

ENDODONTIC TRIUMPH OVER A RARE THREE-CANALED MANDIBULAR SECOND PREMOLAR: A CASE REPORT

Endodontics

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ABSTRACT

Mandibular second premolars typically present a straightforward internal anatomy, characterized by a single root and a single canal system in approximately 98% of cases. Extreme variations, such as the three-canaled configuration (Vertucci Type VIII), are exceptionally rare anomalies occurring in less than 0.5% of the population. Misidentifying or neglecting these accessory root canals can lead to persistent post-operative infections and subsequent endodontic failure. This article reports the case of a 54-year-old patient diagnosed with symptomatic irreversible pulpitis. Radiographic examination revealed a single canal that trifurcated in the middle third of the root and terminated in three separate apices. This case highlights that while 3D imaging remains ideal, clinicians can successfully detect and manage complex anatomical variations using traditional diagnostic modalities, rigorous multi-angled radiography, magnification loupes, and meticulous tactile investigation.

KEYWORDS

Three-canaled Premolar, Morphological Variations, Enigma to Endodontists.

INTRODUCTION

A thorough and comprehensive understanding of internal root canal anatomy, along with its frequent structural variations, is a fundamental prerequisite for successful endodontic therapy. The main objectives of root canal treatment are the complete debridement of the root canal system, adequate shaping, and three-dimensional fluid-tight obturation. A primary cause of post-treatment endodontic failure is the inability to locate, clean, and fill accessory or extra canals, which leaves behind necrotic tissue and pathogenic microorganisms.

The mandibular second premolar is widely considered by clinicians to be one of the most anatomically challenging teeth to treat endodontically. While macroscopic anatomy typically suggests a single root with a single well-centered canal (Vertucci Type I) in roughly 97.5% of cases, literature indicates that its internal configurations can be highly unpredictable[1]. The occurrence of three distinct root canals extending from the pulp chamber floor to separate apical foramina (Vertucci Type VIII) represents an extreme morphological anomaly, with an incidence rate ranging from 0.4% to 0.5%.[2,3]

The bifurcation of the root canal occurs due to the epithelial root sheath (HERS), which plays a key role in the development of the root and root canal system. A single collar-shaped diaphragm that develops into a single-rooted tooth or several tongue-like extensions that develop into several rooted teeth are the two ways in which HERS extends [4].

This case report details the successful endodontic management of a rare, three-canaled mandibular second premolar, and demonstrates how traditional clinical skills, enhanced by magnification loupes, multi-angled two-dimensional intraoral radiographs, and precise electronic working-length estimation, can yield an excellent, complication-free short-term outcome without relying on advanced 3D scanning equipment.

Case Description

A 54-year-old patient presented to the clinic with a primary complaint of continuous, dull, and mild pain located in the lower left region of the jaw. The patient noted that the discomfort was consistently aggravated by thermal stimuli (both hot and cold fluids) as well as mechanical irritation from food lodgment. The pain was temporarily relieved only upon the self-administration of analgesic medication. Patient also gave history of treatment on the same side 2 weeks ago.

Clinical examination focused on the mandibular left quadrant. Radiographic evaluation using an Orthopantomogram (OPG) (Fig 1A) and an Intraoral Periapical Radiograph (IOPA) revealed faulty restoration involving distal aspect of mandibular left second premolar and mesial aspect of the first molar. A provisional diagnosis of symptomatic irreversible pulpitis wrt 35, 36 was established.



Fig 1A: OPG showing faulty restoration involving 35,36

Fig 1B: IOPA showing distal aspect of the distal premolar

After a comprehensive discussion regarding the diagnosis and treatment plan, the patient provided written informed consent for endodontic therapy wrt 35, 36.

Local anesthesia was administered using an inferior alveolar nerve block to ensure patient comfort. Following profound anesthesia, the tooth was isolated, and standard endodontic access cavity preparation was initiated. Initial access opening was performed using an endodontic access round bur. Upon gaining access to the pulp chamber, an Endo-Z bur (Dentsply Sirona) was used to refine the access cavity walls and safely widen the orifice. Under 3.5x magnification dental loupes (Zumax, China), the internal anatomy was meticulously inspected. Visual and tactile tracking revealed that the main root canal path extended down to the middle third of the root, at which the canal system divided into three distinct, separate root canals.(Fig 1B)

To navigate this complex internal anatomy, a size #08 K-file (Dentsply Sirona) was gently pre-curved and inserted past the middle-third bifurcation (Fig 2A). Through careful tactile negotiation, all three canals were successfully negotiated upto their respective apices. Based on the spatial orientation and the insertion direction of the negotiating instruments, the three distinct root pathways were designated as the mesiobuccal (MB), distobuccal (DB), and lingual (L) canals.

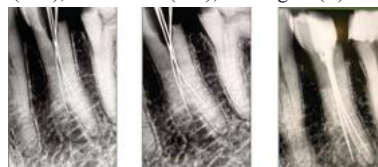


Fig 2A: periapical IOPA view with files placed within the canal

Fig 2B: Serial shift radiographs

Fig 2C: Post obturation radiograph

Working lengths were established independently for each canal. The independent pathways of the three files were verified using an apex locator (Root ZX, J Morita USA, Inc Irvine, CA), which recorded stable, distinct working lengths for each canal branch. Multi-angled intraoral periapical radiographs using SLOB technique, were taken with the instruments in place, radiographically confirming three separate files reaching the apex without convergence (Fig 2B).

Chemo-mechanical preparation of all three canals was carefully advanced up to a final apical size of 30/.02 using hand files, ensuring adequate taper while preserving root dentin integrity at the middle-third split.

A strict irrigation protocol was maintained throughout the instrumentation process to ensure comprehensive disinfection of the intricate web of anatomy. The canals were copiously rinsed with 5.25% Sodium Hypochlorite (NaOCl), 17% Ethylenediaminetetraacetic acid to effectively remove the smear layer, and saline for final rinse. The canals were then dried using sterile paper points.

Because three-dimensional imaging was absent, achieving a dense, fluid-tight seal was critical. Final obturation was executed using the

cold lateral condensation technique. Size 30/.02 master gutta-percha cones were coated with a bioceramic root canal sealer (BioActive RCS, Safe Endo, Gujarat, India) and positioned to the full working length in all three canals. Accessory gutta-percha points were laterally condensed to achieve a dense, uniform three-dimensional fill.

A final post-operative IOPA was taken, displaying three distinct, well-obtured root canals extending cleanly to their independent apices without any overextension or void formation (Fig 2C). The access cavity was permanently restored, and the patient was scheduled for routine follow-ups, where the patient exhibited no postoperative complications.

DISCUSSION

The primary objective of endodontic therapy is the complete chemo-mechanical debridement and fluid-tight three-dimensional obturation of the root canal system. A major contributor to post-treatment endodontic failure is the failure to locate, clean, and obturate accessory or extra root canals, leaving untouched necrotic debris and bacterial niches. The complex internal architecture of the mandibular second premolar remains a clinical challenge for clinicians, exhibiting highly variable root canal configurations that diverge significantly from standard textbook definitions.

Historically, standard endodontic literature suggests that mandibular second premolars present with a single root and a single canal system (Vertucci Type I configuration) in approximately 85% to 98% of cases. When morphological variations occur, they typically present as two distinct canals. The occurrence of a Vertucci Type VIII configuration—where a single main canal splits into three separate canals with individual apical portals of exit—represents an extreme anatomical anomaly. Classical studies by Vertucci et al. reported the incidence of three canals in second premolars as 0.0%, while Zillich and Dowson established a marginal prevalence ranging between 0.4% and 0.5%[3]. In the present report, the use of tactile sensation, magnification with dental loupes, and radiographic imaging helped locate and negotiate the extra canals.

Morphological evaluations across various Indian sub-populations place the prevalence of three root canals in mandibular second premolars between a mere 0.1% and 0.8%. For instance, comprehensive internal morphological variability studies in the North Indian population identified Vertucci Type VIII configurations in only 0.8% of evaluated second premolars, while other regional screening sets report figures closer to 0.1%[5,6]. This structural variation frequently manifests as a mid-root or middle-third bifurcation where the root canal breaks away into independent mesiobuccal, distobuccal, and lingual paths, earning the tooth its clinical reputation as the "Endodontic Enigma".

In modern endodontic practice, three-dimensional diagnostic platforms like Cone-Beam Computed Tomography (CBCT) are the gold standard for evaluating complex root canal morphology without anatomical structures overlapping. However, clinical limitations such as restricted technological accessibility, economic constraints, and strict adherence to the ALARA (As Low As Reasonably Achievable) radiation safety guidelines make routine 3D scanning unfeasible. Additionally, intraoperative dental photography of the internal pulp chamber floor mapping can be structurally limited by spatial dimensions during treatment under standard dental magnification loupes.

Reliance on alternative diagnostic clues is therefore essential. Clinically, sudden changes in tactile file pathways, an asymmetrical eccentric outline of the pulp chamber floor, or an unexpected instrument deviation during negotiation can signal an underlying split. Radiographically, the "fast break" phenomenon—a sudden, sharp disappearance or narrowing of a prominent root canal space on a standard straight intraoral periapical radiograph (IOPA)—is indicative of a mid-root division.[7]

In this case, the lack of 3D diagnostic confirmation was thoroughly mitigated by a strict clinical and radiographic verification workflow. The application of the three-angle radiographic rule—utilizing distinct straight, mesio-shifted, and disto-shifted IOPA views—clearly demonstrated three independent, separate files extending to the full working length without spatial convergence. Martínez-Lozano et al. [8] have suggested that a 40-degree mesial angulation of the X-ray beam helps identifying additional canals. Furthermore, tactile manual

negotiation under 3.5x magnification loupes paired with consecutive, stable readings from an apex locator validated the independent apical patency of the mesiobuccal, distobuccal, and lingual branches.

Chemo-mechanical preparation was carefully advanced up to 30/.02, maintaining a precise instrumentation taper to preserve remaining radicular dentin strength[9,10]. Copious irrigation with 5.25% Sodium Hypochlorite and 17% EDTA ensured deep tissue debridement within the narrow middle-third split. The subsequent application of the cold lateral condensation technique generated a dense, uniform three-dimensional seal, which was radiographically confirmed on the post-obturation radiograph.

Follow-up examination revealed that the patient remained asymptomatic with no evidence of secondary periapical breakdown or clinical tenderness. This demonstrates that even when CBCT imaging is unavailable, clinicians can successfully diagnose and manage extreme endodontic anomalies by combining strict traditional diagnostics, tactile sensitivity, and rigorous multi-angled radiography.

CONCLUSION

The occurrence of three distinct root canals in a mandibular second premolar represents a rare anatomical variant that can easily mislead clinicians and lead to endodontic failure if overlooked. This case demonstrates that while advanced three-dimensional imaging like CBCT is the preferred diagnostic standard, its absence does not preclude successful clinical management. By combining structural magnification loupes, careful manual tactile scouting, precise electronic apex location, and meticulous multi-angled intraoral periapical radiography, clinicians can successfully diagnose, negotiate, and obturate complex configurations using conventional, widely accessible endodontic tools to achieve favorable short-term outcomes.

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