

# Case Report of a Rare Anatomical Variation of Vertucci Type II Canal Configuration in Maxillary First Molar

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## ABSTRACT

Different root morphologies and canal configurations have been associated with the first maxillary molar. It has significant clinical importance in endodontics. There are extensive studies documented in literature about additional roots and canals however, the occurrence of fewer roots or canals is comparatively rare and the clinicians must be aware about it. Such anatomical deviations lead to challenges during diagnosis, treatment planning and prognosis. If improperly identified it may lead to mishaps like leading to missed canals, perforations, instrument separation inadequate debridement of the root canal system and obturation etc. The case report describes the endodontic management of a maxillary first molar which had a single root in a 45-year-old female patient. For accurate radiographic assessment of the internal anatomy, Digital Volumetric Tomography (DVT) was used. It enabled identification of the root canal morphology which was Vertucci Type II (2-1) canal configuration. After access opening, one buccal orifice and one palatal orifice were located. These two canals merged into a single canal apically. Biomechanical preparation was performed using Protaper file system. Standard irrigation protocols were followed to ensure effective cleaning and disinfection. The canals were later obturated with calcium-hydroxide based sealer and single cone obturation technique. The patient was asymptomatic in the one-month review indicating the favourable treatment outcome and no complication. This case highlights the importance of careful clinical evaluation and using advanced imaging systems for such uncommon root canal anatomies.

**Keywords:** Digital volumetric tomography, Maxilla, Tooth root

## CASE REPORT

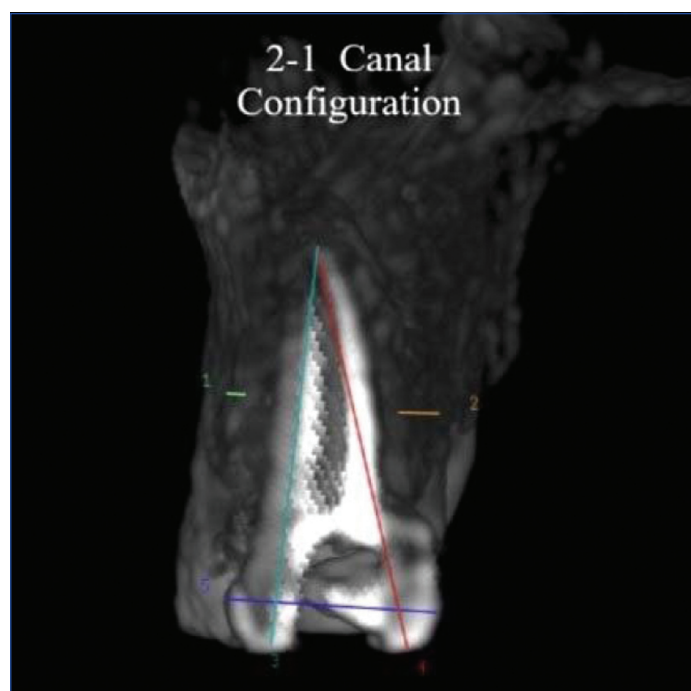
A 45-year-old female patient reported with chief complaint of decayed teeth in upper right back region of jaw since six months. The teeth were not associated with pain or swelling. The medical history and past dental history were noncontributory. Clinical examination revealed deep palato-occlusal caries were present in relation to 16 and disto-occlusal caries in relation to 15. The tenderness on percussion was negative in both teeth. Electric pulp vitality testing was indicative of non-vitality in both the teeth. In the preoperative radiograph, single root morphology of 16 was observed. Using SLOB technique, two root canals were identified in one root. Radiographic examination revealed caries involving pulpal space of 16 with widening of periodontal ligament space. Radiographic examination of 15 revealed caries approaching the pulpal space with widening of periodontal ligament space [Table/Fig-1]. Based on clinical and radiographic evaluation, the diagnosis was pulp necrosis with asymptomatic apical periodontitis in tooth number 15 (Permanent right second premolar) and 16 (Permanent right maxillary first molar). The root canal therapy for 15 and 16 were advised.

To confirm the root canal morphology, after the consent of the patient the DVT was performed. The DVT revealed no evidence of fusion but presence of single root no with two canals [Table/Fig-2]. One buccal canal orifice and one palatal canal orifice in the coronal third of the root [Table/Fig-3]. The DVT section at the apical third showed presence of one foramen. The morphology was suggestive of Vertucci Type II (2-1) canal configuration with tooth 16 [Table/Fig-4].

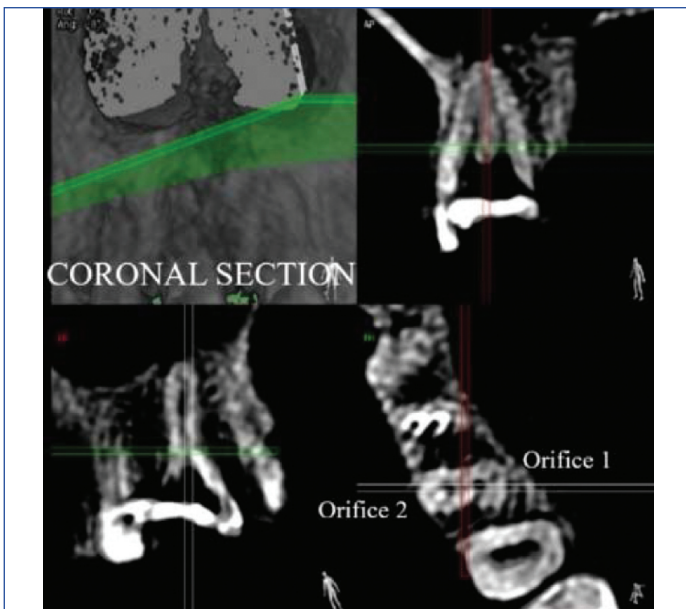
The tooth 16 was isolated under rubber dam (GDC). After the removal of caries, endodontic access opening was made using BR-45 (Mani INC, Tochigi, Japan). Two orifices were located in the



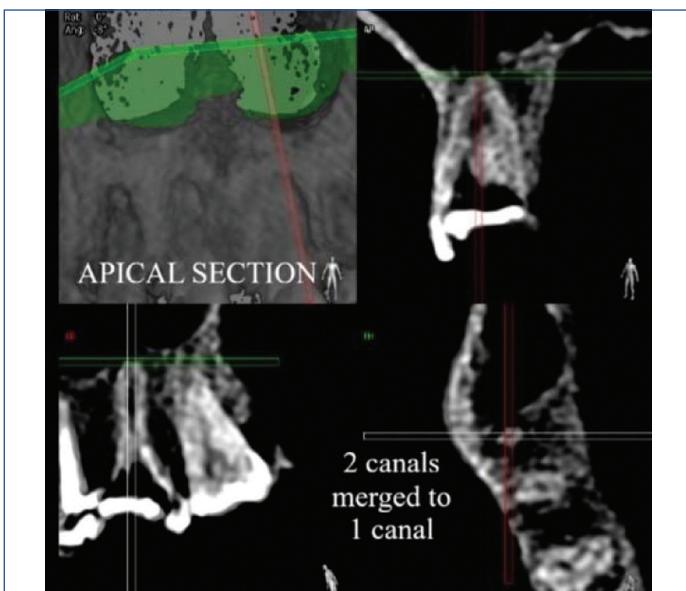
[Table/Fig-1]: Preoperative radiograph.



[Table/Fig-2]: DVT showing 2 canals in one root.



[Table/Fig-3]: DVT showing two orifices at coronal third of root.

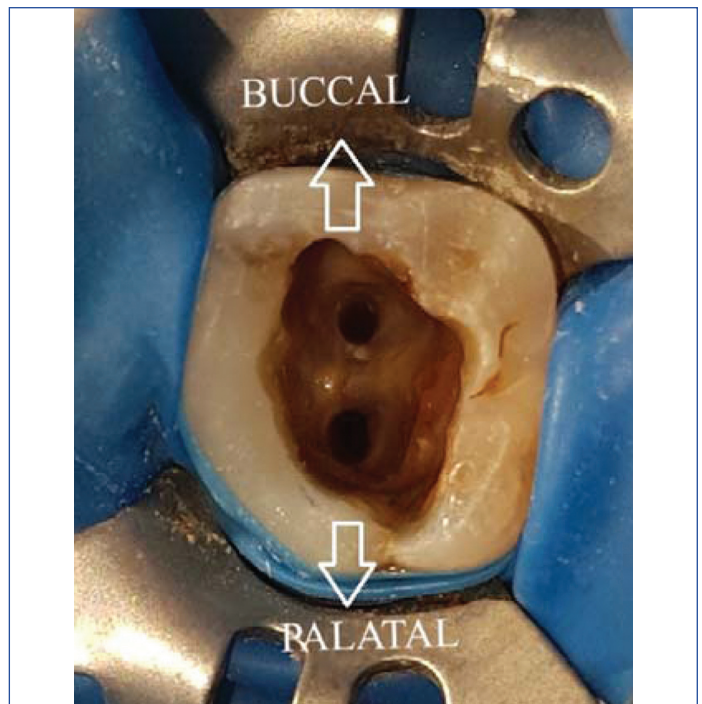


[Table/Fig-4]: DVT at apical foramen.

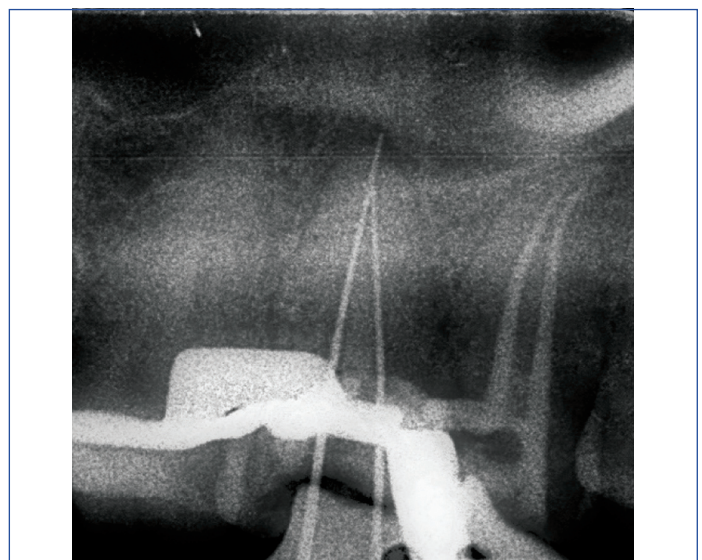
centre of the tooth using DG 16 probe, one in the buccal aspect and other orifice in the palatal aspect of the tooth. The shape of access cavity was ovoid rather than the conventional triangular or cloverleaf [Table/Fig-5]. The canals were negotiated with stainless steel K-file 2% 10 size (Mani INC, Tochigi, Japan). Working lengths of 17 mm with palatal canal and 17 mm with buccal canal were determined using Propex pixi apex locator (Dentsply, Maillefer, Switzerland) and confirmed with Radiovisiography [Table/Fig-6]. The Sx File was used for coronal flaring. The canals were negotiated till stainless steel K-file till 2% 40 sizes (Mani INC, Tochigi, Japan). The sequence of Protaper universal system was followed for the biomechanical preparation of both the canals. The canals were prepared till F4 Protaper Universal Rotary NiTi files (Dentsply, Maillefer, Switzerland) with apical diameter of ISO#40mm and 6% taper.

Copious irrigation was performed with saline and 3% sodium hypochlorite during the preparation. Calcium hydroxide intracanal medicament- RC-Cal (Prime Dental, India) was placed in the root canals and sealed with temporary filling for a week. The calcium hydroxide was removed from the canal using 3% sodium hypochlorite and ultrasonic agitation. The canals were dried out with 6% Size 40 paper points (Dentsply, Maillefer, Switzerland).

To verify the Vertucci Type II canal configuration in this case, the meeting point was clinically determined by placing the 6% size 40 master cone in buccal canal and stainless-steel K file 2% size 30 in



[Table/Fig-5]: Clinical picture of two orifices.



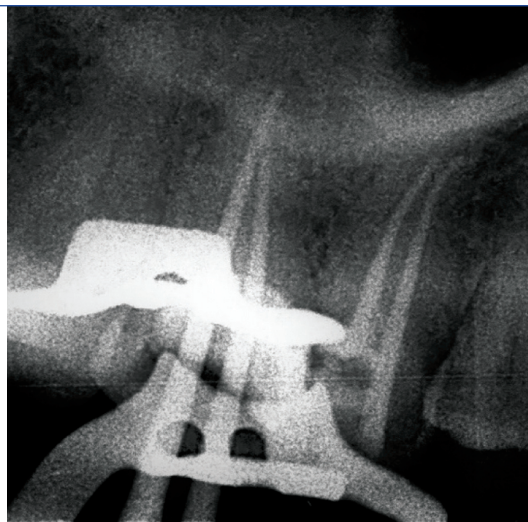
[Table/Fig-6]: Working length RVG.

the palatal canal. The file left an indentation on the cone and thus the confluence was confirmed. The palatal canal gutta percha was trimmed so it only reached the point of junction. The two master cone gutta percha points of 6% taper No. 40 (Dentsply, Maillefer, Switzerland) were placed in buccal and palatal canals. The master cone RVG was obtained for confirmation of the fit [Table/Fig-7].

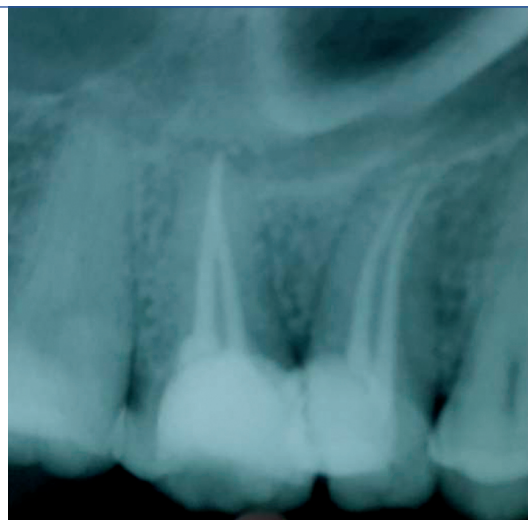
Endo activator was used to activate the sealer in the confluence. The tooth 16 was obturated using seal -apex sealer (Kerr dental, USA). The access cavity was permanently sealed with composite post-endodontic treatment restoration [Table/Fig-8]. The root canal treatment procedure was also completed with tooth 15. The patient was clinical asymptomatic with no mobility or tenderness on percussion in period of one month follow-up.

## DISCUSSION

The recognition of anatomical variations and complexities in root canals are vital for the victory of endodontic treatment. According to four studies including 416 maxillary first molar teeth, 95.9% of had three rooted morphology, 3.8% had two roots and 0.2% had single root [1]. A study to examine the roots and the canal morphologies of first and second maxillary molar in Indians was conducted by Neelakantan P et al., in 2010 applying Cone Beam Computed



**[Table/Fig-7]:** Master cone RVG.



**[Table/Fig-8]:** Post-obturation RVG.

Tomography (CBCT). The results stated that 96.8% of teeth had three separate roots whereas only two teeth among 220 were first maxillary molars with single root, one with Vertucci type I and Vertucci type V [2].

Many authors have classified root canal morphologies. Weine in 1969 identified three types of canal configurations (Type I, II, and III) based on the mesiobuccal root of maxillary first molars. [3] followed by Vertucci FJ, in 1984 [4]. Vertucci classified the canal morphology based on the number and configuration of root canals from the pulp chamber floor to the root apex [5].

In 1998, Kartal N et al., modified "Vertucci's Type II into two subgroups [6]-

Type II a: Two separate canals merge into one canal before reaching the apex.

Type II b: Two separate canals joining within the apical foramen and then exited as one apical foramen. Gulabivala K et al., in 2001 classified Type I to Type VII [7]. Sert S and Bayirli GS 2004 added configurations Type IX -Type XXIII to Vertucci Classification [8].

In literature, case reports of maxillary first molar with single root have been reported [Table/Fig-9] [9-18].

There are some case reports of maxillary first molar with single root and single canal but only one case report with Vertucci type II configuration published in 2024. This is another case report with such canal configuration [18]. The single root anatomy of the first maxillary molar is a rare entity. In 1964, Robbins IM and Keene HJ reported single pyramid-shaped roots in molars were inherited in an autosomal dominant inheritance pattern [19]. Prior to root development, the root sheath in multi rooted teeth forms

S. No.	Author	Year	Canal Anatomy details	Detection
1.	Shingli A et al., [9]	2010	Vertucci Type- I	Spiral CT
2.	Chhabra N et al., [10]	2013	Vertucci Type- I	CBCT
3.	Saxena A et al., [11]	2014	Vertucci Type- I	Spiral CT
4.	Desai N et al., [12]	2015	Vertucci Type- I	Multiple IOPA
5.	Gajjela R et al., [13]	2017	Vertucci Type- I	Multiple IOPA
6.	Alsaeed A and Jamleh A [14]	2019	Vertucci Type -V	CBCT
7.	Nair R et al., [15]	2021	Vertucci Type- I	CBCT
8.	Battula MS et al., [16]	2022	Sert and Bayirli type-IX canal configuration	CBCT
9.	Ali A et al., [17]	2023	C Shaped canal	CBCT
10.	Bajaj H et al., [18]	2024	Vertucci Type II	CBCT

**[Table/Fig-9]:** Previous case reports of maxillary first molar with single root [9-18].

the epithelial diaphragm. One developmental theory states that this diaphragm undergoes differential growth which leads to division of the trunk into one, two, three or more number of roots. The failure of the differential growth might lead to single rooted maxillary molar [20]. The Vertucci Type II canal configuration might be the result of merger of two separate canals in the apical area or incomplete separation of two canals during dentin formation [21].

Thorough examination of preoperative radiographs would be helpful to suspect some unusual anatomy. To visualise the complex root and canal morphology using a 2D radiograph may be difficult due to superimposition and distortion. Hence, 3D imaging could be the key in such cases [22]. In 1990, using 3D reconstruction of root canal configurations using CT in endodontics was first reported by Tachibana H and Matsumoto K [23]. The CT scanning uses a high dose of radiation. Hence, CBCT and the DVT have been the newer modalities which work at lower radiation than conventional CT [24]. Advantages of DVT include 3D visualisation of the root and canal morphology, good resolution with reduced distortion of images and less cost and time [25].

After the endodontic access is achieved, the dentinal map along with the laws of access opening given by Krasner P and Ranko HJ provide a guide in determining the root canal configurations [26]. The bubble test, white test, red test using dyes, use of ultrasonic and probing by DG-16 like instruments can help in locating the unusually located or missed canal orifices.

In this case, Sx File was used for coronal flaring. The initial enlargement of the coronal third of the root canal improves the straight-line access and irrigation flow in the root canal. It also reduced risks of ledge formation and instrument separation [27]. Because of the aberrant canal morphology, apical gauging was performed in this case to determine the master apical file size [28]. Size 40 K-file met resistance at the working length, helped in identifying the F4 as the final finishing file.

Biomechanical preparation and obturation of teeth with Vertucci Type II canal morphology can be challenging. It does not necessarily reduce prognosis as compared to Vertucci Type I if both canals are appropriately cleaned, shaped, and obturated.

There is a risk of canal stripping in such cases due to excessive thinning of dentinal wall at the point of junction of two canals. Shaping using files from two different directions may lead to drop shaped foramen as compared to round foramen in Vertucci Type I canal configuration. The risk of endodontic file separation increases in such cases due to high stress at the point of confluence of both the canals [29]. Also, one must be meticulous while cleaning and shaping such canals, as dentinal debris from one canal might block the other canal leading to loss of patency [30]. To prevent this, recapitulation was used in this case.

Some challenges can also be faced while obturating Vertucci Type II canals. The canals join apically, hence there is limited space for two

separate master cones to fit simultaneously. Master gutta percha point in one canal might displace the master cone in another canal [31]. Voids or incomplete 3D seal in the obturation might occur due to filling of one canal might push back in another canal [32].

Along with endodontic therapy, the periodontal consideration is imperative as single rooted maxillary molars are at higher risks for periodontal disease progression. The cause is said to be the reduced root surface area [33].

## CONCLUSION(S)

For achieving success in the endodontic treatment, appropriate knowledge of the various kinds of root canal morphology is imperative. The usage of CBCT, DVT proves to be the key in detecting unusual canal configuration. It helps in preventing iatrogenic errors while treating such cases. During access opening, proper scouting of the canal orifices in uncommon locations is imperative. When atypical anatomy is present, clinicians should adapt appropriate cleaning and shaping taking into consideration of two canal orifices coronally merging into one apically. One must take adequate care while obturating 2-1 anatomical morphology so as to achieve 3D seal. Reporting such infrequent anatomical variations helps the clinician's knowledge and management skills in similar cases.

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