

# Single-Visit Endodontic Treatment of a Mandibular Second Molar with S-Shaped Mesial Root Canal Curvature: A Case Report

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## Abstract

Root canal treatment of teeth with complex canal morphology, such as S-shaped curvatures, presents significant clinical challenges and increases the risk of procedural errors. Mandibular second molars may exhibit severe canal curvatures, particularly in the mesial root, complicating instrumentation and disinfection.

This case report describes the successful single-visit endodontic treatment of a mandibular second molar (tooth 37) in a patient diagnosed with asymptomatic pulpitis due to deep caries. The mesial root exhibited an S-shaped curvature, requiring a careful and controlled instrumentation approach.

After anesthesia and rubber dam isolation, canal preparation was performed using a combination of hand and nickel-titanium rotary instruments. Initial coronal preflaring was achieved using rotary instruments to facilitate apical access. Canal patency was established using a pre-curved stainless steel hand file. Glide path preparation and subsequent shaping were completed using flexible nickel-titanium systems. The distal canal was prepared to a larger apical size due to its anatomical characteristics. Standard irrigation protocols were applied, and obturation was completed in the same visit.

The treatment was completed without complications, and the patient remained asymptomatic.

This case highlights the importance of proper technique, instrument selection, and clinical strategy in managing complex root canal anatomy. Single-visit endodontic treatment can be a predictable and efficient approach when adequate disinfection and canal preparation are achieved.

**Keywords:** S-shaped canal, mandibular molar, single-visit endodontics, curved canals, nickel-titanium instruments

## Introduction

Endodontic treatment success is highly dependent on effective cleaning, shaping, and obturation of the root canal system. Anatomical complexities, particularly severe canal curvatures, represent a major challenge for clinicians (1,2).

S-shaped canals, also known as double-curved canals, are particularly difficult to manage due to the presence of two distinct curvatures along the canal path. These curvatures increase the risk of procedural complications such as ledge formation, canal transportation, instrument separation, and inadequate cleaning (3,4).

Mandibular molars frequently present with curved mesial canals, and in some cases, these curvatures may be pronounced and multi-planar (5). Proper management of such anatomy requires a combination of mechanical skill, appropriate instrumentation, and adherence to endodontic principles.

Single-visit endodontic treatment has gained popularity due to its clinical efficiency and patient convenience. Studies have demonstrated comparable success rates between single- and multiple-visit treatments when proper disinfection protocols are followed (6,7).

This case report describes the management of a mandibular second molar with an S-shaped mesial canal treated successfully in a single visit using a controlled and minimally invasive approach.

### Case Description

A patient presented with deep caries affecting tooth 37. Clinical examination revealed no spontaneous pain, and the tooth responded positively to vitality testing, but with lowered threshold of irritation, consistent with a diagnosis of asymptomatic pulpitis.

Radiographic evaluation suggested complex root canal anatomy in the mesial root, including possible severe curvature (fig.1)

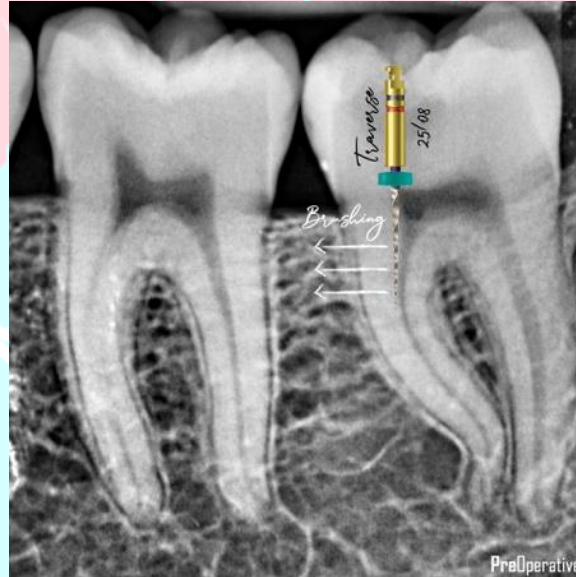


**Fig. 1. Preoperative x-ray showing complex anatomy of the mesial root of tooth 37**

Following informed consent, local anesthesia was administered and rubber dam isolation was achieved. Access cavity preparation was performed, ensuring straight-line access while preserving tooth structure.

The treatment protocol included:

- Coronal preflaring (mesial canals): Traverse (Kerr) 25/.08 to facilitate access to the apical third (fig. 2).



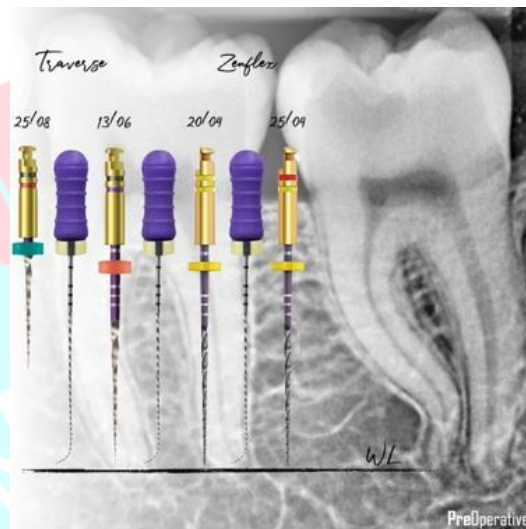
**Fig. 2. Coronal preflaring**

- Canal negotiation: size 10 stainless steel hand file with pre-curved tip to establish patency (fig. 3).



**Fig. 3. Canal negotiation using hand file #10 with prebended tip**

- Glide path preparation: Traverse 13/.06
- Canal shaping (mesial canals): ZenFlex (Kerr) 20/.04 followed by 25/.04 (fig. 4).



**Fig. 4. Shaping protocol for the mesial root**

The mesial canals exhibited an S-shaped curvature, requiring careful instrumentation with minimal apical pressure and controlled movements.

The distal canal was treated using the same sequence, without pre-curving of the hand file, and was enlarged to size 40/.04 due to its larger anatomical dimensions.

Root canal disinfection was carried out using a standardized irrigation protocol. A 5.25% sodium hypochlorite solution was used during instrumentation, followed by 17% EDTA to facilitate smear layer removal. Both irrigants were activated using an endo-activator (red tip), with three activation cycles of 20 seconds per canal. Final irrigation was performed with sterile saline.

Obturation was performed using a hydraulic single-cone technique with gutta-percha and a bioceramic sealer. The sealer was applied to the canal walls, and a master cone matching the final apical preparation was placed to working length, allowing hydraulic distribution of the material into canal irregularities. This approach minimizes mechanical stress and is particularly suitable for maintaining the integrity of S-shaped canals (fig. 5).



**Fig. 5. Preoperative and postoperative x-ray of tooth 37.**

The patient tolerated the procedure well and remained asymptomatic.

## Discussion

The management of S-shaped root canals represents one of the most technically demanding challenges in endodontics. These canals contain two opposing curvatures, often in different planes, which significantly increase the risk of iatrogenic complications (3,8). Anatomical variations in mandibular molars are well documented, with mesial roots frequently presenting complex curvature patterns that complicate instrumentation (1,5).

One of the primary risks associated with S-shaped canals is canal transportation. Due to the inherent tendency of instruments to straighten within curved canals, excessive dentin removal may occur along the outer wall of the curvature, potentially weakening the root structure or leading to perforation (9). Furthermore, the apical curvature is particularly susceptible to ledge formation and canal blockage, especially when rigid instruments or improper techniques are used (4).

Instrument separation is another major concern in such anatomies. The risk of cyclic fatigue increases significantly when nickel-titanium instruments are used in double-curved canals, particularly in the apical third (8,10). Structural defects and microcracks within instruments may develop during repeated stress, increasing the likelihood of fracture (10).

In the present case, several key strategies contributed to successful treatment. Coronal preflaring using rotary instruments improved access to the apical third and reduced torsional stress on shaping instruments (11). This step is widely recommended as it enhances control and decreases the risk of procedural errors during instrumentation (2,11).

The use of a pre-curved stainless-steel hand file allowed safe negotiation of the S-shaped canal and establishment of patency. Pre-curving is essential in such cases, as it enables the instrument to follow the original canal trajectory rather than forcing straightening (4).

The creation of a glide path using dedicated instruments ensured a reproducible and safe pathway for rotary shaping. Glide path preparation has been shown to significantly reduce the incidence of canal aberrations and instrument fracture (12).

Nickel-titanium rotary instruments offer superior flexibility and resistance to cyclic fatigue compared to stainless steel files, making them indispensable in the management of curved canals (9,13). Their metallurgical properties allow better preservation of the original canal anatomy, which is particularly important in double-curved systems (13).

Single-visit endodontic treatment remains a topic of ongoing debate; however, current evidence indicates that it can achieve comparable success rates to multiple-visit treatment when proper disinfection is achieved (6,7,14). In cases of vital pulp, such as asymptomatic pulpitis, the microbial load is generally lower, which supports the use of a single-visit approach (6,14).

The advantages of single-visit treatment include reduced risk of inter-appointment contamination, elimination of temporary restorations and their potential leakage, improved patient comfort, and increased clinical efficiency (7,14). These factors are particularly relevant in complex cases where maintaining aseptic conditions is critical.

Irrigation remains a cornerstone of endodontic disinfection, especially in anatomically complex canals where mechanical instrumentation alone is insufficient (15). Sodium hypochlorite provides

effective organic tissue dissolution and antimicrobial activity, while ethylenediaminetetraacetic acid facilitates smear layer removal, enhancing penetration of irrigants into inaccessible areas (15). Overall, the successful management of S-shaped canals requires a combination of anatomical knowledge, careful technique, and appropriate instrument selection. Failure to respect canal curvature and biomechanics may lead to procedural errors and compromised outcomes (2,3). This case demonstrates that, with a structured and evidence-based approach, even highly complex canal anatomies can be treated predictably in a single visit.

## Conclusion

S-shaped root canal anatomy presents significant clinical challenges and increases the risk of procedural complications.

A structured treatment approach, including preflaring, glide path preparation, and the use of flexible nickel-titanium instruments, is essential for safe and effective management.

Single-visit endodontic treatment can be successfully performed in cases of asymptomatic pulpitis when adequate disinfection is achieved.

Careful technique and adherence to endodontic principles allow predictable outcomes even in complex anatomical situations.

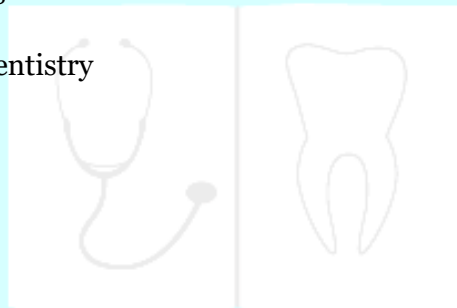
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