

Endodontic management of a bifid mandibular canine: A case report and focused literature update

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ABSTRACT

A thorough understanding of root canal morphology is essential for successful endodontic therapy. The mandibular canine typically presents with a single root and canal; however, rare variations such as bifid roots with separate canals may occur and pose diagnostic and therapeutic challenges. Failure to recognize these variants can lead to missed canals and compromised outcomes. This report describes endodontic management of a mandibular right canine with two roots and two separate root canals in a 32-year-old female. Root canal treatment was performed under magnification using chemomechanical preparation followed by warm vertical compaction obturation. At 12 months, clinical and radiographic follow-up demonstrated satisfactory periapical healing. As a comprehensive review exists up to 2017, this report presents a focused update of later cases, enriching the limited global literature and improving clinical awareness of anatomical variations in mandibular canines.

Key words: Bifid root, Endodontic management, Mandibular canine, Root canal morphology

The mandibular canine is traditionally regarded as one of the most morphologically consistent teeth within the human dentition [1]. Its elongated single root and stable periodontal attachment contribute significantly to canine guidance and the functional harmony of the masticatory system [2]. The prevalence of a single root canal configuration (Vertucci Type I) in mandibular canines is approximately 92% [3]. Additional canal configurations have been reported in approximately 7–8% of cases, most commonly Vertucci Types II and III [3,4]. Overall, anatomical variations appear slightly more frequently in mandibular canines (approximately 7%) than in maxillary canines (approximately 4%), although a single-canal pattern remains the most prevalent in both [5]. Failure to detect these variations may result in missed canals, procedural mishaps, and inadequate shaping and cleaning, ultimately compromising treatment outcome and long-term prognosis [6-8]. Previous studies have documented similar anatomical variations in mandibular canines [9-11], indicating that these configurations, though rare, are clinically significant. Reporting such cases adds to the existing literature and enhances clinician awareness, thereby supporting accurate diagnosis and appropriate treatment planning.

This case report describes a rare anatomical variation in a mandibular canine and its successful endodontic management. In addition, a focused review of the literature is presented to consolidate existing evidence on this uncommon variation.

CASE REPORT

This case report was prepared in accordance with the Preferred Reporting Items for Case reports in Endodontics 2020 guidelines. A 32-year-old female patient presented with a complaint of pain in the lower right anterior region for the past 3 months. The pain had intensified over the preceding 3 days, was spontaneous in nature, radiated toward the angle of the mandible, and was aggravated by thermal stimuli, particularly heat.

Extraoral examination revealed no abnormalities. Intraoral evaluation revealed a deep occlusal-proximal caries in the teeth #43 and #44, with #43 exhibiting mild rotation (Fig. 1a). Periodontal probing depths were within normal limits. Teeth #43 and #44 were tender on percussion and exhibited normal physiological mobility.

Pulp sensibility testing using refrigerant spray (Roeko Endo-Frost, Coltene, Germany) and an electric pulp tester (Vitality Scanner; SybronEndo, Boston, MA) elicited a lingering response in teeth #43 and #44, while adjacent teeth demonstrated normal responses. An intraoral

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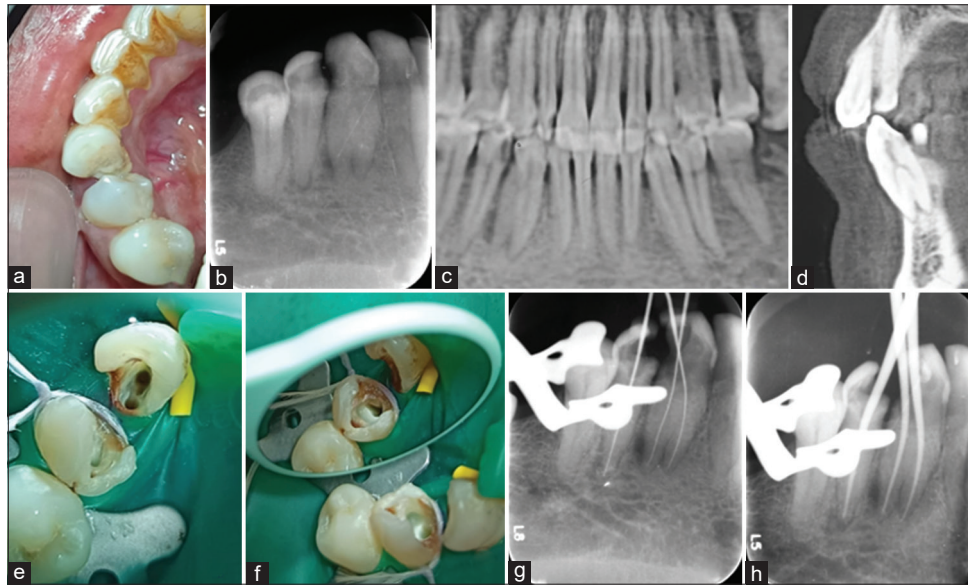


Figure 1: (a) Pre-operative intraoral clinical photograph showing deep occlusal–proximal caries in the mandibular right canine (#43) and first premolar (#44), with mild rotation of tooth #43. (b) Pre-operative intraoral periapical radiograph revealing deep caries involving teeth #43 and #44 with associated periapical changes and an unusual root outline suggestive of bifid root morphology in tooth #43. (c) Panoramic radiograph demonstrating a bifid mandibular right canine (#43) with unilateral involvement. (d) Cone-beam computed tomographic sagittal section of tooth #43 confirming two distinct roots with separate root canal systems. (e) Intraoperative clinical photograph showing access cavity preparation in tooth #43 under magnification. (f) Intraoperative clinical photograph showing access cavity preparation in tooth #44. (g) Working length determination radiograph demonstrating independent canal paths in the two roots of tooth #43. (h) Master cone radiograph confirming adequate cone adaptation in both canals of tooth #43

periapical radiograph revealed deep caries involving teeth #43 and #44 with associated periapical changes, and an apparent anatomical variation in tooth #43 suggestive of bifid root and canal configuration (Fig. 1b). Cone-beam computed tomographic (CBCT) imaging was indicated to further evaluate the suspected variation and confirm the root canal morphology (Fig. 1c and d). CBCT imaging demonstrated two well-defined roots with separate root canals in #43. Based on clinical and radiographic findings, a diagnosis of symptomatic irreversible pulpitis with apical periodontitis was established for teeth #43 and #44.

The treatment plan included non-surgical endodontic therapy for teeth #43 and #44, followed by definitive post-endodontic restoration. Written informed consent was obtained from the patient before initiation of treatment. Basic periodontal therapy and oral hygiene reinforcement were completed before initiating endodontic treatment. Two visit root canal therapies were performed under local anesthesia (2% lignocaine with 1:100,000 epinephrine). At the first appointment, rubber dam isolation was achieved, and access cavity preparation was done under magnification in teeth #43 and #44, using a tapered fissure bur (Fig. 1e and f). Canal patency was established using K-files ranging from #10 to #20. Working length was determined using an electronic apex locator (Root ZX; J Morita, Kyoto, Japan) and confirmed radiographically (Fig. 1g). Cleaning and shaping were performed using a rotary nickel-titanium file system (ProTaper Gold rotary files, Dentsply Sirona, North Carolina, USA) with irrigation using 5.25% sodium hypochlorite. Both canals in tooth #43 and the canal in tooth #44 were prepared to size F3. This was followed by final irrigation with 17%

ethylenediaminetetraacetic acid, activated using a sonic device. Calcium hydroxide was placed as an intracanal medicament, and the access cavities were sealed with a temporary restoration for 1 week. At the subsequent visit, the patient was asymptomatic. The canals were obturated using gutta-percha and resin-based sealer (AH plus, Dentsply Sirona, North Carolina, USA) using a warm vertical compaction technique (Fig. 1h). The access cavities were permanently restored with a resin composite restoration (Te-Econom Plus, Ivoclar Vivadent, Liechtenstein) (Fig. 2a and b). Definitive full-coverage restorations were placed 2 weeks after obturation.

Clinical and radiographic follow-up was performed at 6 and 12 months. At the 12-month review, the patient remained asymptomatic, and radiographic examination demonstrated complete healing of the periapical radiolucencies with normal periapical bone trabeculation (Fig. 2c and d).

DISCUSSION

The presence of unusual root canal anatomy poses a significant challenge; therefore, clinicians must be familiar with not only common anatomies but also rarer variations. Although the mandibular canine is usually considered morphologically predictable, clinically relevant deviations do occur and may directly influence access design, canal negotiation, debridement, and obturation outcomes. Missed anatomy remains a well-recognized cause of post-treatment disease and retreatment.

Conventional periapical radiography may suggest a bifid root pattern, but superimposition can obscure

additional roots or canals. In such situations, limited-field CBCT provides a definitive three-dimensional assessment that can guide access refinement and canal location [7]. Chanda *et al.* highlighted that complex mandibular anatomy can be underestimated on two-dimensional imaging and is more reliably appreciated with CBCT, supporting its selective use when anatomy is ambiguous [8].

A historical synthesis of mandibular canine two-root/two-canal reports up to 2017 has already been published, emphasizing the rarity of these presentations in the global literature [9]. Therefore, the present article provides a focused update of subsequently reported

mandibular canine anatomical variations (January 2017–December 2025). A literature search was performed using PubMed/MEDLINE, Scopus, and Google Scholar with combinations of “mandibular canine,” “two roots,” “two canals,” “bifid,” and “anatomical variation,” and only case reports/case series were included [9-35].

The post-2017 published cases (Table 1) indicate that the most frequently reported configuration of mandibular canine variation is a true bifurcation with two separate roots and canals, while canal division within a single root and bilateral presentations are uncommon. A female predominance is observed in the reported literature, and the right mandibular canine appears to be involved

Table 1: Published case reports of mandibular canine anatomical variations (2017–2025)

Author/Year	Country	Tooth	Age (year)/Sex	Root canal configuration*
Plascencia <i>et al.</i> , 2017 [9]	Mexico	#43	47/Female	Birouted (Two roots, two canals)
Roy <i>et al.</i> , 2018 [10]	Nepal	#33	45/Female	Birouted (Two roots, two canals)
Van der Vyver and Jonker, 2018 (Case1) [11]	South Africa	#43	55/Male	Birouted (Two roots, two canals)
Van der Vyver and Jonker, 2018 (Case 2) [11]	South Africa	#43	51/Male	Birouted (Two roots, two canals)
Van der Vyver and Jonker, 2018 (Case 3) [11]	South Africa	#43	47/Female	Birouted (Two roots, two canals)
Malik <i>et al.</i> , 2018 (Case 1) [12]	India	#43	28/Female	Birouted (Two roots, two canals)
Malik <i>et al.</i> , 2018 (Case 2) [12]	India	#33	50/Male	Birouted (Two roots, two canals)
Abdelgawad <i>et al.</i> , 2019 [13]	Saudi Arabia	#33	41/Female	Birouted (Two roots, two canals)
Abishek <i>et al.</i> , 2019 [14]	India	#33	35/Female	Birouted (Two roots, two canals)
Prashanth, 2019 [15]	Saudi Arabia	#33	28/Female	Birouted (Two roots, two canals)
Agarwal <i>et al.</i> , 2020 [16]	India	#43	40/Male	Birouted (Two roots, two canals)
Almuthhin <i>et al.</i> , 2020 (Case 1) [17]	Saudi Arabia	#33	70/Female	Birouted (Two roots, two canals)
Almuthhin <i>et al.</i> , 2020 (Case 2) [17]	Saudi Arabia	#43	36/Female	Birouted (Two roots, two canals)
Almuthhin <i>et al.</i> , 2020 (Case 3) [17]	Saudi Arabia	#43	40/Female	Birouted (Two roots, two canals)
Almuthhin <i>et al.</i> , 2020 (Case 4) [17]	Saudi Arabia	#33	58/Female	Birouted (Two roots, two canals)
Bhaskar <i>et al.</i> , 2020 [18]	India	#43	35/Female	Birouted (Two roots, two canals)
Alhomaiddhi, 2021 [19]	Saudi Arabia	#43	23/Female	Birouted (Two roots, two canals)
Varatharajan <i>et al.</i> , 2021 (Case 1) [20]	India	#43	30/Male	Type II [2-1]
Varatharajan <i>et al.</i> , 2021 (Case 2) [20]	India	#43	35/Female	Birouted (Two roots, two canals)
Dewan <i>et al.</i> , 2021 (Case 1) [21]	India	#33	36/Male	Birouted (Two roots, two canals)
Dewan <i>et al.</i> , 2021 (Case 2) [21]	India	#33	55/Male	Birouted (Two roots, two canals)
Nair <i>et al.</i> , 2022 [22]	India	#33	45/Female	Birouted (Two roots, two canals)
Sawhney <i>et al.</i> , 2022 [23]	India	#33 and #43 (bilateral)	53/Female	Birouted (Two roots, two canals)
Shetty <i>et al.</i> , 2022 [24]	India	#43	35/Male	Birouted (Two roots, two canals)
Singh <i>et al.</i> , 2022 [25]	India	#43	35/Female	Birouted (Two roots, two canals)
Michelotto <i>et al.</i> , 2022 (Case 1) [26]	Brazil	#43	63/Female	Birouted (Two roots, two canals)
Michelotto <i>et al.</i> , 2022 (Case 2) [26]	Brazil	#33	77/Female	Birouted (Two roots, two canals)
Advaitha Narayan <i>et al.</i> , 2022 [27]	India	#43	35/Female	Birouted (Two roots, two canals)
Bansal <i>et al.</i> , 2023 [28]	India	#33	50/Male	Birouted (Two roots, two canals)
Aljanakh, 2023 [29]	Saudi Arabia	#33	32/Female	Birouted (Two roots, two canals)
Kakkad, 2023 [30]	India	#33 (impacted)	15/Female	Birouted (Two roots, two canals)
Mushtaq <i>et al.</i> , 2024 [31]	Pakistan	#43	28/Female	Birouted (Two roots, two canals)
Ain <i>et al.</i> , 2024 [32]	Pakistan	#43	66/Female	Birouted (Two roots, two canals)
Zhang <i>et al.</i> , 2024 [33]	China	Bilateral: #33 and #43	31/Female	Birouted (Two roots, two canals)
Alfahadi <i>et al.</i> , 2025 [34]	Saudi Arabia	#33	56/Female	Birouted (Two roots, two canals)
Satpute <i>et al.</i> , 2025 [35]	India	#43	50/Female	Type II [2-1]

*Vertucci's root canal configuration. Table 1 summarizes published clinical case reports describing anatomical variations of mandibular canines reported between January 2017 and December 2025. Only clinical case reports and case series involving mandibular canines were included; imaging-only reports and prevalence studies were excluded. Tooth numbering follows the FDI system. Root canal configurations are described according to Vertucci's classification where applicable

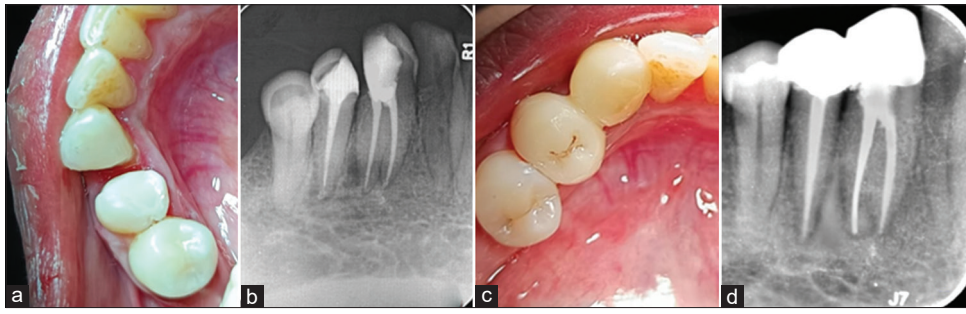


Figure 2: (a) Post-operative intraoral clinical photograph following endodontic treatment of teeth #43 and #44. (b) Post-operative intraoral periapical radiograph showing satisfactory obturation of both canals in tooth #43 and the canal in tooth #44. (c) Post-endodontic restorative phase showing definitive full-coverage restorations placed on teeth #43 and #44. (d) Twelve-month follow-up intraoral periapical radiograph demonstrating resolution of periapical radiolucencies and normal periapical bone trabeculation around teeth #43 and #44

slightly more often than the left. Based on the focused review from 2017 to December 2025, approximately thirty cases have been reported worldwide, with the majority originating from Asia and the Middle East, and fewer reports from Europe, Africa, and the Americas. Although derived from isolated case reports, these findings suggest geographic clustering and reinforce the need for heightened anatomical awareness when clinical or radiographic features indicate possible complexity. This report and focused review aim to contextualize the present findings within existing literature and contribute to cumulative clinical knowledge on mandibular canine anatomical variations.

CONCLUSION

Although mandibular canines are commonly considered to exhibit a simple root canal anatomy, anatomical variations such as bifid root configurations may be encountered and can influence diagnostic and therapeutic decisions. This case report, together with a focused review of the literature reported after 2017, highlights that such variations, while uncommon, continue to be documented across populations. Awareness of these anatomical possibilities, supported by careful radiographic assessment and appropriate use of advanced imaging when indicated, is essential for accurate diagnosis and predictable endodontic outcomes.

REFERENCES

- Ash MM, Nelson SJ. Wheeler's Dental Anatomy, Physiology, and Occlusion. 8th ed. St. Louis: Saunders; 2003.
- Brand RW, Isselhard DE. Anatomy of Orofacial Structures. 7th ed. St. Louis: Mosby; 2003.
- Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol 1984;58:589-99.
- Martins JN, Ensinas P, Chan F, Babayeva N, Von Zuben M, Berti L, *et al.* Worldwide anatomic characteristics of the mandibular canine-a multicenter cross-sectional study with meta-analysis. J Endod 2024;50:456-71.
- Magat G, Uzun S. Evaluation of root and root canal morphology of mandibular and maxillary canine teeth in Turkish subpopulation by cone beam computed tomography with using two classification systems. BMC Oral Health 2024;24:1499.
- Vertucci FJ. Root canal morphology and its relationship to endodontic procedures. Endod Topics 2005;10:3-29.
- García-Torres E, Guerrero-Falcón DL, Bojórquez-Armenta HA, Almeda-Ojeda OE, Barajas-Pérez VH, Solís-Martínez LJ. Imaging findings of clinical significance in endodontics during cone beam computed tomography scanning of the upper airway-the anterior, bilateral, C-shaped, dual of mandibular root canals: A brief case report. Diagnostics (Basel) 2025;15:3157.
- Chanda S, Manoj R, Ramaswami E, Santosh V, Waghmare M, Vahanwala S. Anatomical variations of mandibular canal using cone-beam computed tomography: A retrospective study. J Indian Acad Oral Med Radiol 2021;33:183-8.
- Plascencia H, Cruz Á, Gascón G, Ramírez B, Díaz M. Mandibular canines with two roots and two root canals: Case report and literature review. Case Rep Dent 2017;2017:8459840.
- Roy DK, Cohen S, Singh VP, Marla V, Ghimire S. Endodontic management of mandibular canine with two roots and two canals: A rare case report. BMC Res Notes 2018;11:111.
- Van Der Vyver PJ, Jonker CH. Root canal treatment in mandibular canines with two roots: A review of the literature and report of three cases. S Afr Dent J 2018;73:507-13.
- Malik A, Bansal P, Nikhil V, Singh D. Biradicular mandibular canine: A review and report of two cases. Endodontology 2018;30:159-62.
- Abdelgawad RA, Aljohani MZ, Taymour NM. Mandibular permanent canine with two roots and two canals: A case report. Biomed J Sci Tech Res 2019;20:14729-32.
- Abishek L, Keerthi E, Dileep SK, Sugavasi GD. Management of a rare case of mandibular canine with two roots and two root canals. Int J Dent Sci Innov Res 2019;2:21-5.
- Prashanth MB. Endodontic management of mandibular canine with two roots and two root canals: A case report. Saudi J Oral Dent Res 2019;4:213-5.
- Agarwal K, Samant PS, Srivastava V, Jain G. Demystifying anatomical variations - Endodontic therapy of twin rooted mandibular canine with concomitant root canals: An unusual case report. IP Indian J Conserv Endod 2020;5:150-3.
- Almuthhin M, Abdulaziz AT, Alsahly H. Mandibular canine with two roots. Clin Case Rep Open Access 2020;3:151.
- Bhaskar A, Kumar R, Nawal RR, Talwar S. Management of mandibular canine with two roots: A case report. Cureus 2020;12:e7072.
- Alhomaidhi LM. Endodontic retreatment of a mandibular canine with two roots and two canals: A case report. Int J Med Dev Ctries 2021;5:403-6.
- Varatharajan PN, Thirunavukkarasu MK, Kurian AB, Madhuram K. Endodontic management of multiple roots and root canals in mandibular canine: A case series. IP Indian J Conserv Endod 2021;6:166-70.
- Dewan RG, Gulati M, Singh A. Endodontic treatment of biradicular mandibular canines: Case reports. Int J Appl Dent Sci 2021;7:508-12.
- Nair AN, Nair MG, Gopinath AS, Pratheek VS. Mandibular canine with two roots and two canals: A case report. Int J Dent Med Sci Res 2022;4:55-7.
- Sawhney H, Kumar J, Mishra R, Sharma A, Agarwal V. Bilateral bifid mandibular canines: A rare case report. IP Int J Maxillofac Imaging 2022;8:20-3.
- Shetty V, Barik S, Richhawal A, Sachdev SS, Kawle S. Endodontic management of a bi-rooted mandibular canine. IP

- Indian J Conserv Endod 2022;7:194-6.
25. Singh P, Bhatt A, Rajkumar B, Singh J. Multi-rooted mandibular canine confirmed by CBCT: A rare case report. J Global Oral Health 2022;5:58-60.
 26. Michelotto AL, Oda LY, Yamamoto AT, Cavenago BC, Batista A. Endodontic retreatment of mandibular canines with two roots: Report of two cases. Rev Port Estomatol Med Dent Cir Maxilofac 2022;63:92-8.
 27. Advaita Narayan S, Naveen Kumar V, Kurian AB, Shuruthi J. Endodontic management of biradicular mandibular canine and mandibular lateral incisor with a missed canal: A rare case report. IP Indian J Conserv Endod 2022;7:135-8.
 28. Bansal T, Adhikari HD, Saha K. Management of mandibular canine with two roots and two root canals: A case report. IOSR J Dent Med Sci 2023;22:31-4.
 29. Aljanakh MD. Restorative and endodontic management of a mandibular canine with two roots and two canals: A case report. Cureus 2023;15:e36460.
 30. Kakkad A. Presence of two roots and two canals in mandibular canine: A rare case report. Glob J Res Anal 2023;12:77-8.
 31. Mushtaq TB, Azam S, Baig I. Permanent mandibular canine with two roots and two root canals: A case report. J Popul Ther Clin Pharmacol 2024;31:229-31.
 32. Ain QU, Azam S, Baig I. Permanent mandibular canine with two roots and two canals. Biol Clin Sci Res J 2024;2024:1147.
 33. Zhang Q, Ran X, Zhao Y, Qin K, Zhang Y, Cui J, *et al.* Bilateral symmetrical mandibular canines with two roots and two separate canals: A case report and literature review. Curr Med Imaging 2024;20:e15734056317207.
 34. Alfahadi HR, Alyami YA, Alkazman FH, Al Fadhil MH, Alyami SA, Alyami AM, *et al.* Endodontic management of mandibular permanent canine with two roots and two root canals using CBCT. Saudi Endod J 2025;15:76-81.
 35. Satpute A, Zarekar M, Zarekar M. Mandibular canine with Vertucci's type II configuration: Report of a case with literature review. Turk Endod J 2025;10:56-61.

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