



# Endodontic Management of Mandibular Second Molar with Middle Distal Canal

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## ABSTRACT

Mandibular second molar is often associated with variations in root canal morphology. Despite the intricate association, the occurrence of middle distal canal in endodontic literature is limited, with an incidence of 0.2% to 3%. Therefore, this study presents a case report describing a clinical situation in mandibular second molar that shows four canals, opening into different apical foramens. A 30-year-old male patient came to the Rumah Sakit Gigi dan Mulut of Universitas Sumatera Utara with the main complaint of intermittent pain in the lower right tooth persisting for two days. The results of clinical examination of the lower right second molar labeled as #47, showed a temporary filling, while radiography indicated widened periodontal ligament space and termination of lamina dura. After receiving informed consent, root canal therapy was carried out, and a direct resin composite onlay was selected for final restoration. To locate and treat hidden and unusual anatomy, dentists are often required to possess a comprehensive understanding of internal dental anatomy and use modern instruments, such as the dental operating microscope and ultrasonic tips. In certain clinical, direct resin composite onlay restorations can represent a valid alternative to traditional indirect restorations. In conclusion, this study shows that a comprehensive understanding of the potential variances in the internal anatomy of human teeth is essential to achieving successful outcomes in endodontic therapy.

**Keywords:** Mandibular Second Molar, Middle Distal Canal, Endodontic Treatment

## ABSTRAK

Gigi molar kedua rahang bawah umumnya menunjukkan variasi akar dan morfologi saluran akar. Kejadian saluran distal tengah dalam literatur endodontik jarang terjadi, dengan insiden 0,2% hingga 3%. Laporan kasus ini menggambarkan situasi klinis yang melibatkan gigi molar kedua rahang bawah yang menunjukkan adanya empat saluran akar dan empat foramen apikal yang berbeda. Seorang laki-laki berusia 30 tahun datang ke Rumah Sakit Gigi dan Mulut Universitas Sumatera Utara dengan keluhan utama nyeri intermiten pada gigi kanan bawah sejak dua hari yang lalu. Pemeriksaan klinis, #47 terungkap dengan tambalan sementara. Pemeriksaan radiografi menunjukkan #47 menunjukkan pelebaran ruang ligamen periodontal dan terminasi lamina dura. Setelah mendapat *informed consent*, terapi saluran akar dilakukan dan onlay resin komposit langsung dipilih untuk restorasi akhir. Sangat penting bagi dokter gigi untuk memiliki pemahaman komprehensif tentang anatomi gigi bagian dalam dan memanfaatkan instrumen modern, seperti mikroskop operasi gigi dan ujung ultrasonik, untuk menemukan dan menangani anatomi yang tersembunyi dan tidak biasa. Secara klinis, restorasi onlay komposit resin langsung dapat mewakili alternatif yang valid dibandingkan restorasi tidak langsung tradisional. Memiliki pemahaman yang komprehensif tentang potensi variasi dalam anatomi internal gigi manusia sangat penting untuk mencapai hasil yang sukses dalam terapi endodontik.

**Kata Kunci:** Molar Kedua Mandibula, Kanal Distal Tengah, Perawatan Endodontic



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## 1. Introduction

Endodontic therapy is used in cases when the dental pulp of a tooth sustains injury or becomes exposed. This treatment effectively maintains the integrity of the original tooth, mitigating potential future complications related to occlusion or functionality. The four main objectives of endodontic therapy include (1) eradication of pathogenic bacteria and prevention of penetration into root canal, (2) obturating the root apex to prevent fluid movement, thereby inhibiting bacterial growth and inflammation of the surrounding tissue, (3) sealing the access cavity to avoid further bacterial infiltration into the pulp chamber, and (4) enabling healing of any inflammation in the periapical tissues [1]. The combination of an accurate diagnosis and thorough cleaning as well as shaping of root canal system contributes to a reliable and effective treatment. However, the inability of dentists to identify additional roots or canals in problematic teeth is a significant contributing factor to the lack of effectiveness in endodontic therapy [1,2].

Mandibular molar generally has a complex and diverse morphology [3], serving as commonly observed teeth in dentistry practice that require endodontic therapy. The mesial root of mandibular molar frequently shows a mesiobuccal (MB) and a mesiolingual (ML) canal, although distal root typically includes a single canal. Additionally, an isthmus is a narrow connection containing pulp tissue, often observed between two canals located mesially or distally, resulting in anatomical differences. Based on previous studies, the initial documentation of middle mesial (MM) canal in mandibular molar was provided by Vertucci and Williams. Meanwhile, Beatty and Krell reported the presence of five canals in both mandibular first and second molars [4,5].

Numerous clinical investigations have been conducted to examine the prevalence of MM canal in mandibular molar. Before the advent of cone-beam computed tomography (CBCT), the prevalence of MM canal varied from 1 to 15%. However, a recent investigation has shown a significant prevalence of 46.2% in mandibular first and second molar. This shows that the adoption of CBCT has facilitated the identification of root canal system. According to Harris et al, 36% of mandibular first molars were shown to consist of more than two canals within mesial root [2].

The implementation of troughing on the floor of the pulp chamber and the dental operating microscope (DOM) have also been suggested as a viable and secure method for assessing mesial root in search of the prospective MM canal. Furthermore, a limited number of cases have been reported regarding the presence of a third canal in distal root. The occurrence of middle distal (MD) canal is an infrequent phenomenon, with a prevalence ranging from 0.2% to 3% [2]. According to a previous study, the occurrence of a single canal in the mesial root of mandibular second molar is more prevalent, with a frequency of 14%, compared to the first molar, which has an incident rate of 4.2% [5]. This shows the need for clinicians to understand the anatomy of the root canal to effectively apply suitable treatment methods and protocols, enhancing the potential of a higher success rate [2, 3].

Based on the background above, this study presents a case report describing endodontic therapy of a rare permanent mandibular second molar with three canals in distal root. The identification of the atypical morphology was facilitated through the DOM, along with several angulated radiographs. The access cavity was altered to adopt a trapezoidal configuration and include all canals. Subsequently, the pulp chamber was systematically examined by following root dentinal maps to identify and discover new canals using ultrasonic troughing methods. After biomechanical preparation, canals were chemically debrided using sonic activation and obturated three-dimensionally. This case report presents an effective endodontic therapy management of distal canal variations.

## 2. Case Report

A 30-year-old male patient presented at Rumah Sakit Gigi dan Mulut Fakultas Kedokteran Gigi Universitas Sumatera Utara with the main complaint of intermittent pain in the lower right tooth persisting for two days. The dental history of the patient showed an oligodontia condition, characterized by the absence of some teeth since birth, leading to the use of dentures. As depicted in Figures 1 and 2a, clinical examinations showed temporary restoration on the lower right second molar (#47) and pain on percussion. The cold test and electric pulp testing (EPT) elicited a positive response, while the periapical X-ray film in Figure 2b showed

widened periodontal ligament space and termination of lamina dura. Meanwhile, the previous diagnosis of this case was initiated therapy with symptomatic apical periodontitis.



Figure 1. Clinical examinations

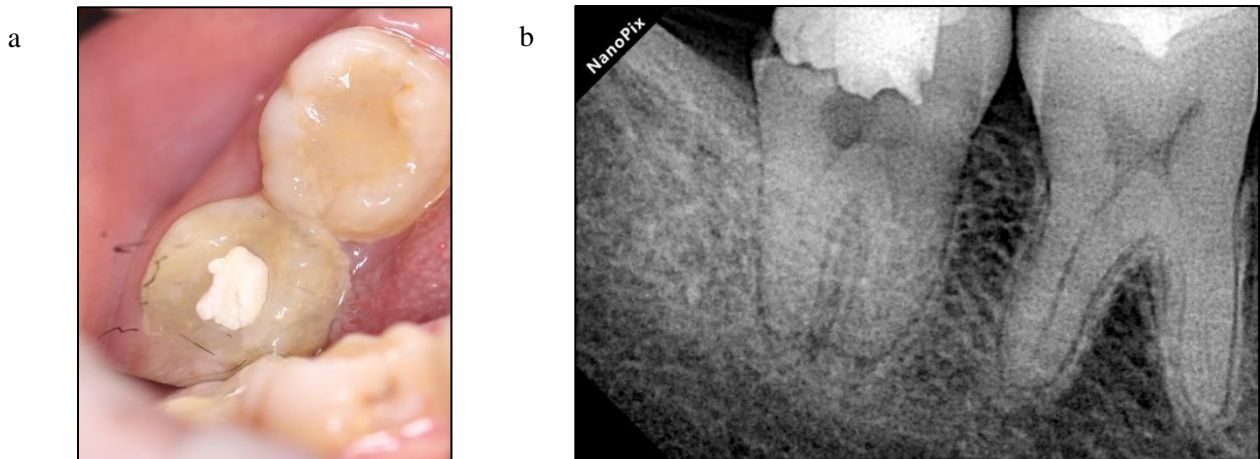


Figure 2. (a) Clinical examination on tooth 47; (b) Pre-operative radiograph

### 3. Case Management

The detailed procedure was explained to the patient and informed consent was obtained. This was followed by the administration of local anaesthesia using 2% lidocaine and rubber dam isolation. After achieving anaesthesia, the temporary restoration was removed and adequate endodontic access was made, followed by the inspection of the pulpal floor under the DOM. Subsequently, copious irrigation of the pulp chamber was carried out and four canal orifices were observed after careful examination with endodontic explorer, as shown in Figure 3a. Among these orifices, one was found in mesial root and three in distal root, comprising distobuccal, MD, and distolingual. Working lengths were estimated by using an electronic apex locator using size #10 K-file and confirmed with radiographs, as shown in Figure 3b. This was followed by the preparation of root canals using the crown-down method.

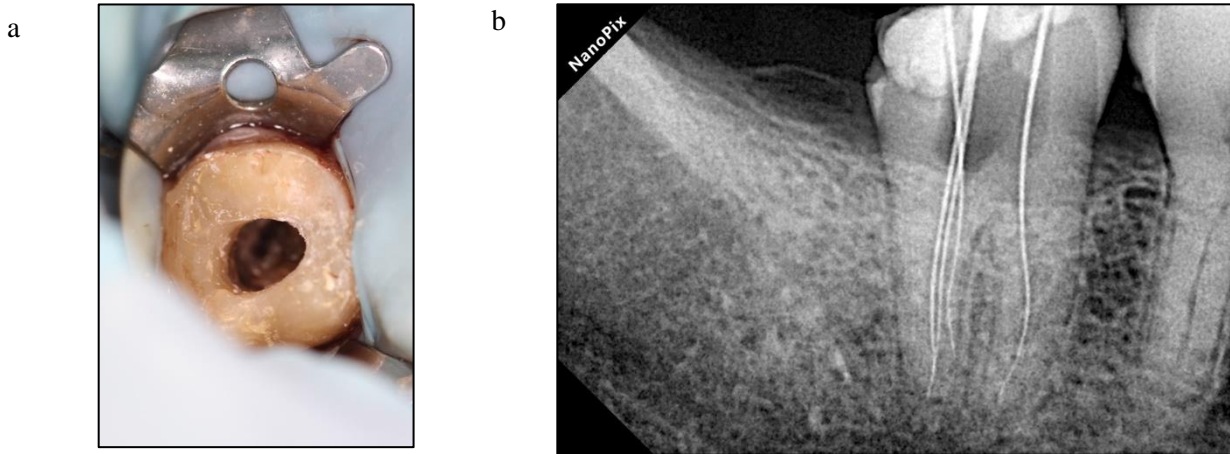


Figure 3. (a) Access opening of the teeth; (b) Working length determination

All canals were cleaned and shaped using an E-flex blue file system, followed by preparation to a size of approximately #20.04. Between each instrument change, irrigation was performed using 5.25% sodium hypochlorite and saline. Subsequently, canals were dried with paper points and corticosteroid-antibiotic paste was placed as an intracanal medicament, followed by cavity sealing with temporary restorative material.

At the second appointment, the tooth was in an asymptomatic condition, with percussion and palpation negative. After isolation with a rubber dam, all canals were recapitulated, irrigated with 5.25% sodium hypochlorite, EDTA 17% as well as saline, and dried thoroughly. Master cones were selected and a radiograph was taken, as shown in Figure 4. After verification of master cone length, canals were obturated using gutta-percha and Ceraseal bioceramic root canal sealer (Meta Biomed Co., Cheongju, Korea), as presented in Figure 5. A post-obturation radiograph was taken (Figure 6) and the cavity was restored with composite restoration (Figure 7).

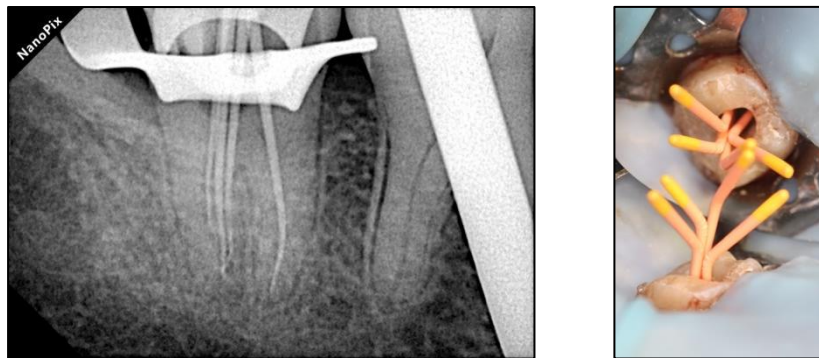


Figure 4. Master cone selection

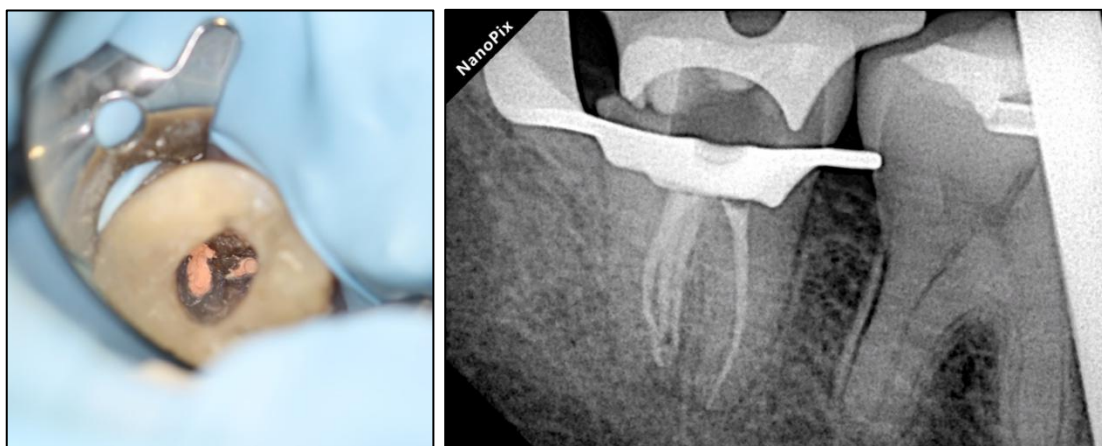


Figure 5. Obturation





Figure 6. Post-obturation radiograph



Figure 7. Direct restoration

The patient came for the recall visit after 1 month, 3 months, and 6 months since completion of root canal treatment. The medical history remained unchanged, had no symptoms, and tooth #47 responded within normal limits. Radiograph presented in Figure 8 showed normal periapical tissues and normal lamina dura.

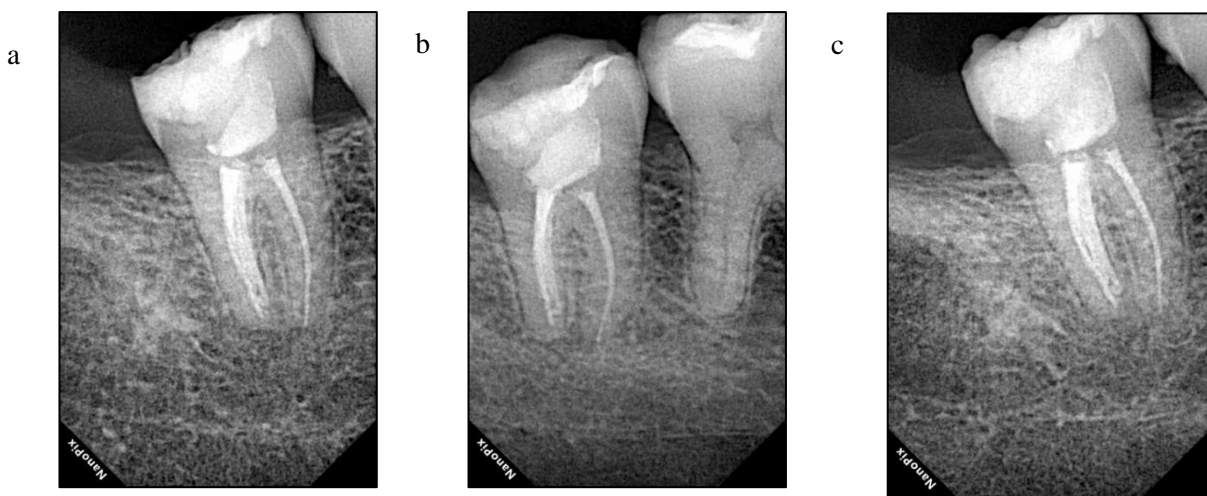


Figure 8. (a) 1 month; (b) 3 months; (c) 6 months

#### 4. Discussion

The main objective of endodontic therapy is to achieve thorough removal of all organic pulp tissue and necrotic residues before the process of obturation. Before initiation, accurate identification of variances in anatomy and abnormal root canal morphologies is essential due to significant differences in mandibular molar. This is because anatomical variations in the external and internal anatomy of root canals are present throughout all dental groups, among individuals, and diverse ancestral backgrounds. Therefore, there is a need to understand these variations in anatomy and differences among various population groups [6].

The majority of dental anatomy and endodontic textbooks primarily focus on the typical root and root canal morphology of mandibular second molar. A significant variability has been reported, with the lower mandibular second molar showing a bisection into a mesial and a distal root. However, these teeth can contain a maximum of two, three, or four root canals [6], showing the need for considering morphologic variations and aberrations in root canal anatomy at the initiation of treatment” [4].

Various morphological differences in teeth occur can present challenges in root canal treatment [7,8]. Therefore, the identification of additional canals requires a comprehensive understanding of root canal morphology and common variations. A thorough analysis of the pulpal floor, precise troughing, and enhanced visualization facilitated by the DOM are also crucial in identifying supplementary canals within mandibular second molar [9,10,11]. This phenomenon shows the need for dentists to possess knowledge regarding variances and effectively use the existing instruments to manage the root canal system, thereby enhancing the overall treatment outcome [12,13].

A thorough assessment of two or more periapical radiographs is essential in endodontic therapy [14]. Specifically, the use of angled radiography serves as a valuable tool for obtaining essential insights into the morphology of root canals. Friedman et al stated that any efforts to develop strategies capable of reducing the number of radiographs could result in the omission of potentially crucial information for effective therapy [15]. Diagnostic methods are also essential in identifying the location of root canal orifices., including the use of multiple preoperative radiographs, examination of the pulp chamber floor using a sharp explorer, and troughing of grooves with ultrasonic tips. Other methods include staining the chamber floor with 1% methylene blue dye, performing the sodium hypochlorite 'champagne bubble' test, and visualizing canal bleeding points [15].

The anatomical occurrence of an additional canal within distal root of mandibular second molar is referred to as MD canal. The occurrence of this condition has been reported to vary from 0-3% across several ethnic groups [3,16] According to Azim et al. [9], MM canal was present in 46.2% of cases, where 6.6% were identified after conventional access preparation, and 39.6% were discovered through standardized troughing. Additionally, a significant increase in the prevalence of MM canal was observed among patients in the younger age group. In this study, the patient presented with reduced symptoms, and the cold test showed a positive reaction following the initial cleaning and shaping procedure, indicating the potential presence of more canals.

The use of selective troughing in both mesial and distal roots, along with enhanced visualization facilitated by the DOM, contributed to the identification of supplementary MM and distal canals. Wallace and Baugh [17] have reported a case of MM canal in mandibular first molar, which formed as a distinct orifice, and converged with the main canal in the apical third of the root. Moreover, Izaz et al. [18] reported a case of MD canal showing fusion with the primary canal in the apical third, which originated as distinct orifices and maintained unique identities.

An extensive examination of endodontic literature showed that the occurrence of mandibular second molar with three canals in distal root is infrequent. In this study, Vertucci's classification type VIII canal configuration was found in distal root, showing a trifurcation pattern, with three different canals and corresponding orifices, along with a unique apical aperture. In line with existing literature globally, the direct restoration method discussed in this case is only feasible when there is a small amount of healthy dental structure loss. Posterior teeth with endodontic access preparation and no structural damage may potentially benefit from a conservative bonded restoration [19, 20].

## 5. Conclusion

In conclusion, this study showed the importance of understanding the precise root canal morphology of patient to achieve favorable outcomes in endodontic therapy of symptomatic teeth. The varied position and configuration of MD canal present difficulties in both the preparation and obturation of canal. The results showed that successful treatment depended on radiographs, magnification, latest instruments, proper irrigation protocol, and sealing of all portals of exit.

## 6. Conflict of Interest

The authors declare that there is no conflict of interest.

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