

Endodontic Management of C-shaped Canals Configuration in Taurodontic Teeth: A Report of Two Cases

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ABSTRACT

Taurodontism represents a rare morpho-developmental dental anomaly characterised by apical displacement of the pulpal floor and an enlarged pulp chamber. It presents serious endodontic and diagnostic difficulties when combined with abnormal canal shapes like C-shaped canals. Besides advanced imaging aids like Cone-Beam Computed Tomography (CBCT) along with magnification and illumination, irrigation activation with NaOCl are helpful in managing these cases. This report describes the endodontic treatment of two mesotaurodontic teeth with different C-shaped canal anatomies. A mandibular second molar in Case 1 exhibited a C2-type canal configuration whereas in Case 2, mandibular second premolar had a C4-type pattern. CBCT along with magnification was essential in defining the interior anatomy and directing the course of treatment. Enhanced irrigation activation was employed for effectively disinfecting the uninstrumentable intercommunications, apical splits, and ramifications in conjunction with a modified hybrid rotary technique for cleaning and shaping. Obturation was modified in both the cases and was accomplished by combining calcium silicate based sealer with lateral compaction and resin based sealer followed by thermoplasticised gutta-percha technique to ensure three-dimensional sealing of the intricate canal system. Over the course of the 12-month follow-up period, both cases showed good healing and remained asymptomatic. The successful therapy of taurodontic teeth with C-shaped canals highlights the critical role that CBCT plays in diagnosis along with the use of magnification. To overcome the anatomical complexities associated with such morphologies, a customised biomechanical, chemical and obturation procedure is essential.

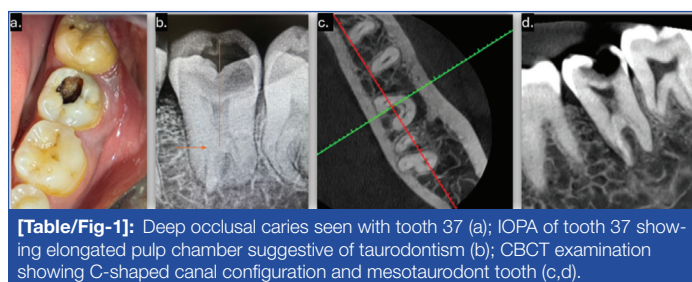
Keywords: Cone-beam computed tomography, Dental morphologic anomaly, Endodontic treatment, Mesotaurodont

CASE REPORT

Case 1

Mesotaurodont with C2 type canal configuration: A 31-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, with a chief complaint of pain in lower left back region since past one month. Pain aggravated on eating hot and cold food and relieved by taking over the counter medications. The patient also reported nocturnal pain. No relevant medical and dental history noted. Clinical examination, revealed a deep and extensive occlusal carious lesion in left mandibular second molar #37 with pain on percussion and positive response to cold test (Endo Roeko Frost cold spray; ColteneGermany) [Table/Fig-1a].

On radiographic examination, IOPA showed, a Mesotaurodontic molar [Table/Fig-1b]. CBCT examination confirmed the tooth to be a C-shaped mesotaurodontic molar [Table/Fig-1c,d]. With the diagnosis of chronic irreversible pulpitis and chronic apical periodontitis, the patient was scheduled for a root canal treatment.



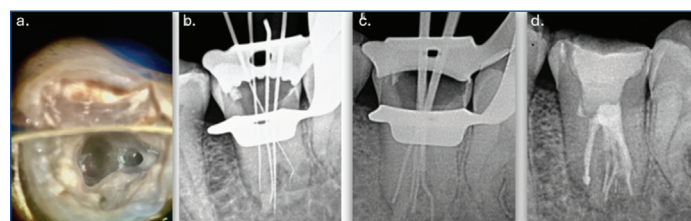
[Table/Fig-1]: Deep occlusal caries seen with tooth 37 (a); IOPA of tooth 37 showing elongated pulp chamber suggestive of taurodontism (b); CBCT examination showing C-shaped canal configuration and mesotaurodont tooth (c,d).

After taking an informed consent, in the first visit, after administration of inferior alveolar nerve block using 2% lignocaine with adrenaline (Neon Laboratories, India). The tooth was then isolated with rubber dam, and an access cavity was prepared using round diamond bur (BR 41, Mani

Inc., Japan) with high-speed air-rotor hand piece and modified using Endo z safe end bur (Mani Inc., Japan) [Table/Fig-2a]. The orifices were negotiated with #8 and #10 K-files (Mani Inc., Japan) using tactile control technique. Working length was determined as 18 mm for C-shape canal orifice and mesial canals by an electronic apex locator (Root ZX Mini; J. Morita Corp., Japan) and confirmed radiographically [Table/Fig-2b]. Cleaning and shaping were completed by crown-down technique till 25/4% for distal canal and 30/4% for C-shape canal orifice (Hero Shaper Gold; Micro-Mega, France) under active copious irrigation with 5.25% sodium hypochlorite (Prime Dental Products, India) and 17% liquid EDTA (Prime Dental Products, India) and normal saline.

Final irrigation was done using 5.25% sodium hypochlorite that was activated ultrasonically (Endo X Activator; Waldent Innovations, India) with three cycles of one minute followed by saline and 17% liquid EDTA, alternatively.

After taking master cone radiograph [Table/Fig-2c], all the canals were dried with sterile paper point (Sure-Endo, Korea) and obturated by Lateral compaction with gutta-percha (META, South Korea) using Bioactive RCS (SafeEndo Bioactive RCS; China), with the calcium silicate-based sealer followed by post-obturation restoration using composite resin (3M Filtek Z350 3M ESPE, USA) [Table/Fig-2d]. Follow-up visits were conducted at 1 month and 12 months, during which the patient remained clinically and radiographically asymptomatic.



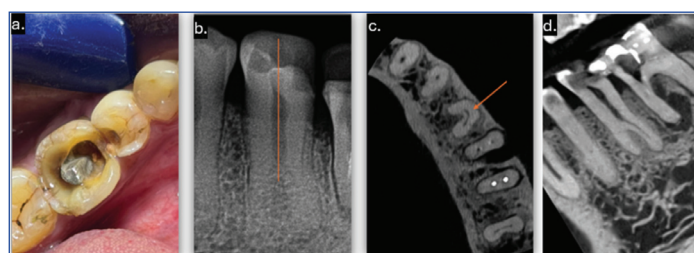
[Table/Fig-2]: Access opening showing C-shaped canal orifice and a mesial orifice; (a) Working length determination; (b) Master cone fit check; (c,d) Obturation using calcium silicate based sealer.

Case 2

A Mesotaurodont with C4 canal configuration: A 37-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, with a chief complaint of pain in lower left back region of the jaw since a week. Patient had pain on biting and on eating hot and cold food. Pain was relieved after taking over the counter medications. Past medical history was non-contributory. Patient had undergone root canal treatment with #36 years back. The tooth was tender on percussion and upon further investigation it was diagnosed with vertical crown-root fracture and was advised to undergo extraction.

Tooth of interest #35 revealed a deep and extensive carious lesion distally [Table/Fig-3a] in left mandibular second premolar with a positive response to pain on percussion and cold test (ROEKO Endo-Frost Cold Spray).

Radiographic examination, IOPA, showed a mesotaurodontic premolar [Table/Fig-3b]. CBCT confirmed it to be a C-shaped mesotaurodontic premolar [Table/Fig-3c,d]. With the diagnosis of chronic irreversible pulpitis and chronic apical periodontitis, the patient was scheduled for a root canal treatment.



[Table/Fig-3]: Deep disto-occlusal caries seen with tooth 35; (a) IOPA of tooth 35 showing elongated pulp chamber suggestive of taurodontism; (b) CBCT examination showing C-shaped canal configuration and mesotaurodont tooth; (c,d).

After taking an informed consent, in the first visit, 2% lignocaine with adrenaline was administered using inferior alveolar nerve block (Neon Laboratories, India) technique. Tooth was then isolated under rubber dam and an access cavity was prepared. Initial negotiation was done by tactile control technique using 8 and 10k file (Mani Inc., Japan). Working length was determined as 19 mm for C-shape canal and distal canals by an electronic apex locator (Root ZX Mini; J. Morita Corp., Japan) and confirmed radiographically [Table/Fig-4a]. Cleaning and shaping were completed by crown-down technique till 25/4% for distal canal and 30/4% (Hero Shaper Gold; Micro-Mega, France) for C-shape canal orifice under active copious irrigation.

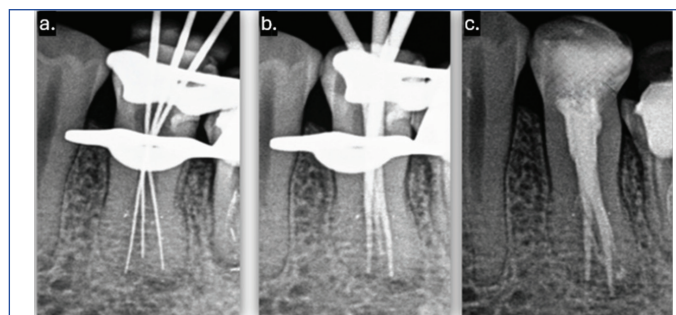
Final irrigation was done using 5.25% sodium hypochlorite (Prime Dental Products, India) that was activated ultrasonically with three cycles of one minute, followed by saline and 17% liquid EDTA (Prime Dental Products, India), alternatively.

After taking master cone radiograph [Table/Fig-4b], all the canals were dried with sterile paper point and obturation was done with gutta-percha (META, South Korea) using AH plus sealer (Dentsply, Germany) in the apical third followed by Warm Vertical compaction (WVC) technique by Calamus (Dentsply Sirona, Switzerland) in the coronal and middle third. The post-obturation restoration was completed using composite resin (3M FiltekZ350 3M ESPE, USA) [Table/Fig-4c].

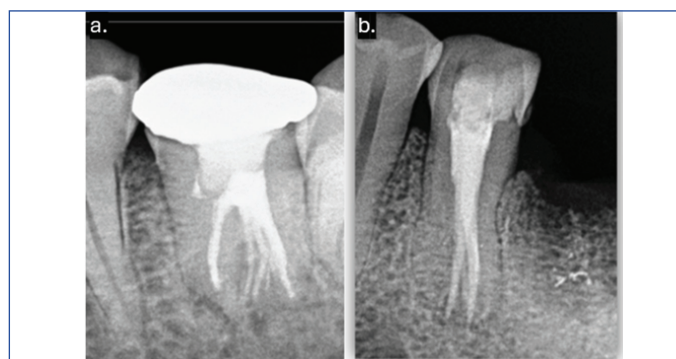
A follow-up visit was conducted one month and 12 months, during which the patient remained clinically and radiographically asymptomatic [Table/Fig-5a,b].

DISCUSSION

Taurodontism, described by Witkop, is characterised by vertical enlargement of the pulp chamber with apically displaced root furcation and absence of normal cervical constriction at the cemento-enamel junction [1]. In Indian population, according to Jain A et al., the prevalence was found to be 3.7%, comprising 1.6% among males and 2.1% among females [2]. Arıcıoğlu B et al., reported a significant association between taurodontism and



[Table/Fig-4]: Working length determination (a); master cone fit check (b); Obturation using modified obturation technique (c).



[Table/Fig-5]: (a,b) 12 month follow-up of case 1 and 2 with no radiographic abnormalities noted.

complex C-shaped canal configurations, both attributed to altered development and early invagination failure of Hartwig's epithelial root sheath during root formation [3].

The American Association of Endodontists (AAE) classifies endodontic management of taurodontic teeth as moderately difficult [4]. Schalk-van der Weide Y et al., reported that endodontic therapy of such teeth is challenging due to alteration in canal orifice location [5]. The most frequent cause of endodontic failure in C-shaped root canals was leakage within the canal system (45.2%), followed by the presence of isthmuses (23.8%), missed canals (9.5%), overextension of filling material (7.1%), and iatrogenic errors (7.1%) [6].

Taurodontism cannot be reliably diagnosed by clinical examination due to normal external tooth morphology and is primarily identified through radiographic evaluation, characteristically showing enlarged pulp chamber [7]. While conventional diagnosis is two-dimensional, CBCT provides accurate three-dimensional assessment, improving detection and evaluation of associated anatomical variations [8].

In these cases, due to the limited dimensions of the root canals and the apical positioning of the canal orifices, accurate localisation of canal orifices becomes challenging. The use of magnification, combined with careful examination of the pulpal floor using a DG-16 explorer, adjunctive methods such as troughing dyes and the champagne bubble test, helped reduce the need for excessive troughing of the pulpal floor [9].

In teeth with C-shaped canal anatomy, dentinal walls are often thin. Emphasis on effective chemical debridement rather than extensive mechanical instrumentation helps reduce the risk of iatrogenic complications [10]. Final irrigation using 5.25% sodium hypochlorite for 1 minute, followed by 17% EDTA for one minute is recommended to enhance organic tissue removal [11]. As mentioned by Shahbaz S et al., the irrigant should reach complex anastomosis and apical ramifications using irrigant activation techniques [12]. Passive ultrasonic activation of 20-second per cycles for a total of one minute is recommended to enhance irrigant distribution and cleaning efficacy [13].

In a study by Jaha HS, Warm Vertical Compaction (WVC) demonstrated superior adaptability to the root canal walls and reduced incidence of voids when compared with hydraulic techniques, although both methods provide satisfactory canal obturation [14]. In the first case, lateral compaction with a bioceramic sealer was used due to complex

S. No.	Author	Patient (age/ gender)	Treatment intervention
1.	Li S et al., [18] (2025)	Case 1-20/F Case 2-12/M	Case-1: RC treated Hypertaurodontic 46 with C-shaped canal. Re-root canal was performed. Case-2: Hypertaurodontic 16, RCT was performed.
2.	Ashwini KS et al., [19] (2024)	26/F	Mesotaurodont 37 with C-shaped anatomy; RCT was initiated and Modified obturation technique using lateral compaction and warm vertical compaction was used to obturate the canal.
3.	Chamani A et al., [20] (2024)	Case 1- 12/M Case 2- 43/F Case 3- 39/F	Case-1: Mesotaurodontic 36 with possible C-shaped anatomy. Case- 2: Mesotaurodontic 26 Case- 3: Hypertaurodontic 35, In all the cases, RCT was performed and obturation was done using warm vertical compaction.
4.	Shahbaz S et al., [12] (2021)	26/M	Hypertaurodontic 47 with C-shaped canal; RCT was initiated and Modified obturation technique using lateral compaction and warm vertical compaction was used to obturate the canal.

[Table/Fig-6]: Case reports showcasing taurodontism with C-shaped canals [12,18-20].

and close position of canals. A minor volumetric increase during the setting reaction allows to achieve closer contact with canal dentin, thereby reducing gaps and voids. In addition, their ability to maintain dimensional integrity over time supports the preservation of a stable seal when subjected to functional stresses in such complex cases [15]. Modified obturation technique as described by Tsesis I et al., was used in the second case which combines lateral compaction in the apical portion with vertical compaction of the elongated pulp chamber [16]. The overall incidence of complications associated with either technique remains low [14].

An adequate coronal seal following obturation is essential for enhancing the long-term success of endodontic treatment [17].

Taurodont teeth with complex canal morphology like C-shaped canal present an endodontic challenge as conventional methods are inappropriate for the management of these cases. To the best of current knowledge, limited case reports are available on the management of C-shaped canals in taurodontic teeth [Table/ Fig-6] [12,18-20]. For better clinical understanding, establishing standardised treatment protocols may aid in improving clinical outcomes and for a successful endodontic therapy.

CONCLUSION(S)

Taurodontism with C-shaped canals presents significant endodontic challenges. Accurate diagnosis using CBCT, careful negotiation of canal orifices, conservative instrumentation, effective irrigation activation protocols, and modified obturation techniques are essential for predictable treatment outcomes. These cases demonstrate that with a strategic approach, taurodont teeth with complex canal systems can be managed successfully.

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