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# Detection and Endodontic Treatment of Unusual Anatomic Variations in Second Premolars: A Case Report

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Endodontic treatment of second premolars is challenging due to their complex anatomy and the likelihood of anatomical variations. The current report presents successful treatments of mandibular and maxillary second premolars with different anatomies in a single patient. The first case involved a patient referred from a general practitioner who was unable to complete the root canal treatment of her mandibular second premolar with four root canals. The initial radiograph showed an apical radiolucency, periodontal ligament (PDL) widening, and a fast break suggesting the possibility of root canal branching. With the diagnosis of previous treatment and chronic apical periodontitis, the tooth was successfully retreated with the aid of cone-beam computed tomography (CBCT), a dental operating microscope, and ultrasonic tips. The second case was a maxillary second premolar with Vertucci's type VI root canal morphology, which was not responsive to pulpo-periapical tests. Along with a deep carious lesion and a PDL widening on the initial radiograph, a diagnosis of necrosis with chronic apical periodontitis was made. The root canals were located and treated using a combination of radiography with different angulation and CBCT. Both teeth were clinically and radiographically asymptomatic at the 4-month follow-up session. This case report highlights the importance of thorough preoperative evaluation and the use of advanced technology and techniques in achieving successful endodontic treatment outcomes.

**Keywords:** Anatomic Variation; Bicuspid; Vertucci's Type VI

## Introduction

Anatomical variations are reported in all teeth, especially in premolars [1-4]. One of the main causes of endodontic treatment failure is the inability to detect these anatomical variations, resulting in incomplete cleaning and shaping of the root canal system [5]. A complete understanding of the root canal system and awareness of the prevalence of different possible morphologies in different teeth, along with the ability to find and treat them, is important for treatment success. Maxillary premolars can exhibit a vast variety of canal configurations, which can vary based on race, sex, and geographic location [6, 7].

According to Ingle [8], 51.8% of maxillary second premolars have a single canal, based on 16 anatomical studies. A high proportion of these premolars also possess two canals in one root, as per Vertucci's classification [9]. Asheghi *et al.* [7] reported that the prevalence of Vertucci's type VI in maxillary second premolars among the Iranian population is 0.5%.

Mandibular premolars can also exhibit various anatomical variations. According to Slowey [10], mandibular premolars are the most challenging teeth for root canal treatment. In 99.28% of cases, mandibular second premolars have only one root, and 86.9% of these cases have a single canal. The prevalence of two roots is 0.61%, while the probability of having more than two root canals is very low (0.31%) [11]. Due to these numerous anatomical aberrations, the root canal system of all premolar teeth must be carefully explored before and during treatment.

The purpose of this case report is to introduce useful tools and techniques for identifying and successfully treating two second premolars with two different anatomical variations in one patient

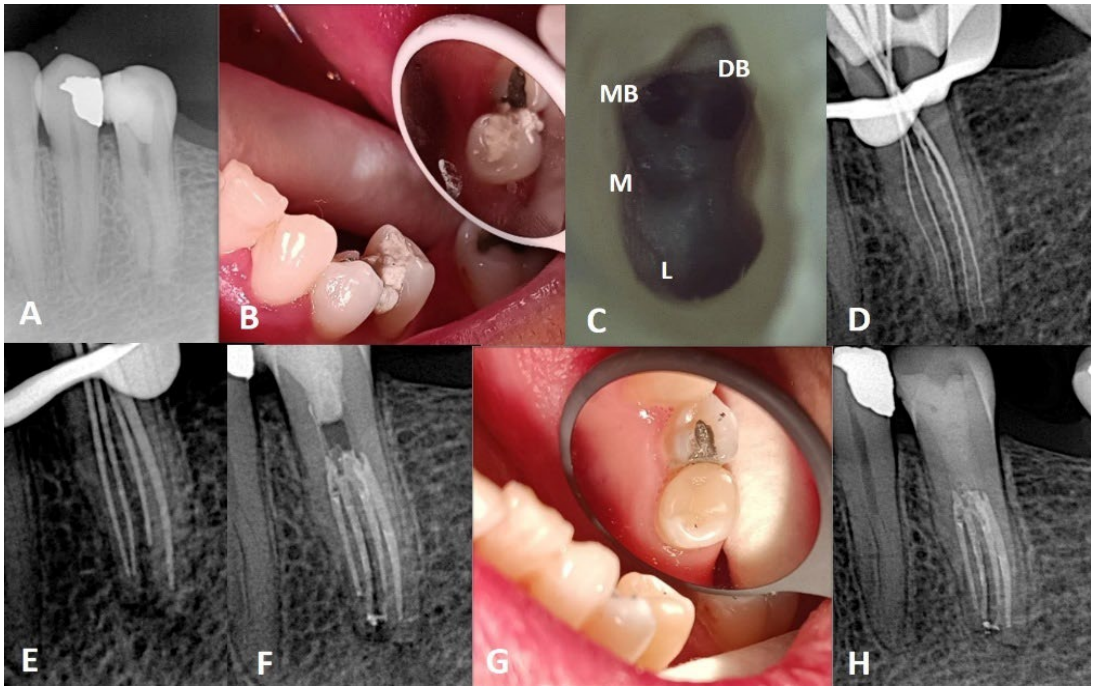


***Figure 1***. Mandibular second premolar; *A*) Preoperative radiograph; *B*) Preoperative photograph; *C*) Dental operative microscope view of four orifices; *D*) Working length confirmation radiograph; *E*) Master cone confirmation radiograph; *F*) Postoperative radiograph; *G*) 4-month follow-up photograph; *H*) 4-month follow-up radiograph

## Case Presentation

***Case 1 (Mandibular second premolar with four root canals)***

A 38-year-old female with a noncontributory medical history was referred to the department of endodontics, school of dentistry, Mashhad University of Medical Sciences, Iran, by her general dentist. The dentist was unable to complete the root canal treatment of her mandibular second premolar due to the different anatomy of the root canal system. The intraoral examination revealed a tooth with temporary restoration (Figure 1A) and no response to electrical (Parkell digital EPT, New York, USA) and thermal (Frisco spray, Arztbedarf, Frenchen, Germany) pulp tests, while the adjacent teeth responded within normal ranges. No sensitivity to palpation and percussion was observed. A periapical radiograph showed a bifurcated root with a slight apical radiolucency and periodontal ligament (PDL) widening (Figure 1B). A fast break of the radiolucency of the main canal indicated the possibility of multiple root canals. Based on the diagnosis of previous treatment and chronic apical periodontitis, informed consent was obtained, and the patient was scheduled for non-surgical root canal retreatment. At the first treatment session, the tooth was isolated with a rubber dam after a mandibular nerve block with 2% lidocaine and epinephrine 1:100,000 (Darupakhsh, Tehran, Iran). Under a dental operating microscope (Carl Zeiss Meditec Inc., Dublin, CA, USA), the temporary restoration was removed and the access cavity was prepared with high-speed diamond round bur No. 2 (Jota AG, Rüthi, Switzerland) and continuous water spray. Three orifices (mesiobuccal/MB, distobuccal/DB, lingual/L) were negotiated with ultrasonic tips and #8 K-file (Mani Inc., Utsunomiya, Japan). The working length was determined as 19.5 mm for the buccal canals and 22 mm for the lingual one by an electronic apex locator (Minipex, Woodpecker, China) and then confirmed with radiography (Figure 1C). Due to the presence of a sticking point at the mesial side of the pulp chamber floor and suspicion of the existence of the fourth canal, a cone-beam computed tomography (CBCT) was ordered, and the continuation of the treatment was postponed to the next session. CBCT confirmed the presence an extra mesial (M) canal (Figure 2). After a week, Chemomechanical cleaning and shaping was completed by crown-down technique with T-Pro rotary files (Dental Perfect, Shenzhen, China) up to size 25/04 for three canals (MB, DB, L) under copious irrigation with 5.25% sodium hypochlorite and normal saline alternately. The mesial canal was prepared manually with K-files (Mani, Utsunomiya, Tochigi, Japan) up to size 25/02. A final irrigation with 17% EDTA (Morvabon, Tehran, Iran) was performed to remove the smear layer (Figure 1D). All canals were dried with paper points (META, Chugbuk, South Korea) and obturated with

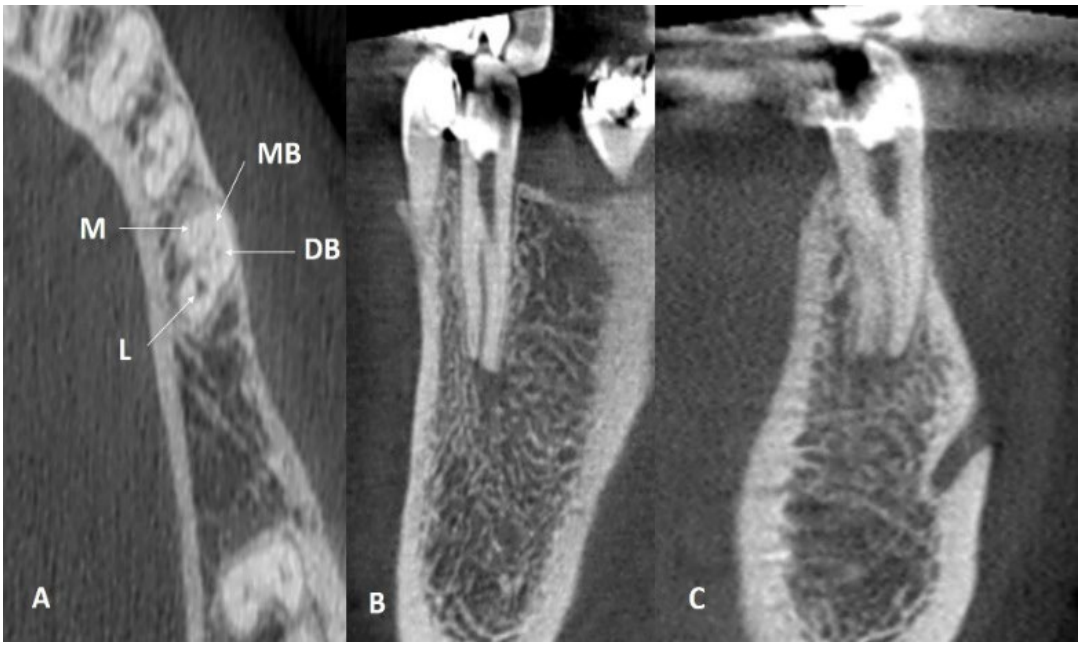


***Figure 2.*** CBCT views; *A*) Axial view; *B*) Sagittal view; *C*) Coronal view

gutta-percha (META, Chugbuk, South Korea) and AH-Plus sealer (Dentsply DeTrey, Konstanz, Germany) using warm vertical technique by FastFill warm obturator (Fast Fill Obturation System, Eighteeth, Changzhou, China). Finally, Cavit (Cavisol, Tehran, Iran) was applied as a temporary restoration and the patient was referred to the department of restorative dentistry for permanent restoration (Figure 1E, 1F). The tooth was clinically and radiographically asymptomatic at the 4-month follow-up session (Figure 1G, 1H).

***Case 2 (Maxillary second premolar with Vertucci's type VI root canal morphology)***

The same patient was also scheduled for root canal treatment of maxillary second premolar with a deep carious lesion and no sensitivity to pulpo-periapical tests. Radiographic examination showed a slight PDL widening (Figure 3A), confirming the diagnosis of necrosis and chronic apical periodontitis. The patient signed an informed consent form agreeing to the treatment plan. After a local infiltration with 2% lidocaine and epinephrine 1:100,000 (Darupakhsh, Tehran, Iran), the access cavity was prepared with high-speed diamond fissure bur No. 012 (Jota AG, Rüthi, Switzerland) under continuous water spray and rubber dam isolation. The buccal and palatal canals were negotiated with #10 K-file (Mani, Utsunomiya, Tochigi, Japan) and the working length was determined as 20 mm for both canals by an electronic apex locator (Minipex, Woodpecker, China). The working length confirmation radiograph revealed a Vertucci's type VI root canal configuration (Figure 3B). The cleaning and shaping process was performed with T-Pro rotary instruments (Dental Perfect, Shenzhen, China) up to size 25/04 under copious irrigation with 5.25% sodium hypochlorite and normal saline alternately. A final irrigation with 17% EDTA (Morvabon, Tehran, Iran) was performed to remove the smear layer. Canals were dried with paper points (META, Chugbuk, South Korea) and AH-Plus sealer (Dentsply DeTrey, Konstanz, Germany) was applied. In or der to fit the master cone, a K-file was inserted into the path with easier access (palatal path in the present case) and a 25/02 gutta-percha cone (META, Chugbuk, South Korea) impregnated with sealer was placed in the path with more difficult access (buccal path in the present case). Then, the K-file was removed, and another gutta-percha cone was inserted into the palatal path (Figure 3C). Using warm vertical technique, obturation was done by FastFill warm obturator (Fast Fill Obturation System, Eighteeth, China). The tooth was restored temporarily and the patient was referred to the department of restorative dentistry for permanent restoration (Figure 3D). Due to the absence of clinical and radiographic signs and symptoms in the 4-month follow-up session, the treatment was considered successful (Figure 3E, 3F).

## Discussion

Detection, cleaning and shaping of the root canal system appropriately are the key factors in achieving the best treatment results [12]. Therefore, it is necessary for the practitioner to benefit from advanced tools in root canal treatment, in addition

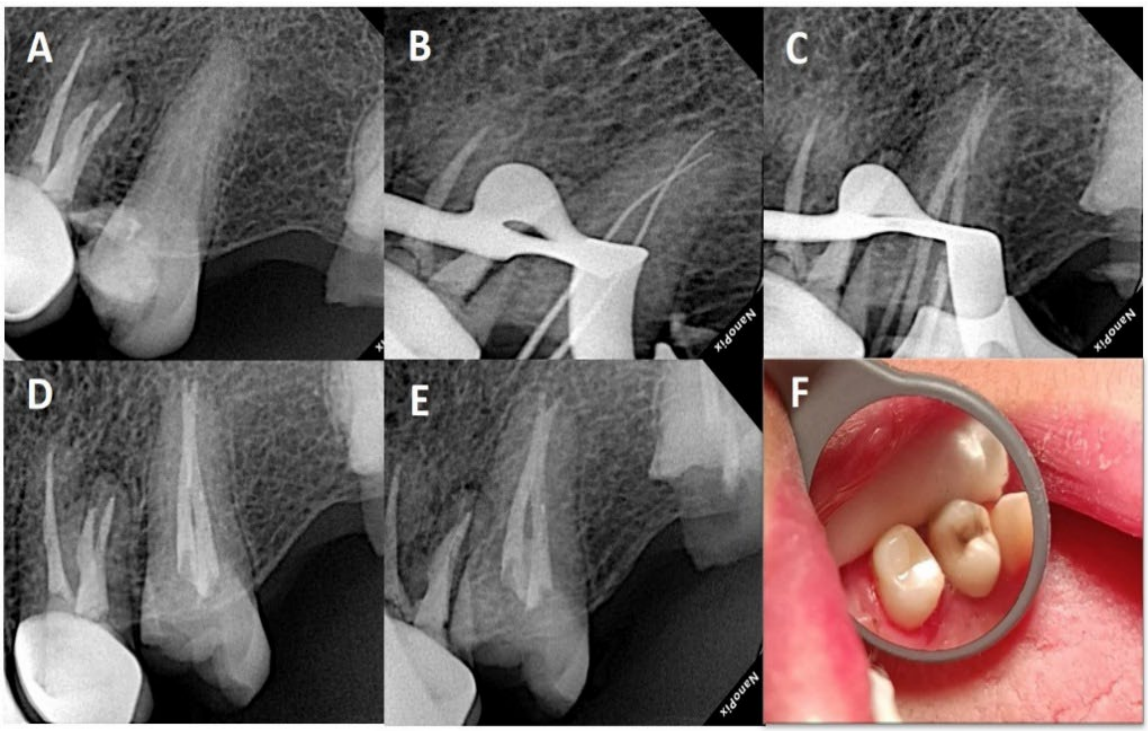


***Figure 3***. Maxillary second premolar; *A*) Preoperative radiograph; *B*) Working length confirmation radiograph; *C*) Master cone confirmation radiograph; *D*) Postoperative radiograph; *E*) 4-month follow-up radiograph; *F*) 4-month follow-up photograph

to having thorough knowledge of the root canal system and understanding the possibility of anatomical variations and their management methods [13]. CBCT can provide high-quality images of the internal anatomy of the root canal. However, it is important to note that the patient is exposed to a relatively higher dose of radiation and the probability of radiographic artifacts is also higher [14]. A properly angulated preoperative radiograph can reveal most of the morphologic variations of the root canal system [15]. The fast break guideline [16] and buccal object rule [17] are both helpful in detecting extra canals and aberrant anatomies. Additionally, a careful interpretation of the periodontal ligament space on conventional radiographs can also indicate the presence of an extra canal or root [15]. Several reports have highlighted the advantages of these tools in the treatment of premolar teeth with anatomical variations [18-21]. Proper magnification is another tool that helps explore extra orifices on the pulpal floor or deep root canal branching at the middle/apical third. Karamifar *et al.* [20] used 21.25× magnification to identify the extra canals of a maxillary premolar tooth with 4 separate root canals. Conservative extension of the access cavity with divergent walls and careful examination of the pulp chamber floor with a fine pre-curved K-file, and troughing with ultrasonic tips under magnification and illumination can be very helpful in finding extra canals [15, 20, 22]. Dadresanfar *et al.* [18] suggested the precise tactile examination of all canal walls in premolar teeth. Preparation of canals with different apical sizes and tapers prevents further removal of dentin and weakening of narrow roots that are already weakened by having multiple canals. In present cases, using rotary instruments with minimal cutting efficiency and manual filing of small canals, along with copious irrigation with sodium hypochlorite, we tried to preserve as much dentin as possible and keep shaping to a minimum. Finally, the application of simple and fast obturation techniques such as the warm vertical technique can be helpful in canals with complex anatomy. In their case series, Bugea *et al.* [14] also recommended single cone technique combined with biosealers to promote hydroxyapatite formation.

## Conclusions

This case report provided useful information about endodontic management of teeth with aberrant anatomies. The overall conclusion can be summarized as follows:

1. Most premolars are single rooted and single canalled. But

anatomical variations in premolars are very common and it is better to verify the existence of these aberrations in all cases, preoperatively.
2. The use of advanced technology in endodontic treatment such as magnification, illumination, ultrasonic devices and 3D imaging is strongly recommended in teeth with complex anatomy.
3. Conservative shaping of the root canal system along with maximum disinfection followed by the use of straightforward and fast obturation techniques is beneficial.

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Conflict of Interest: 'None declared'.

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