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Research Paper

# Endodontic Management of C-Shaped Root Canal System in Mandibular First Molar: A Rare Case Report

Medical Science

**KEYWORDS :** Anatomy,C-shaped root canal, canal configuration, mandibular first molar.

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| **Patil Avinash A.** | MDS, Reader, K.L.E.V.K. Institute of Dental Sciences, Belgaum, Karnataka, India. |
| ***Patil Sanjana A.** | MDS, Lecturer, K.L.E.V.K. Institute of Dental Sciences, Belgaum, Karnataka, India. *Corresponding Author |

## ABSTRACT

*The aim of this case report is to present the endodontic management ofC-shaped root canal system in mandibular first molar. A patient with root canal treatment initiated with right mandibular first molar was referred for further treatment. Radiograph revealed the presence of an unusual root canal morphology with the presence of a single conical root. The pulpal floor revealed normal mesiolingual orifice and semicolon groove that ran continuously from mesiobuccal orifice along the buccal wall to the distal canal orifice, suggestive of C-shaped canal anatomy which was confirmed with the aid of surgical loupes. Cleaning and shaping was carried out using rotary as well as hand files combined with passive ultrasonic irrigation with sodium hypochlorite. Obturation was done using combination of lateral compaction and thermoplasticized gutta-percha. Many reports deal with C-shaped root canal system, but very few describe its management in mandibular first molar, indicating a rare anatomical configuration.*

**Introduction:**
The goal of root canal therapy is thorough cleaning and obturation of root canal system in all its dimensions.[1] Knowledge of both normal and abnormal anatomy of the root canal system dictates the parameters for execution of root canal therapy and can directly affect the outcome of endodontic treatment.[2] Various anatomical variations have been described in different teeth. One of the important anatomic variations is the "C" configuration of the canalsystem.

The C-shaped canal, which was first documented in endodontic literature byCooke and Cox in 1979, is so named for the cross-sectional morphology of the rootand root canal. Instead of having several discrete orifices, the pulp chamber of theC-shaped canal is a single ribbon-shaped orifice with a 180° arc (or more), which, inmandibular molars, starts at the mesiolingual line angle and sweeps around the buccalto end at the distal aspect of the pulp chamber.[3]Typically, this canal configuration is found in the teeth with fusion of the roots either on its buccal or lingual aspect.[4]It is speculated that this anatomy is caused by the failure of the Hertwig's epithelial root sheath to fuse on the lingual or buccal root surface.[5]

These can be classified into two basic groups: (1) those with a single, ribbon-like, C-shaped canal from orifice to apex and (2) those with three or more distinct canals below the C-shaped orifice. Fortunately, C-shaped canals with a single swath of canal are the exception rather than the rule.[6]

C-shaped canal system is most commonly found in mandibular second molars but may rarely occur in mandibular first molars and maxillary molars too.[3,7,8]Studies on mandibular second molars have shown a high incidence of C-shaped roots and canals (10%-31.5%).[9]

There is significant ethnic variation as well in the incidence of C-shaped molars. Reported prevalence includes: 2.7-8% for Americans, 13% for mixed Asian population, 31.5% for Chinese and 44.5% for Korean population.[10] It has thus been established that this particular anatomy is more frequent in Asians than in other racial groups.When present on one side, a C-shaped canal may be found in the contralateral tooth in over 70% of individuals.[9]

Once recognized, the C-shaped canal provides a challenge with respect to debridement and obturation, especially because it is unclear whether the C-shaped orifice found on the floor of the pulp chamber actually continues to the apical third of the root.[3]

Though there are several cases reported in the dental literature of C-shaped canal system, very few cases have been reported in which C-shaped canal system was found in mandibular first molar.[11,12]In this report, we present endodontic management of a C-shaped mandibular first molar which is a rare anatomic variant; thus making this case one of its own kind.

**Case Report:**
A 21-year-old male patient with root canal treatment initiated with right mandibular first molar was referred from a general practitioner to the Department of Conservative Dentistry and Endodontics.The intraoral periapical radiograph revealed an endodontic access cavityand also indicated an unusual root canal morphology with the presence of a single conical root [Figure 1].

It was decided to continue with the root canal treatment. The patient received local anesthesia of 2% lidocaine. Rubber dam isolation was not done as patient's medical history revealed that the patient was asthmatic. After removing the temporary restoration, the pulp chamber was observed carefully. The pulpal floor revealed a normal mesiolingual orifice and a semicolon groove that rancontinuously from the mesiobuccal orifice along the buccal wall to the distal canal orifice, suggestive of C-shaped canal anatomy [Figure 2]. Canal system identification was confirmed with the aid of 2.5 magnification prismatic loupes (Seiler, St. Louis, MO).

Working length was determined using an electronic apex locator(Dentaport ZX, J Morita corp.). Cleaning and shaping was performed with ProTaper Universal rotary NiTifiles(DentsplyMaillefer)in the mesiolingual canal and the wider portions of the C-shaped canal, followed by circumferential instrumentation using hand instruments in the isthmus portion. During instrumentation, the canals were irrigated with 3% sodium hypochlorite(Vishal Dentocarepvt. Ltd, Ahmedabad, Gujarat, India), followed by 17% liquid EDTA (Smear Clear, Sybron Endo, CA, USA), and one minute of passive ultrasonic irrigation with 3% sodium hypochlorite to remove organic tissue, planktonic bacteria and dentin debris from inaccessible areas.Ultrasonic instrumentation was performed with Enac-3 EM-OSADA (Enac-3 EM-OSADA, Tokyo, Japan), that produces ultrasonic vibration with a frequency of over 20.000 Hz. The power adjustment of the unit was set at level 3. Pre obturation radiograph was taken to confirm the working length [Figure 3].

Obturation was done using combination of lateral compaction and thermoplasticized gutta-percha (Elements Obturation System, Sybron Endo, CA, USA)alongwith AH Plus root canal sealer(Dentsply,Maillefer) [Figure 4]. Post obturation pulp chamber floor shows C-shaped canal obturation [Figure 5].The patient was then referred back to the general practitioner for permanent restoration.

**Discussion:**
The mandibular first molar generally has two separate roots with a round, or more frequently elliptical canal in the distal

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root and two canals in the mesial root. Although, the presence of three canals is a more common finding, four canals exist in approximately one-third of the mandibular first molars. The Distal canal is normally straight all the way to the apex, oval or flattened in cross- section, but quite large which makes instrumentation easy. Often the most apical 1-2 mm of this canal curves up to 90 degrees distally, but this is seldom a clinical problem.[13]

However, in C-shaped canal system, presence of a high incidence of transverse anastomoses, lateral canals, and apical deltas makes it difficult to clean and seal the root canal system. Because of its challenging morphology, the C-shaped canal anatomy would increase the difficulty in root canal therapy and may account for the frequent occurrence of endodontic failures. [14]Therefore recognition and thereby proper treatment of C-shaped root canal is of utmost importance for endodontic success.

Radiographically it may present as a single fused root or as two distinct roots. Radiographs taken while probing the root canal system reveal two characteristics: instruments tend to converge at the apex;instruments appear clinically and radiographically to perforate the furcation.[13]

Cone-beam computed tomography (CBCT) has been shown to be more accurate than radiographs in determining root canal systems; however, it was not used in this case as it was not available in the present dental set up. Nevertheless, the use of surgical loupes along with radiographs was helpful in detecting the variations of the root canal system.Clinical recognition of C-shaped canals is based on specific anatomy of pulp chamber, difficult to control bleeding because of anastomosis, large pulp chamber in occluso-apical dimension with deep lying bifurcation.[13]

After anaesthesia, the mesiolingual, mesiobuccal and distal canal spaces were prepared normally using ProTaper rotary NiTi files. However, the isthmus was prepared with smaller hand K-files not larger than ISO no. 25; otherwise strip perforation is likely to occur.Extravagant use of small files and copious irrigation was the key to thorough debridement of narrow canal isthmus since irregular areas in C-shaped root canal system may housesoft tissue remnant or infected debris which is difficult to clean otherwise. Also, the use of ultrasonics assured further cleaning of the isthmus.

Mesiobuccal, mesiolingual and distal canals were obturated as standard canals using lateral compaction technique. However, since the isthmus could not be prepared with asufficient flare to permit deep placement of the spreader;application of thermoplasticized gutta-percha was moreappropriate. The compaction of softened gutta-percha should predictably move gutta-percha and sealer into the root canal aberrations.

Paramount in the successful treatment of this tooth was the early recognition of the abnormal canal shape. The pretreatment radiograph indicated a somewhat unusual root configuration for mandibular first molar. This forewarning led to a more rapid identification of the C-shaped canal that enabled better debridement and obturation of the root canal space ensuring greater endodontic success.

Statement of no support: "I affirm that I have no financial affiliation (e.g., employment, direct payment, stock holdings, retainers, consultantships, patent licensing arrangements or honoraria), or involvement with any commercial organization with direct financial interest in the subject or materials discussed in this manuscript, nor have any such arrangements existed in the past three years. Any other potential conflict of interest is disclosed."

**Conclusion:**

The variation of root canal morphology, especially in multirooted teeth, is a constant challenge for diagnosis and successful endodontic therapy.[15] "C"configuration, which is an important anatomic variation,presents a challengewith respect to cleaning, shaping and obturation due to its intricate anatomy. Although several case reports have confirmed its frequent presence in mandibular second molars; this case report affirms that this canal system does exist in mandibular first molar as well and therefore alert the dentist to have knowledge of its distribution in various other teeth and proceed with a thorough radiographic and clinical examination of the pulp chamber floor to ensure better endodontic successs.

**Figure 1: Pre operativeperiapical radiograph**

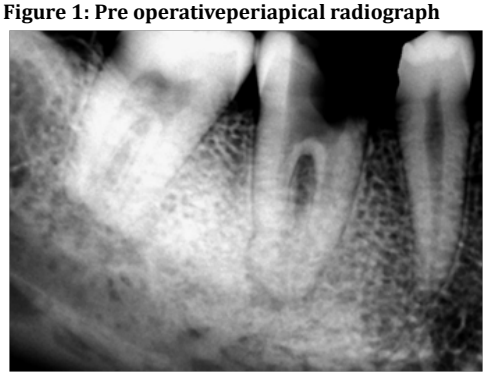

**Figure 2: Pre instrumentation photograph of chamber floor**

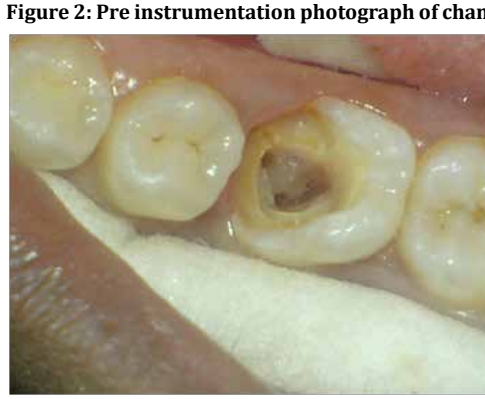

**Figure 3: Pre obturation radiograph**

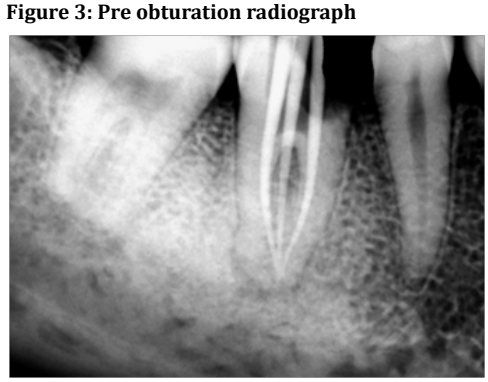

**Figure 4: Post obturation radiograph**

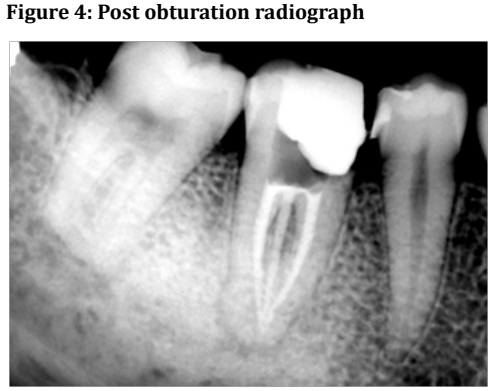

**Figure 5: Post obturation photograph of chamber floor**

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