fin or web-like connection between canals forming a C-shaped cross-section. This configuration may extend as a continuous ribbon-shaped canal throughout the root or divide into separate canals toward the apex. Due to their complex anatomy, C-shaped canals are often difficult to detect on conventional radiographs. Therefore, accurate diagnosis requires a combination of clinical expertise, careful inspection of the pulpal floor, and advanced imaging techniques such as cone-beam computed tomography (CBCT). The use of magnification (dental operating microscope) further enhances visualization, allowing for precise negotiation, debridement, and obturation of these challenging canal systems. This case report describes the successful endodontic management of a mandibular second molar with a C-shaped canal configuration using magnification, and tailored instrumentation and obturation techniques. It highlights the critical importance of thorough morphological assessment and individualized treatment planning in achieving favorable outcomes in cases involving anatomical complexities.

Keywords: C-shaped canal, Mandibular second molar, Root canal morphology, Cone- beam computed tomography (CBCT), Endodontic management

Introduction

A thorough understanding of root canal anatomy and its variations is crucial for the success of endodontic therapy. Among posterior teeth, mandibular second molars are well- documented for their morphological complexity, with C-shaped root canal systems representing one of the most challenging anatomical variations encountered in clinical practice. These configurations arise due to the failure of Hertwig's epithelial root sheath to fuse on the lingual or buccal aspect during root development, resulting in a longitudinal groove and a characteristic C-shaped cross-sectional morphology [1].

C-shaped canal first reported by Cooke and Cox in 1979, C-shaped canals are most commonly found in mandibular second molars, with reported prevalence ranging from 2.7% to over 40%, depending on ethnic and geographic variations [2], [3]. These canal systems often present with a single, ribbon-like orifice at the chamber floor that may persist throughout the root or divide into two or more canals apically [4]. Their complex internal anatomy, including fins, isthmuses, and intercanal communications, significantly complicates debridement, shaping, and obturation [5].

C-shaped canals can be easily missed with conventional two-dimensional radiographs, as their unusual morphology is not always radiographically evident [3]. Therefore, the use of Cone-Beam Computed Tomography (CBCT) plays a vital role in the accurate diagnosis and assessment of the canal configuration [6]. In addition, magnification aids are invaluable in locating and treating these complex canal systems [7].

Effective management of C-shaped canals requires not only advanced diagnostic tools but also an individualized approach to canal preparation and obturation. A combination of rotary and hand instrumentation, copious irrigation, and thermoplasticized obturation techniques is often necessary to achieve a favorable outcome [8].

This case report presents the endodontic treatment of a mandibular second molar with a confirmed C-shaped root canal morphology, emphasizing modified clinical protocols in successfully managing such anatomical variations.

Case Report

A 35-year-old male patient reported to the department of conservative dentistry and endodontics with the chief complaint of spontaneous pain and sensitivity in the lower left back tooth region for the past one week. Clinical examination revealed deep occlusal caries in the mandibular left second molar (tooth #37) with tenderness on vertical percussion. Pulp vitality tests (cold and electric pulp test) elicited a lingering pain response, indicative of irreversible pulpitis.

Preoperative periapical radiograph as shown in Fig. 1. an indistinct root canal outline with fused roots and a deep carious lesion approaching the pulp space. Based on clinical and radiographic findings, nonsurgical root canal treatment was planned.

Local anesthesia (2% lidocaine with 1:100,000 epinephrine) was administered, and rubber dam isolation was performed. After access cavity preparation, two- C-shaped canal orifices was observed on the pulp chamber floor. Canal negotiation was performed using ISO #10 and #15 K-files under magnification. Working length was determined using an apex locator and verified radiographically as shown in Fig. 2.

Cleaning and shaping were carried out using a hybrid technique combining hand instrumentation and rotary NiTi files, with copious irrigation using 5.25% sodium hypochlorite and 17% EDTA. The canal was dried with paper points, master cone radiograph was taken as shown in Fig. 3. and obturation was completed using sectional obturation and warm vertical compaction technique and bioceramic sealer as shown in Fig.

4. The access cavity was restored with composite resin. The patient was asymptomatic at the 1-week and 1-month follow-up visits.

Discussion

C-shaped canals are recognized as one of the most complex and challenging endodontic anatomies to treat, particularly due to their variable internal morphology and high prevalence in mandibular second molars [1]. Root fusion is the underlying cause of this configuration, leading to an irregular, fin-like canal that may harbor multiple ramifications and isthmuses that are difficult to clean and fill effectively [2].

In this case, the diagnosis of a C-shaped canal was suspected radiographically and confirmed using CBCT, which provided valuable three-dimensional insight into the canal configuration and curvature. Patel et al. emphasized that CBCT is indispensable in diagnosing such complex anatomies that are often missed on conventional radiographs [6]. The cleaning and shaping of C-shaped canals pose a particular challenge due to the presence of irregular cross-sections, webs, and fins, which harbor pulp tissue and bacteria. As noted by Jafarzadeh and Wu, conventional rotary instrumentation alone may be insufficient, and a combination of hand files and activated irrigation is often necessary to ensure complete debridement [5]. In this case, a hybrid approach with copious irrigation and EDTA was used to optimize canal disinfection.

Conclusion

C-shaped root canal systems represent a significant endodontic challenge due to their complex and variable internal anatomy. Successful management of such configurations requires a comprehensive understanding of root canal morphology, along with the integration of advanced diagnostic tools like CBCT and clinical aids such as magnification. This

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case underscores the importance of early identification, meticulous cleaning, and an individualized obturation approach in achieving optimal clinical outcomes. A tailored treatment strategy, informed by detailed anatomical assessment, is essential for the long- term success of endodontic therapy in teeth with C-shaped canal configurations.

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Figures

Fig. 1 Pre-operative IOPA X-ray with 37

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Fig. 2 Working length determination with 37

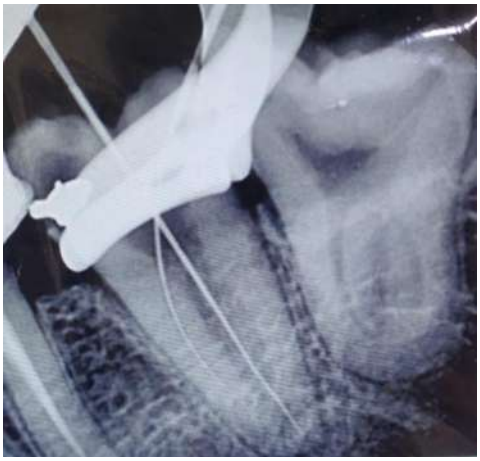

Fig. 3 Master cone IOPA X-ray with 37

Fig. 4 Post-operative IOPA X-ray with 37

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