Management of C- shaped Canals- A case report

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Abstract

A successful endodontic therapy depends on the thorough knowledge of root canal anatomy. A C-shaped canal with varying configuration is commonly seen in mandibular second molars. Cooke and Cox (1979) first documented the C-shaped canals in endodontic literature. The presence of high incidence of complex anatomy like transverse anastomoses, lateral canals, and apical deltas makes it difficult to clean and seal the root canal system in these teeth. The main reason for failure in endodontic treatment of mandibular second molars is the inability to detect the presence of C-shaped canals prior to an endodontic therapy. This case report presents successful management of a case of C-shaped canal configuration in a mandibular send molar.

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Introduction

A thorough knowledge of the root canal anatomy and its variations is required for achieving success in root canal therapy, along with diagnosis, treatment planning and clinical expertise. One such variation of the root canal system is the C-shaped canal configuration. It is termed so because of the C-shaped cross-sectional anatomical configuration of the root and root canal. C-shaped canal anatomy was first documented by Cooke and Cox in mandibular second molar. Canal configuration has a high prevalence in mandibular second molars (2.7% - 45.5%).[1]

C-shaped canal configuration is a result of the failure of the Hertwig's epithelial root sheath to fuse or its inadequate development during the root embryologic stage. Failure of the Hertwig's epithelial sheath to fuse on the buccal side will lead to formation of a lingual groove, and failure to fuse on the lingual would lead to formation of a buccal groove. Failure of the sheath to fuse on both the buccal and lingual sides will result in the formation of a conical root.[2]

Due to the high incidence of root fusion in the mandibular second molars, C-shaped canals are frequent. This anatomy is more common in Asians than in whites. Gulabivala *et al*., using a canal staining and tooth clearing technique, reported the incidence of 22.4% in Burmese patients; in another study, the same author used the injection of Indian ink and noted the prevalence of 10% in Thai population, while Wang *et al*., found a high incidence of C-shaped canal system (41.27%) in mandibular second molars of a Chinese population.[3]

Case Report

A 55year old patient reported to the Department of Conservative Dentistry and Endodontics with pain in the lower left back region of the jaw since 2 months. On intraoral examination class II dental caries on tooth 37 with pulpal involvement and tenderness to percussion was seen. The tooth was nonresponsive to vitality tests. Radiographically, a large coronal radiolucency was seen in tooth 37 closely approximating the pulp space along with an associated periapical radiolucency. Tooth was conical in shape with fused mesial and distal roots. (Fig 1)

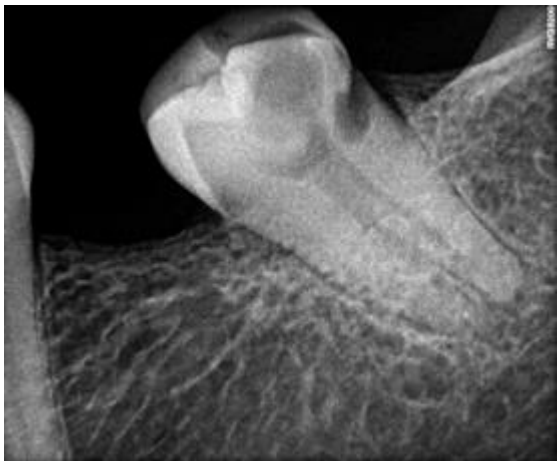


Fig 1

After proper isolation and anesthesia, an access cavity was prepared and one single large orifice is located (Fan et al 2004 C4 type). (Fig 2)

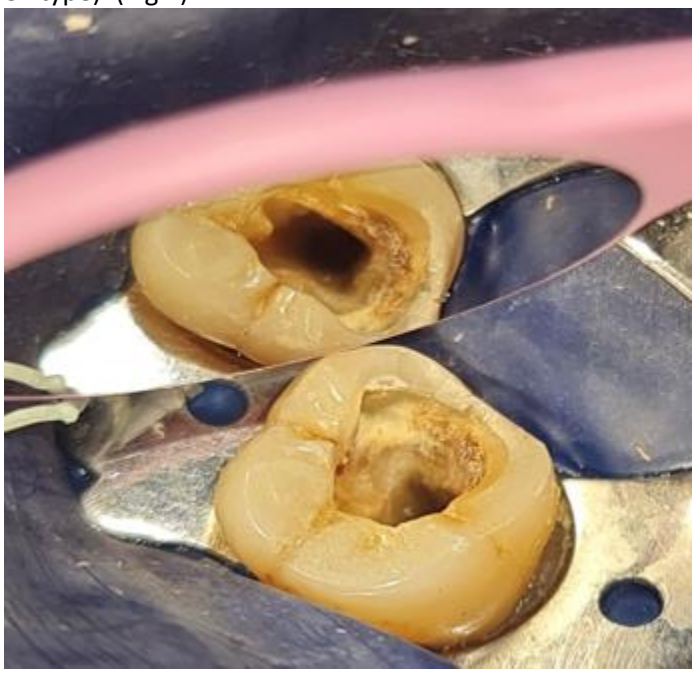


Fig 2

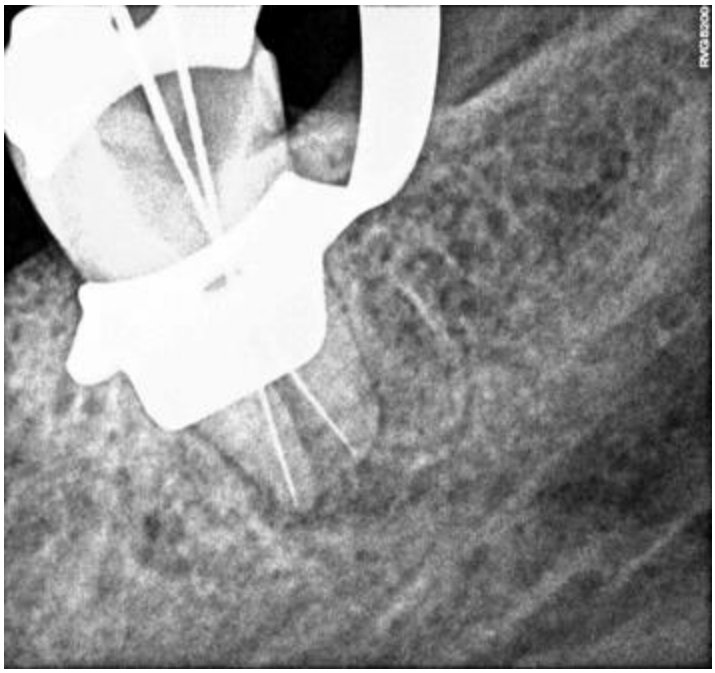


Fig 3

Working length was determined radiographically and using an apex locator. (Fig 3) Patency was established for both the canals with 15 no. k file. Cleaning and shaping was done till F2 6% using Protaper gold rotary files (Dentsply Maillefer, Switzerland). Irrigation was done using side vented needles using saline and 3.2% sodium hypochlorite. 3ml of 17% EDTA was used to remove smear layer and sonic dynamic agitation was done using an endoactivator (Dentsply Maillefer, Switzerland). Calcium hydroxide (RC Cal Prime Dental Products, Thane, India) was placed as an intracanal medicament. After 1 week, after the canal was found to be dry, the master apical cones size 25 6% were inserted in the canal and fit was confirmed radiographically. The master cones were then coated with AH plus sealer and placed in the canals. (Fig 4) Both the cones were seared off at the bifurcation of the canals using an obturation pen and the remainder of the canal was filled using backfill technique using thermo-plasticised gutta percha (Calamus, Dentsply Maillefer, Switzerland). Post endodontic restoration was done with composite after one week. (Fig 5)

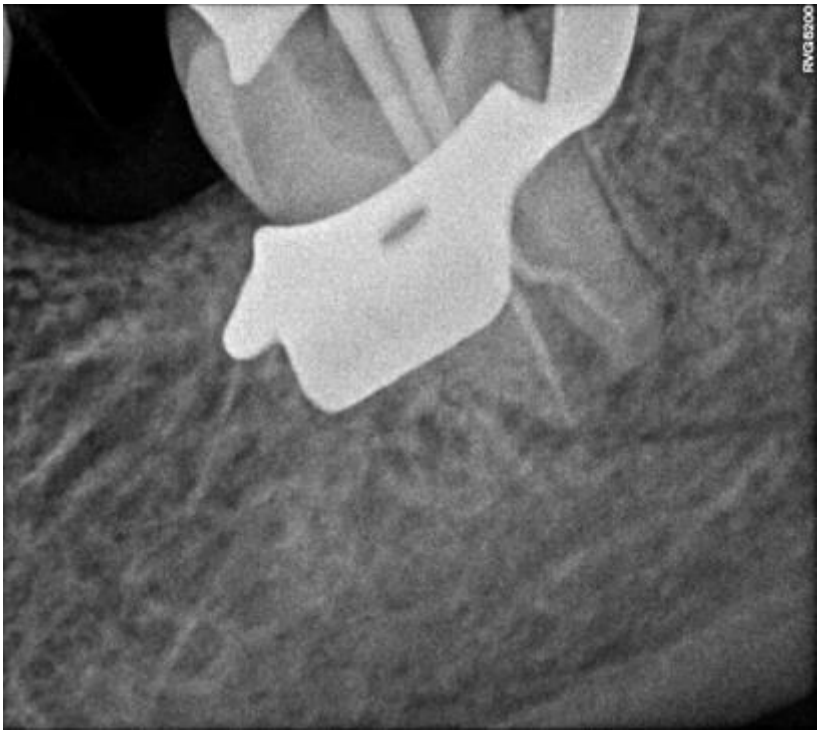


Fig 4

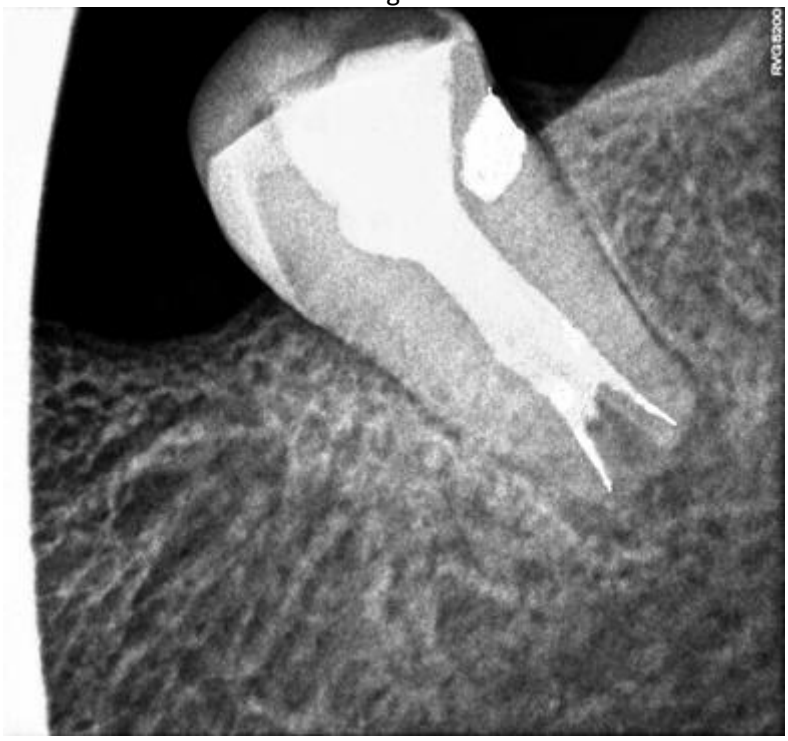


Fig 5

Discussion

The C-shaped canal, was first documented in endodontic literature by Cooke and Cox in 1979, is so named for the cross-sectional morphology of the root and root canal. Instead of having several discrete orifices, the pulp chamber of the C-shaped canal is a single ribbon-shaped orifice with a 180° arc (or more), which, in mandibular molars, starts at the mesio-lingual line angle and sweeps around the buccal to the end at the distal aspect of the pulp chamber. Below the orifice level, the root structure can harbour a wide range of anatomic variations. 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.[4]

Incidence:

The C-shaped canal configuration shows an ethnic predilection. It has frequently been reported in countries belonging to the Asian continent. East Asian population groups like Chinese (0.6%-41.27%) and Koreans (31.3%-45.5%) display a high prevalence of this variant. Among the South Asian countries, Burmese population showed a prevalence of 22.4%, which was much higher than the Indian, Thai or Sri Lankan population.[5] In mandibular second molars it is seen with a percentage ranging between 2.7%-45.5%, maxillary first molars (0.12%), maxillary third molars (4.7%), mandibular third molars (3.5%-4%) and mandibular second premolars (1%). Bilateral occurrence of C-shaped canals has been reported in a percentage of 70%-81%.[5]

Etiology:

Failure of the Hertwig's epithelial root sheath to fuse on the lingual or buccal root surface is the main cause of C-shaped roots, which always contain a C-shaped canal. The C-shaped root may also be formed by coalescence because of deposition of the cementum with time. C-shaped canals appear when fusion of either the buccal or lingual aspect of the mesial and distal roots occurs. This fusion remains irregular, and the two roots stay connected by an interradicular ribbon. The floor of the pulp chamber is deep and has an unusual anatomic appearance. Two or three canals may be found in the C-shaped groove, or the C-shape may be continuous throughout the root length.[5]

Classification:

Various classifications of C-shaped canal configurations have been proposed to make the diagnosis and treatment. Melton et al in 1991 proposed a classification in which the C shaped canals are classified into three types, Type I, Type II and Type III. (Fig 6)

1. Category I: continuous C-shaped canal running from the pulp chamber to the apex defines a C-shaped outline without any separation (i.e.,C1 in Fig 6).
2. Category II: the semicolon-shaped (;) orifice in which dentine separates a main C-shaped canal from one mesial distinct canal (i.e., C2 in Fig 6).
3. Category III: refers to those with two or more discrete and separate canals: (Fig 6)

-Subdivision I, C-shaped orifice in the coronal third that divides into two or more discrete and separate canals that join apically;

-Subdivision II, C-shaped orifice in the coronal third that divides into two or more discrete and separate canals in the mid-root to the apex; and

-Subdivision III, C-shaped orifice that divides into two or more discrete and separate canals in the coronal third to the apex.[6]

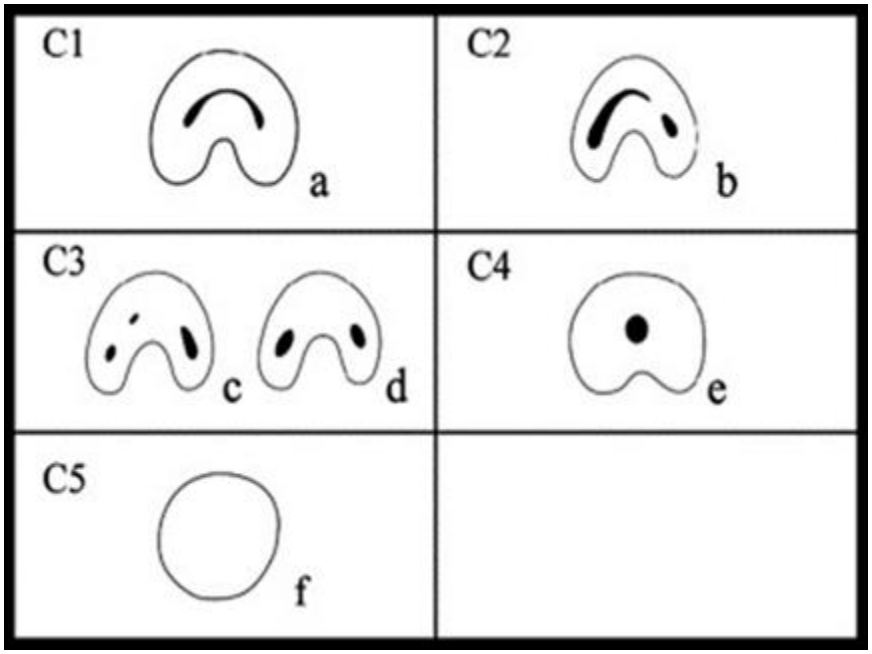


Fig 6

Fan et al. suggested a new classification for C- shaped canals in 2004 . He modified Melton's classification and divided the C-shaped canals into five types. (Fig 7)

Type I configuration- having continuous shape,

Type II configuration- with semicolon shape

Type III configuration- having two or three separate canals

Type IV configuration- only one round or oval canal

Type V configuration- with no canal lumen.[6]

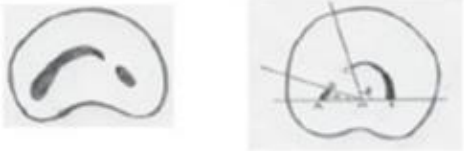
C1		The shape is an uninterrupted "C" with no separation or division
C2		The canal shape resembles a semicolon resulting from a discontinuation of the "C" outline, but either angle α or β should be no less than 60°
C3		Two or three separate canals and both angles, α or β are less than 60°
C4		Only one round or oval canal in that cross-section
C5		No canal lumen can be observed (which is usually seen near the apex only)

Fig 7

Diagnosis:

Pre- operative radiographic diagnosis:

A preoperative radiograph and an additional radiograph with 20˚ mesial or distal projection may be the noninvasive means to clinically provide clues about the canal morphology. Some investigators described four radiographic characteristics that can allow prediction of the existence of this anatomical condition: radicular fusion, radicular proximity, a large distal canal or a blurred image of a third canal in between.[4] In C-shaped molars the radiograph may reveal a large and deep pulp chamber. The pulp chamber in the teeth with C-shaped canals may be large in the occluso-apical dimension with a low bifurcation. The fact that the canal may be connected in the coronal portion yet separated in the apical region. When the canal orifice appears continuously connected at the sub-pulpal level, a separate root canal exiting at the apical level may be present.[5,7]

Clinical Diagnosis:

Fan et al. stated that for mandibular second molar to qualify as having a C-shaped canal system, it has to exhibit all the following three features:

a. Fused roots
b. A longitudinal groove on lingual or buccal surface of the root
c. At least one cross-section of the canal should belong to the C1, C2, or C3 configuration, as per Fan's anatomic classification.[5]

Access Cavity Preparation:

Modifications in the access cavity designs may be required for teeth with C-shape configuration to facilitate location and negotiation of the complete canal system depending on type of C-configuration is present. When the orifice is continuous C-shape or arc like mesio-buccal-distal (MB-D), the number of canals can vary from one to three; when the orifice is oval or flat, the number of canals may be one or two; and when the orifice

is round, there is usually only one canal below the orifice. Hence, for continuous C-shape orifice, 3 initial files are inserted, one at either end and one in the middle. When the orifice is oval, two files are inserted, that is, one file at each end of the orifice and when the orifice is round, one initial file is inserted. [5]

Cleaning and Shaping:

During cleaning a C-shaped root canal morphology, particular attention should be paid to 'isthmus' (Grocholewiczet al. 2009), 'trough' (Barnett 1986)24 and 'fin' (Bolger and Schindler 1988). These structures are narrow, ribbon-shaped communications between two root canals which may contain pulp or pulp-derived tissue and are the so called reservoirs for bacteria. The application of nickel-titanium (NiTi) rotary instruments reduces the risk of perforation during mechanical root canal preparation. After instrumentation by NiTi rotary instruments, K-files could be passively introduced into the canal, and filing could be specifically directed towards the isthmus areas to obtain better debridement in clinical practice. Intracanal instruments may not reach and debride the entire portion of the continuum, this makes irrigation procedures more significant.[5,6]

Obturation:

Sir Herbert Schilder stated that, "What you remove from the root canal is more important than what you place inside it." Cold lateral condensation was the method employed for obturation in each case previously.[4] Sealing the isthmus is difficult if lateral condensation is the only method used. Thermomechanical obturation is the technique to decrease the viscosity of gutta percha and increase it's plasticity. It is the method of choice for three dimensional obturation of gutta percha in C shaped canals. This ensures accurate filling of the apical third and of areas where isthumus is present.[5]

Post-endodontic restoration:

Composite is a better choice as the core or as the final restoration of these teeth. During follow- up examination, Dentist should check the furcal region as it is associated with the greatest risk of perforation as it is the most difficult to obturate.

Conclusion

C shaped canals presents with a wide variety of variation and it is most important to have a correct diagnosis, perform root canal instrumentation with great care to avoid iatrogenic errors, with copious irrigation and a modification in the obturation technique to achieve a successful outcome in the management of such a case.

References

1) Kanika Yadav, Ida de Noronha de Ataide, Marina Fernandes, Rajan Lambor. Management of C shaped canals: 3 case reports. International Journal of Contemporary Medical Research 2016;3(5):1340-1342.
2) Manning SA. Root canal anatomy of mandibular second molars. Part II: C shaped canals. Int Endod J. 1990;23:40–5.
3) Kadam NS, Ataide IN. Management of C-shaped canals: Two case reports. J Orofac Sci 2013;5:37-41.
4) Jadhav, S., Vaidya, M.J. and Hegde, V., Management of C Shaped Canals: A Case Series, IOSR March 2021; 20(3):70-75.
5) Fernandes M, De Ataide I, Wagle R. C-shaped root canal configuration: A review of literature. Journal of conservative dentistry: JCD. 2014 Jul;17(4):312.
6) CS S, Saji S, Eugine AA, Raveendran T. Management of C Shaped Canals–A Case Series, IIJST July 2021; 6(7).
7) Fan B, Cheung GSP, Fan M, Gutmann JL, Bian Z. C-shaped canal system in mandibular second molars: Part I-anatomical features. J Endod 2004;30:899-903.