Case Report

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Endodontic treatment of mandibular premolars with root canal variations: a case series

Elife Ülkü Tatar, Esra Balkanlıoğlu, Aliye Kamalak

Department of Endodontics, Kahramanmaraş Sütçü İmam University, Kahramanmaraş, Turkiye

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ABSTRACT

Mandibular premolar teeth predominantly have a single root and canal. However, they may sometimes present with additional roots and canals. The objective of this study is to provide a comprehensive literature review on mandibular premolar teeth with extra roots and canals, as well as to retrospectively evaluate four cases from shaping to obturation. A literature review was conducted on cases involving the number of roots and canals in mandibular premolar teeth with additional roots and canals between 2021 and 2024. The diversity of root canal configurations in mandibular premolars was assessed using PubMed and Google Scholar databases. Patients presenting with endodontic treatment needs were evaluated at the Endodontics Clinic of Kahramanmaraş Sütçü İmam University Faculty of Dentistry Hospital. Patients with mandibular premolar teeth exhibiting additional root and canal variations were selected, and endodontic treatment of these teeth was performed using personalized treatment methods tailored to each case. A review of the literature revealed that while mandibular premolar teeth predominantly have a single root, variations in root morphology, including two roots, three roots, taurodontism, and C-shaped configurations can occur. These variations may be accompanied by diverse canal structures ranging from one to five canals with various configurations. It was found that 78.3% of mandibular first premolars and 90.3% of mandibular second premolars had single canals. The frequency of double-rooted premolars was found to be higher in males compared to females. During the examination of our cases, difficulties in accessing the root canal system were frequently encountered when additional root canals were present, requiring the adaptation of standard root canal treatment techniques to meet individual patient needs. Consequently, extended treatment durations were needed, often requiring multiple treatment sessions compared to standard root canal therapy. A literature review revealed that mandibular premolar teeth with extra roots and canals exhibit highly diverse canal configurations. However, such cases require extended treatment durations with multiple sessions and personalized treatment techniques tailored to each case due to the difficulty in accessing the root canal system.

Keywords: Additional root, additional canal, accessory canal, mandibular premolar teeth

INTRODUCTION

The success of root canal treatment depends on a comprehensive knowledge of root and root canal morphology to accurately locate all canals and properly clean, shape, and fill the canal space three-dimensionally.[1]

While mandibular premolar teeth are typically described in textbooks as having a single root and canal, they may possess additional roots and canals that are not easily diagnosed with periapical radiographs.[2] Morphologically, these teeth may exhibit two roots, three roots, Tomes' root, and radicular grooves in the root, as well as additional canals, accessory canals, and isthmuses.[3] Mandibular premolar teeth have the highest incidence of endodontic failure among all teeth due to numerous variations in root canal morphology and the difficulty in accessing additional canal systems.[1]

When evaluating root canals, it is crucial to examine their arrangement, path, and shape. The Vertucci classification system is used to understand the root canal system. This classification system analyzes anatomical variations and helps in understanding root canal configurations.[4]

Due to these variations in mandibular premolars, it is of paramount importance to develop personalized treatment strategies.[3] Accurate determination of root canal anatomy through thorough pre-operative assessment will positively influence the clinical success of canal treatment.[5]

Conventional radiography, despite its limitation of producing two-dimensional images of three-dimensional structures, remains a valuable diagnostic tool. The careful analysis of multiple intraoral periapical radiographs, captured at various horizontal angles, allows clinicians to discern intricate structural and anatomical details of root canal systems. These radiographic examinations are particularly effective in elucidating the morphological characteristics of root canals.

Corresponding Author: Esra Balkanlıoğlu, dt.esrabalkanlioglu@gmail.com

In cases where conventional radiographic techniques cannot provide clear information and further detail is required, advanced diagnostic radiographic techniques such as cone beam computed tomography (CBCT) can be highly useful in detecting these variations.[6] However, CBCT should not be employed in every case, but rather in accordance with the as low as reasonably achievable (ALARA) optimization principle, following a cost-benefit analysis, when digital radiography proves insufficient in identifying root canal configuration.

Given the atypical and intricate canal morphology, the present cases, in conjunction with a literature review, suggest that mandibular premolar teeth with additional roots and canals can be effectively managed through conventional endodontic treatment.

CASES

Patients presenting at Kahramanmaraş Sütçü İmam University Faculty of Dentistry Hospital with indications for root canal treatment in mandibular premolar teeth were examined. Through radiological examination, patients with mandibular premolar teeth exhibiting additional root and canal system variations were selected. These variations were demonstrated through four cases, and personalized treatment methods appropriate for each case were implemented. Informed consent forms containing treatment-related information were obtained from the patients.

Case 1

A 41-year-old female patient was referred to the endodontics clinic with a complaint of pain in the right mandibular second premolar tooth. The intraoral clinical examination revealed percussion sensitivity in the tooth. There was no swelling or fistula present. A previously placed restoration was noted. Radiographic examination showed evidence of a prior unsuccessful root canal treatment attempt. The presence of two roots and two canals was identified, with one canal incompletely filled and the other appearing untreated and unfilled (**Figure 1a**). A decision was made to perform retreatment on this tooth. Radiographically, a root bifurcation was observed in the middle third of the root.

The tooth was isolated with a rubber dam. The old restoration was completely removed and secondary caries were eliminated. Access to the pulp cavity was established, exposing the gutta-percha at the canal access. A path was created through the gutta-percha using a size 10 K-type file with a 0.2 taper (Jensen JP-1, Dresden, Germany) in a rotational motion. Subsequently, a size 15 manual steel H-type file (Jensen JP-1, Dresden, Germany) was used to advance through the created path, attempting to remove the gutta-percha with a pulling motion. Progressively larger H-type hand instruments were used to remove all the gutta-percha. The access cavity was then enlarged up to the middle third of the root, where the bifurcation was observed, using long-shank burs and Gates Glidden drills (Dia Dent Gate Drills, Dentsply Sirona, Germany). Two canals, one buccal and one lingual, were identified using a size 10 K-type manual file (Jensen JP-1, Dresden, Germany). Working lengths were determined using an apex locator (WOODPECKER Woodpex-3 Gold Plus, Guilin Woodpecker Medical Instrument Co. Ltd., China). Both canals were manually instrumented, with the final instrument being a size 25 K-type manual steel file (Jensen JP-1, Dresden, Germany). Irrigation with 2.5% NaOCl (microvem sodium hypochlorite, Sakarya, Turkiye) was performed between each file. Irrigation activation was achieved using an EndoActivator (Dentsply-Sirona, Germany). Calcium hydroxide (saver calcium hydroxide, India) was placed, and a follow-up appointment was scheduled for one week later.

During the second appointment, the calcium hydroxide (Saver Calcium Hydroxide, India) paste was removed using NaOCl (microvem sodium hypochlorite, Sakarya, Turkiye) irrigation and an EndoActivator (Dentsply-Sirona, Germany). The bifurcated portions of the canals were filled using 0.2 taper size 25 gutta-percha points (Pearl Endo Gutta Percha Points, Brussels, Belgium). The root portion up to the bifurcation in the middle third was filled using a warm obturation technique (DiaDent Gutta Percha Obturator, Korea). The coronal restoration of the tooth was completed using composite resin (Nova Compo C A2 Imicryl, Konya, Turkiye), and a final radiograph was obtained (**Figure 1b**).

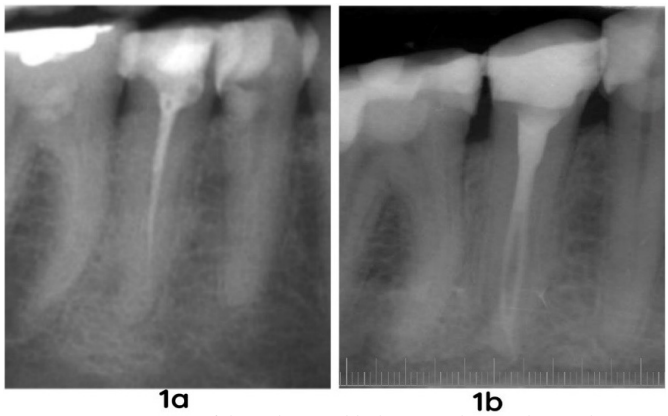

Figure 1. Retreatment of the right mandibular second premolar tooth

*a) Initial film showing incomplete root canal treatment and periapical lesion of the right mandibular second premolar tooth. b) Final film taken after treatment of two roots and two canals

Case 2

A 14-year-old male patient presented to the clinic with severe pain in tooth number 34. Clinical examination revealed pain on percussion and a deep carious lesion in the tooth. The periodontal tissues appeared healthy. Radiographic examination indicated that the caries had reached the pulp, necessitating root canal treatment. The radiographic image revealed that the tooth had two roots, with bifurcation beginning from the middle third of the root (**Figure 2a**). Following local anesthesia (Maxicaine (40 mg/ml articaine hydrochloride and 0.009095 mg/ml epinephrine bitartrate), Vem Pharma, İstanbul, Turkiye), tooth 34 was isolated with a rubber dam. After complete removal of the carious tissue, an access cavity was prepared. The root canal orifice appeared oval, similar to that of a single-rooted tooth. An attempt was made to access the canals using a size 10 K-type stainless steel hand file with a diameter of 0.2 mm (Jensen JP-1, Dresden, Germany). While the buccal canal was easily accessible, access into the lingual canal was not possible. The coronal portion up to the middle third of the root was enlarged buccolingually

using long burs and Gates Glidden drills (DiaDent Gate Drills, Dentsply Sirona, Germany). However, access to the lingual canal remained unattainable. Calcium hydroxide (saver calcium hydroxide, India) was placed in the accessible canal and root interior, and the patient was scheduled for a second appointment.

During the second appointment, the calcium hydroxide paste (Saver Calcium Hydroxide, India) was removed from the canals using saline and 2.5% NaOCl (microvem sodium hypochlorite, Sakarya, Turkiye). Access to the lingual canal was achieved using a size 8 K-type stainless steel hand file with 0.2 taper (Jensen JP-1, Dresden, Germany) and a pre-bent tip towards the lingual aspect. It was observed that the lingual canal separated from the main canal at a sharp angle resembling a right angle. The working length was determined using an apex locator (Woodpecker Woodpex-3 Gold Plus, Guilin Woodpecker Medical Instrument Co. Ltd., China). The lingual canal was manually instrumented up to a size 20 K-type file with 0.2 taper (Jensen JP-1, Dresden, Germany), while the buccal canal was instrumented using an endomotor (Woodpecker Ai Endo Motor, Guilin Woodpecker Medical Instrument Co. Ltd., China) up to a size 25 NiTi file with 0.4 taper and 25 mm apical diameter (NIC Super Files Gold Rotary, Ireland). Irrigation with 2.5% NaOCl (Microvem Sodium Hypochlorite, Sakarya, Turkiye) was performed between each file. Activation was achieved using EndoActivator (Dentsply-Sirona, Germany). After drying the canals with paper points (Pearl Endo Paper Points, Brussels, Belgium), the lingual root was filled with a size 20 gutta-percha cone with 0.2 taper (Pearl Endo Gutta Percha Points, Brussels, Belgium), and the buccal root was filled with a size 25 gutta-percha cone with 0.4 taper (Pearl Endo Gutta Percha Points, Brussels, Belgium), and canal sealer (Meta Biomed Adseal, Ruhr, Germany). The gutta-percha points were sectioned at the bifurcation, and the coronal portion of the root was filled using a warm vertical compaction technique (DiaDent Gutta Percha Obturator, Korea). After sealing the canal orifices with resin-modified glass ionomer cement, the tooth's coronal restoration was completed using composite resin (Nova Compo C A2) (**Figure 2b**).

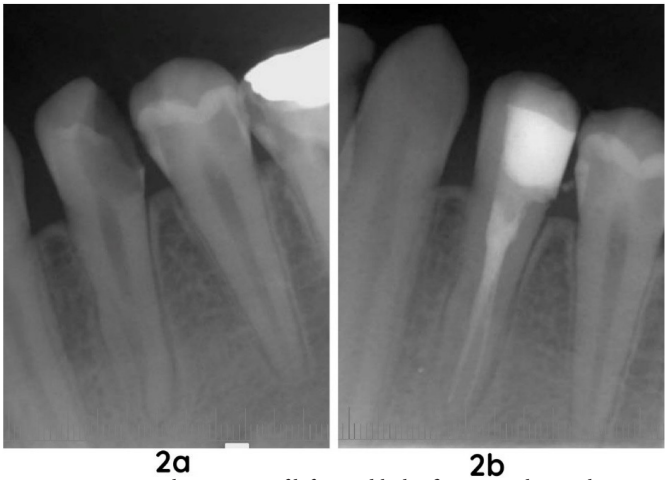

Figure 2. Root canal treatment of left mandibular first premolar tooth

*a) Initial film showing the two roots and two canals of the left mandibular first premolar tooth with a deep carious cavity. b) Final film showing the root canal treatment

Case 3

A 38-year-old female patient presented to the clinic with a complaint of pain in tooth number 45. Following clinical and radiographic examination, root canal treatment was deemed necessary. Radiographic analysis revealed a pulp cavity extending to the apical region of the root, resembling taurodontism, along with bifurcating roots at the apex (**Figure 3a**).

Local anesthesia (Maxicaine (40 mg/ml articaine hydrochloride and 0.009095 mg/ml Epinephrine Bitartrate), Vem Pharma, Istanbul, Turkiye) was administered, and a rubber dam was placed. After caries removal, an access cavity was prepared. Pre-curved 0.2 taper size 15 K-type stainless steel manual files (Jensen JP-1, Dresden, Germany) were introduced into the canals, one directed mesially and the other distally. Canal length and location were confirmed radiographically. Working lengths were determined using an apex locator (WOODPECKER Woodpex-3 Gold Plus, Guilin Woodpecker Medical Instrument Co. Ltd., China). Both root canals were instrumented using an endomotor (Woodpecker Ai Endo Motor) with 0.4 taper, 25 mm apical diameter nickel-titanium rotary files (NIC Super Files Gold Rotary). The portion above the bifurcation was manually shaped using hand files. The mesial and distal roots were obturated with 0.4 taper size 25 gutta-percha points (Pearl Endo Gutta Percha Points, Brussels, Belgium) and canal sealer (Meta Biomed Adseal, Ruhr, Germany), while the coronal portion of the roots was filled using a warm vertical compaction technique (DiaDent Gutta Percha Obturator). The coronal restoration was completed using composite resin (Nova Compo C A2) (**Figure 3b**).

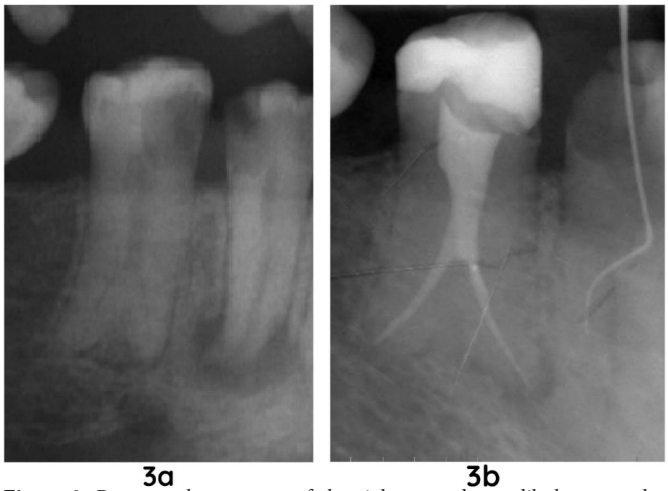

Figure 3. Root canal treatment of the right second mandibular premolar tooth with taurodontism

*a) Initial radiograph showing deep carious cavity, periapical lesion and branching in the last third of the root in the right mandibular second premolar tooth. b) Final radiograph

Case 4

A 58-year-old female patient presented to our clinic for endodontic treatment of her right mandibular first premolar tooth. Clinical examination revealed a fixed prosthetic restoration on the tooth. The patient reported nocturnal pain, and percussion sensitivity was present. Radiographic examination showed a previous unsuccessful root canal treatment, a periapical lesion, and confirmed that the tooth

had two roots and two canals (**Figure 4a**). Local anesthesia (Maxicaine (40mg/ml Articaine Hydrochloride and 0.009095 mg/ml Epinephrine Bitartrate), Vem Pharma, Istanbul, Turkiye) was administered. The fixed prosthetic restoration was removed from the tooth. Caries was observed on the distal aspect of the tooth. The carious tissue was removed, and an access cavity was prepared. Two separate canal orifices were identified using a 0.2 mm diameter #10 K-type steel hand file (Jensen JP-1, Dresden, Germany). The canal orifices began at the cementoenamel junction as two separate accesses, with one canal located buccally and the other on the mesiolingual aspect of the tooth. Canal lengths were determined using an apex locator (Woodpex-3 Gold Plus, Guilin Woodpecker Medical Instrument Co. Ltd., China). Both canals were shaped using an endomotor (Woodpecker Ai Endo Motor, Guilin Woodpecker Medical Instrument Co. Ltd., China) with a 0.4 taper, 25 mm apical diameter nickel-titanium endomotor file (NIC Super Files Gold Rotary, Ireland). Both canals were filled with 0.4 taper, 25 mm diameter gutta-percha (Pearl Endo Gutta Percha Points, Brussels, Belgium) and canal sealer (Meta Biomed Adseal, Ruhr, Germany). The coronal portion of the tooth was restored with composite resin (Nova Compo C A2) (**Figure 4b**).

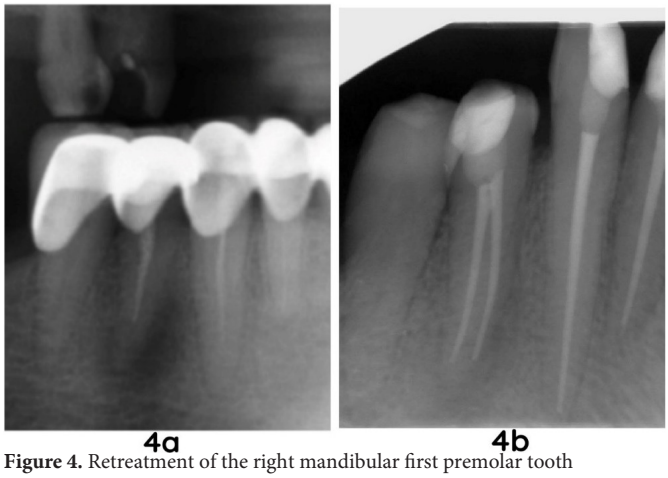

Figure 4. Retreatment of the right mandibular first premolar tooth

*a) Initial film showing the lesion at the root apex of the right mandibular first premolar tooth treated with fixed prosthetic restoration with incomplete root canal treatment. b) Final film of the root canal treatment

LITERATURE REVIEW

In our study, a comprehensive literature review was conducted to examine cases involving root and canal numbers of mandibular premolar teeth with additional roots and canals between 2021 and 2024. The literature search utilized PubMed and Google Scholar databases. Keywords such as additional roots, mandibular premolar, and additional canals were employed in the database searches. A total of 18 studies published between 2021 and 2024 were evaluated, along with our own cases, resulting in the assessment of 24 cases. The inclusion criterion was the presence of additional canals and roots, as well as taurodontism. Teeth with a single root and single canal were excluded (**Table**).[7-18]

Since **Table** in the material method section of the main text of our article was placed at the end of the main text while being revised in accordance with the criteria of your journal, sources numbered 4, 6, 9, 14, 16 in the main text and sources numbered 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, which are not included in the text but only in the table, were included in the **Table**.[7-18]

Table. A literature review encompassing the years 2021-2024 regarding cases demonstrating root and canal diversity in mandibular premolar teeth[7-18]

Study name and date	Gender and age	Tooth	Number of roots and canals
Gurav, Tikesh 2024[9]	Male, 42	Mandibular 1st premolar	2 roots, 2 canals
Arevalo, Llani 2024[4]	Female, 22	Mandibular 1st premolar	3 roots, 3 canals
M. Mohammedi 2024[15]	Female, 36	Mandibular 2nd premolar	Taurodontizm, 3 canals
Aras, Sanket 2024[6]	Female, 19	Mandibular 2nd premolar	2 roots, 2 canals
Solete, 2023[16]	Male, 21	Mandibular 1st premolar	3 roots, 3 canals
Solete, 2023[16]	Male, 29	Mandibular 1st premolar	1 root, 3 canals
Solete, 2023[16]	Male, 39	Mandibular 2nd premolar	2 roots, 3 canals
Solete, 2023[16]	Female, 74	Mandibular 2nd premolar	1 root, 3 canals
Solete, 2023[16]	Male, 37	Mandibular 2nd premolar	2 roots, 4 canals
Brar, Prabhle, 2023[17]	Male, 25	Mandibular 2nd premolar	1 root, 3 canals
Davaji,Mina,2023[18]	Female, 38	Mandibular 2nd premolar	2 roots,4 canals
Mahdavisefat, 2023[19]	Male, 26	Mandibular 1st premolar	3 roots, 3 canals
Awooda, Elh.., 2023[20]	Male, 24	Mandibular 2nd premolar	3 roots, 3 canals
Sibal, Akash, 2022[14]	Male, 27	Mandibular 2nd premolar	2 roots, 2 canals
Sibal, Akash, 2022[14]	Female	Mandibular 2nd premolar	1 root, 2 canals
Jain, Rachit, 2022[21]	Male, 48	Mandibular 1st premolar	1 root, 3 canals
Jain, Rachit, 2022[21]	Male	Mandibular 1st Premolar	2 roots, 2 canals
Niavarzi, 2022[22]	Male, 50	Mandibular 2nd premolar	1 root, 4 canals
Arroyo-Bote, 2022[23]	Male, 59	Mandibular 2nd premolar	3 roots, 3 canals
Shah, Shahz, 2022[24]	Female, 22	Mandibular 2nd premolar	1 root, 2 canals
Penukonda, 202[25]	Male, 35	Mandibular 1st premolar	2 roots, 4 canals
Nouroloyouni, 2021[26]	Male, 18	Mandibular 1st premolar	2 roots, 5 canals
Moghadam, 2021[27]	Male, 19	Mandibular 1st premolar	1 root, 3 canals
Case 1	Female, 41	Mandibular 2nd premolar	1 root, 2 canals
Case 2	Male, 14	Mandibular 2nd premolar	2 root, 2 canals
Case 3	Female, 38	Mandibular 2nd premolar	Taurodontizm, 2 canals
Case 4	Female, 58	Mandibular 1st premolar	2 roots, 2 canals

RESULTS

A recent study conducted in 2024 found that 78.3% of mandibular first premolars and 90.3% of mandibular second premolars consist of single canals. Subgroup analyses revealed higher incidences of single-rooted and single-canal premolars in Asians compared to Caucasians. Furthermore, the study observed a higher frequency of single-rooted premolars in females, while males exhibited a higher frequency of double-rooted premolars.[19] Dental morphology studies have revealed that the majority of examined teeth possess a single root and canal structure. However, the findings indicate that 18% of the teeth exhibit two roots, while 26% demonstrate the presence of two canals.[2] According to a study conducted in 2023, the prevalence of single roots in mandibular first premolars was found to be 98.9%, two roots 1.1%, and the occurrence of three roots was negligible. In mandibular second premolars, single roots were observed in 98.8% of cases, two roots in 1.2%, and the incidence of three roots was negligible.[20]

The data obtained from the literature review are presented in **Table**. Consistent with the literature findings, three of the four cases we evaluated were second premolars, and one was a first premolar. One case a single root with two canals, two cases had two roots with two canals, and one case presented with taurodontism and two canals. Canal bifurcations were observed in the apical third in the case of taurodontism, while in one case, there were two separate entrances near the coronal portion of the root. In two cases, the canals originated from a single entrance and diverged at different levels in the middle third of the root. Consequently, each case required treatment with individualized therapeutic techniques.

DISCUSSION

Although existing cases predominantly show single roots in mandibular premolar teeth, the root morphology may present as two roots, three roots, or taurodontism. This observation highlights the necessity for endodontists to remain prepared for potential variations in each case.

The success of non-surgical root canal treatment (NSRCT) is contingent upon a comprehensive understanding of root and root canal morphology to accurately locate all canals and appropriately clean, shape, and fill the canal space three-dimensionally.[1]

Mandibular premolars predominantly exhibit a single canal morphology. Specifically, 78.3% of mandibular first premolars and 90.3% of mandibular second premolars possess a single canal. Subgroup analyses revealed higher incidences of single-rooted and single-canal premolars among Asian populations and females. Furthermore, while females demonstrated a higher prevalence of single-rooted premolars, males exhibited a higher frequency of double-rooted premolars.[19]

In mandibular first premolars, Vertucci type 1 and type 4 canal configurations are predominantly observed, whereas in second mandibular premolars, Vertucci type 1 and type 5 canal configurations are most frequently encountered.[2] Vertucci's research revealed that 0.5% of mandibular first premolars possess three canals at the apex, 25.5% have two canals, and 74% have a single canal. Two roots and two foramina constitute 4% of the cases.[21]

Second mandibular premolars are predominantly single-rooted (89.5-100%), followed by two-rooted mandibular second premolars with a frequency of less than 8%, while three roots have been reported in only 0.1% to 3.5% of cases.[10] The most frequently observed canal type is Vertucci type I, followed by Vertucci type V and Vertucci type IV. In mandibular second premolars, Vertucci type I is the most commonly observed classification, with a prevalence of up to 99.6%. The second most frequently reported type in mandibular second premolars is Vertucci type V, with a prevalence of 57.1%.[22]

The data obtained through literature review has demonstrate that mandibular premolar teeth predominantly exhibit a single root; however, two roots, three roots, taurodontism, and C-shaped root morphology can also be observed. Consequently, endodontists should be aware of the potential for encountering unexpected variations in each case. Due to these variations in mandibular premolars, it is of paramount importance to develop individualized treatment strategies.[3]

Understanding the root canal configuration in such teeth, attempting to access all canals using alternative techniques, and adapting standard canal treatment techniques to these teeth require extended working time and additional sessions. This necessitates patience from the clinician.

Prior to initiating treatment, radiographs should be obtained from different angles to determine the number and configurations of root canals. During radiographic examination, the internal and external contours of the tooth should be carefully observed. The presence of intersecting lines suggests additional canals. If a radiolucent line is present mesial or distal to the main canal, an additional canal should be suspected. If the radiographic image of the middle third of the root appears equal to or larger in diameter than the crown portion, a variation in root canal configuration may be considered. Radiographs taken from different angles also assist in visualizing additional canals. If the pulp space is observed to suddenly disappear or narrow on the radiograph, the presence of a bifurcation in that area should be considered.[23] Radiographic features, particularly the abrupt narrowing pattern evident in panoramic images of mandibular first premolars with multiple root canals, play a crucial role in enhancing diagnostic precision. This distinctive pattern is characterized by an intensification of radiographic opacity within the apical third of the root. Notably, the occurrence of the abrupt narrowing pattern is significantly more frequent in teeth possessing multiple root canals compared to their single-canal counterparts.[24]

These four distinct cases demonstrate that radiographs can often be sufficient in determining root canal configuration. When standard radiographic techniques prove inadequate for detecting anomalies or necessary information, CBCT imaging may be preferred.

In a study examining the diversity of root morphology in mandibular premolar teeth and associated clinical strategies, it is particularly challenging to fill the root canal below the bifurcation when multiple root canals are present and the bifurcation occurs in the apical third of the root. In such

cases, when performing root canal filling, the root should be divided into segments, including the apical portion below the bifurcation and the more coronal section. After completing the filling of the apical segment, the filling of the upper segment is initiated. If the space in the upper portion is too narrow to accommodate multiple main cones simultaneously, the root canal filling sequence may proceed from the more difficult to the easier segments. The selected main gutta-percha cone is cut extraorally at the tooth level, and subsequently, the easier canal is filled. Bioceramic sealer may provide a superior solution to the filling problem in such challenging cases. During application, an appropriate amount of bioceramic sealer can be applied to the main gutta-percha tip to prevent excessive overflow and impairment of visibility. When filling separately, a paper cone or gutta-percha point can be inserted into another root canal to be filled to prevent the sealer or excess gutta-percha from obstructing the unfilled root canal. After radiographic examination confirms the completion of the filling in the apical segment, the upper portion of the root canal is filled. The upper segment can be filled using warm gutta-percha vertical compaction technology. To prevent thermal damage to the periodontal tissue due to the thin dentin wall transferring heat to the outer surface of the root, appropriate working time and temperature should be controlled during filling. A study similar to ours has also presented a comparable approach as a clinical strategy.[25]

In one case, shaping was performed using only hand instruments, while in another, both hand instruments and an endodontic motor were used. The remaining two cases were shaped exclusively using an endodontic motor. Consequently, when treating teeth with variable root canal configurations, it is essential to develop alternative treatment techniques and formulate personalized treatment strategies.

In the cases included in our study, we determined the root morphology and number solely through 2D radiographic imaging, without the use of CBCT. Clinical success can be achieved through careful planning, investigation, biomechanical preparation, and obturation of all canals. In a study similar to ours, endodontic treatment of a premolar tooth with two roots and canals was successfully completed without the use of CBCT.[26,27]

In cases of mandibular premolars exhibiting complex multi-root canal morphology, the use of CBCT imaging is imperative.

CONCLUSION

A comprehensive review of the literature has revealed that mandibular premolars frequently possess additional roots and canals. This anatomical characteristic negatively impacts the success rate of root canal therapy in these teeth. Endodontists must be prepared for the potential presence of additional roots and canals in these teeth and develop diverse treatment strategies accordingly. Extended treatment sessions and, in some cases, multiple appointments may be necessary. Our investigation has also shown that numerous cases can be effectively diagnosed and treated using conventional radiographic techniques without the need for CBCT imaging. The combination of literature analysis and existing case studies supports the conclusion that mandibular premolars with supplementary roots and canals can be successfully treated through conventional root canal therapy procedures.

ETHICAL DECLARATIONS

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Cleghorn BM, Christie WH, Dong CC. The root and root canal morphology of the human mandibular first premolar: a literature review. *J Endod*. 2007;33(5):509-516. doi:10.1016/j.joen.2006.12.004
2. Induja M, Chokkattu JJ. Root canal morphology of mandibular premolars: CBCT analysis. *Int J Health Sci*. 2022(II):11936-11943. doi:10.53730/ijhs.v6nS2.8222
3. Karobari MI, Batul R, Khan M, et al. Micro computed tomography (micro-CT) characterization of root and root canal morphology of mandibular first premolars: a systematic review and meta-analysis. *BMC Oral Health*. 2024;24(1):1. doi:10.1186/s12903-023-03624-5
4. Arévalo L, Oporto GH, Chuhuaicura P, et al. Root canal treatment of mandibular first premolar with 3 canals: a case report. *Int J Morphol*. 2024;1(2):2.
5. Balkanlıoğlu E, Şimşekyılmaz Z. Evaluation of root canal morphology molar teeth and distance between additional canals using CBCT. *HRU Int J Dent Oral Res*. 2024;4(2):30-37. doi:10.61139/ijdor.1517056
6. Aras SD, Borkar AC, Mujumdar SV, Maral SA, Barbhai SS, Gambhir AS. Endodontic management of an aberrant root canal anatomy: a case report and literature review. *Front Oral Maxillofac Med*. 2024;6. doi:10.21037/fomm-22-68
7. Xu M, Ren H, Liu C, Zhao X, Li X. Systematic review and meta-analysis of root morphology and canal configuration of permanent premolars using cone-beam computed tomography. *BMC Oral Health*. 2024;24(1):656. doi:10.1186/s12903-024-04419-y
8. Rae O, Parashos P. Prevalence and morphology of different root canal systems in mandibular premolars: a cross-sectional observational study. *Aust Dent J*. 2024;69(2):112-123. doi:10.1111/adj.12994
9. Gurav T, Sormare Y, Thakare A, Jadhav V. Solving the mystery: a case study on treating a mandibular first premolar with multiple canals. *Cureus*. 2024;16(7):e63734. doi:10.7759/cureus.63734
10. Wolf TG, Anderegg AL, Wierichs RJ, Campus G. Root canal morphology of the mandibular second premolar: a systematic review and meta-analysis. *BMC Oral Health*. 2021;21(1):309. doi:10.1186/s12903-021-01668-z
11. Rödig T, Hülsmann M. Diagnosis and root canal treatment of a mandibular second premolar with three root canals. *Int Endod J*. 2003;36(12):912-919. doi:10.1111/j.1365-2591.2003.00750.x
12. Shimada Y, Kojima I, Nishioka T, Sakamoto M, Iikubo M. Root canal narrowing patterns of mandibular first premolars on panoramic radiographs according to the number of root canals diagnosed on cone beam computed tomographic images. *Odontology*. 2023;111(1):172-177. doi:10.1007/s10266-022-00713-9
13. Liang CY, Chen WX. Diversity of root canal morphology in mandibular first premolars and its clinical strategies. *Chinese J Stomatol*. 2023;58(1):92-97. doi:10.3760/cma.j.cn112144-20221017-00534

14. Sibal A, Patel A, Singi SR, Bagde A. Two rooted mandibular second premolar: an unusual finding. *Cureus.* 2022;14(5):e25550. doi:10.7759/cureus.25550
15. Mohammadi M, Zarei M. Endodontic management of a mandibular second premolar with three root canals and taurodontism: a case report. *Iran Endod J.* 2024;19(3):228-231. doi:10.22037/iej.v19i3.45174
16. Solete P, Priscilla Antony SD, Teja KV, Chandragupta MS, Sanju D, Suresh Babu NM. Endodontic management of aberrant canal morphology in mandibular premolar: a case series. *J Conserv Dent*. 2023;26(2):236-240. doi:10.4103/jcd.jcd_548_22
17. Brar PK, Brar R, Vashisht R, Gambhir RS. Root canal treatment of a mandibular second premolar with unusual anatomy: a rare case report. *J Datta Meghe Institute Med Sci Univ.* 2023;18(3):500-502. doi:10.4103/jdmimsu.jdmimsu_307_23
18. Davaji M, Valizadeh M, Karimpour S. Detection and endodontic treatment of unusual anatomic variations in second premolars: a case report. *Iran Endod J.* 2023;18(4):254-258. doi:10.22037/iej.v18i4.41716
19. Mahdavisefat E, Kazemi A, Moghtaderi Esfahani E. Endodontic management of three-rooted mandibular first premolar using cone-beam computed tomography: a case report. *Iran Endod J.* 2023;18(2):122-125. doi:10.22037/iej.v18i2.41169
20. Awooda EM, Elyas EEM, Al-Nazhan SA. Conventional root canal treatment of a mandibular second premolar with three roots and three canals performed by an undergraduate student: a case report with 8-year follow-up. *Saudi J Oral Sci.* 2023;10(3):201-206. doi:10.4103/sjoralsci.sjoralsci_57_23
21. Jain R, Mala K, Shetty N, Bhimani N, Kamath PM. Endodontic management of mandibular anterior teeth and premolars with Vertucci's type VIII canal morphology: a rare case. *J Conserv Dent*. 2022;25(2):197-201. doi:10.4103/jcd.jcd_518_21
22. Niavarzi S, Ghabraei S, Malekpour F. Mandibular second premolar with four canals: a case report. *Iran Endod J.* 2022;17(4):209-211. doi:10.22037/iej.v17i4.38604
23. Arroyo-Bote S. Use of cbct in the endodontic management of a second mandibular premolar with three roots: clinical case. *J Clin Exp Dent*. 2022;14(1):e107-e113. doi:10.4317/jced.58612
24. Shah SA. Endodontic management of mandibular second premolar with Vertucci root canal configuration type V. *Case Rep Dent*. 2022;2022:3197393. doi:10.1155/2022/3197393
25. Penukonda R, Pattar H, Siang Lin GS, Kacharaju KR. Cone-beam computed tomography diagnosis and nonsurgical endodontic management of a taurodontic mandibular first premolar with two roots and four canals: a rare case report. *J Conserv Dent*. 2021;24(6):634-639. doi:10.4103/jcd.jcd_580_21
26. Nouroloyouni A, Lotfi M, Milani AS, Nouroloyouni S. Endodontic management of a two-rooted mandibular first premolar with five root canals with cone-beam computed tomography: a case report. *J Dent (Shiraz).* 2021;22(3):225-228. doi:10.30476/DENTJODS.2020.83376.1049
27. Dalaei Moghadam M, Farahi F. Endodontic treatment of bilateral mandibular first premolars with three root canals: a report of two cases. *Iran Endod J.* 2021;16(4):261-264. doi:10.22037/iej.v16i4.34781