

Management of C shaped canal using CBCT, ultrasonic activation and warm vertical obturation - A case series

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Abstract

Perfect Endodontic treatment is a successor to thorough knowledge of root canal morphology. C shape canal morphology is an anatomic variation, commonly observed in mandibular second molars. Generally, 2 or 3 canals are joined by an isthmus or groove to resemble the appearance of letter “C”. Root Canal Treatment of such root canals pose a big challenge to the clinician during negotiation, biomechanical preparation and obturation. Thorough radiographic and clinical assessment is mandatory. Newer techniques like, rotary instrumentation, sonic and ultrasonic assisted BMP and 3-D obturations must be considered.

Keywords: Anatomic Variation, Ultrasonic Irrigation, 3-D obturation

Introduction

Knowledge of pulpal canals anatomy, both usual and unusual is very critical in endodontics for a successful

treatment. One of the most encountered variations is ‘C’ shaped canal configuration [1]. The ‘C’ shaped canal morphology was first reported by Cooke and Cox in 1979. The term was coined in accordance to C- shaped horizontal cross-sectional anatomical arrangement of root canals and orifices, with canals may or may not be separate [2]. Instead of having several discrete orifices, the pulp chamber of the C-shaped canal is a single ribbon shaped orifice with 180° arc (or more).[3]Prevalence for this configuration is common in mandibular second molars ranging between 2.7% - 45.5% [4]. It can also be seen in various tooth like mandibular 1st molar, premolars and maxillary molars [5].

No Studies till date have shown any predilection of C shaped canals with age, sex, and position of tooth. But, in a recent study conducted by Jerome et al. observed incidence of C- shaped molars in Asian population is 31% and in general population about 8% [6]. This results from

the failure of HERS epithelial sheath to develop and fuse in the area of furcation in developing stage of the tooth [7]. Early recognition of C- shaped canal configuration can help the clinician in proper negotiation, preparation which may prevent any irreversible damage to the tooth. Recent classification in action for c- shaped canals is given by Fan et al. stated below.

Fan et al. [8], modified Melton's method into the following categories:

1. **Category I (C1):** interrupted "C" with no separation or division [Figure 1a].
2. **Category II (C2):** resembled a semicolon resulting from a discontinuation of the "C" outline [Figure 1b], but either angle α or β [Figure 2] should be no less than 60° .
3. **Category III (C3):** 2 or 3 separate canals [Figure 1c and d] and both angles, α and β , less Than 60° .
4. **Category IV (C4):** Only one round or oval canal in the cross- section [Figure 1e].
5. **Category V (C5):** No canal lumen could be observed (which is usually seen near the apex only) [Figure 1f].

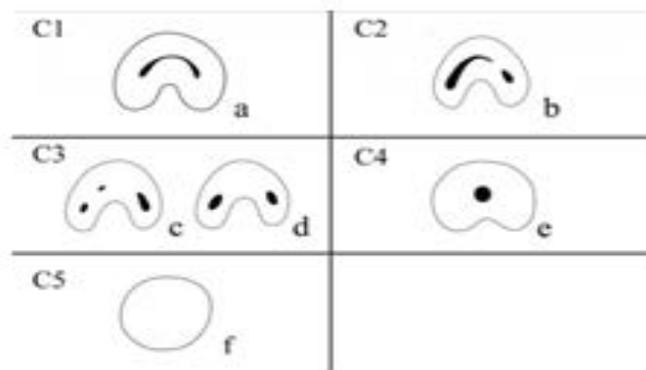


Fig 1: Classification of C-shaped canal configuration^[8]

Case report 1

A 36- year- old male patient reported to Department of Conservative Dentistry and Endodontics with a complaint of pain of his lower left back tooth. There was no associated history of swelling or pus discharge. Clinically, there was a presence of deep disto-occlusal carious lesion approaching pulp. Tooth gave negative response to heat

and Cold test and positive TOP. The medical history was non-contributory.

IOPA Radiograph (Fig 2a.) shows presence of periapical radiolucency with respect to 47. The presence of conical shaped root outline and radiolucent line in middle of the roots suggested C- shaped root canal morphology. Patient was advised to get a CBCT done whose results (Fig 3a.) confirmed type Category II shaped canal.

A diagnosis of necrotic tooth with acute apical periodontitis with respect to tooth 47 with C shaped canals was stipulated. Endodontic treatment was planned, and informed consent was taken from patient. Patient was asked to get third molar extracted for better prognosis of root canal treatment in 47. After rubber dam isolation and profound anaesthesia, an access cavity was prepared. On exploration of pulp chamber, two orifices were recognized, which were semicolon in shape (Fig 3b.). After working length determination by using electronic apex locator (Root ZX mini, J. Morita), it was confirmed with a radiograph (Fig 2b.). The root canals were enlarged using hand K- files with 5 % sodium hypochlorite as the irrigating solution. Ultrasonic Ultra X activator was used to activate the irrigant and flush the canals thoroughly. The final shaping of the canals was achieved with Hyflex EDM rotary file system. Calcium hydroxide, an intra- canal medicament was used, and the patient was recalled after two week. In the next appointment, Master cone was fitted to the working length and radiograph (Fig 2c.) was taken and the canal was obturated with selected master gutta- percha cone with AH- Plus endodontic sealer (Dentsply Maillefer Company, USA). Obturation of canal was done by warm vertical condensation technique using . A heated tip of Beefill system was introduced into a tooth to cut GP leaving 4mm apical length, rest canal was backfilled using Thermoplasticised GP (Fig 2d). This technique is useful to increase the adaptation and density

of teeth obturated with lateral condensation, it is especially indicated for C-shaped canals.

Case Report 2

A 26-year old female patient reported to the department of Conservative Dentistry with a chief complaint of pain in lower left back tooth. Patient gave the negative history of medical and dental history.

Radiographically, a large radiolucency in the crown and the floor of the pulp chamber was seen. Two fused roots indicating a C-shaped canal anatomy was observed (Figure 4a). CBCT confirmed presence of two separate canals leading to diagnosis of c shaped canal Category III (Fig 5a). On examining the floor of the pulp chamber using 2.5 X magnifying loupes, mesial and distal canal orifices were located (Figure 5b). After local anesthesia administration and rubber dam placement, working length was determined using apex locator and confirmed using a working length iopa (Figure 4b). Orifices were preflared with Sx protaper hand file and the canal were prepared till working length using Coltene Hyflex EDM rotary file system and thoroughly irrigated using 5% sodium hypochloride and activated using Ultrasonic Ultra activator. Calcium hydroxide dressing was given, and patient was recalled after 2 weeks. In the next appointment, Master cone was fitted to the working length and radiograph (Fig 4c.) was taken. Canals were sealed obturated with selected master gutta- percha cone with AH- Plus endodontic sealer (Dentsply Maillefer Company, USA). Obturation of canal was done by warm vertical condensation technique using Beefill system (Fig 4d)

Case Report 3

A 16-year-old female patient reported at department of Conservative Dentistry with pain in relation to her left mandibular second molar.

Intraoral examination revealed deep caries and lack of swelling of the surrounding tissue. The patient had pain on percussion. Intraoral periapical radiograph revealed radiolucency in the crown involving the pulp suggestive of a pulpal involvement. The root canal morphology confirmed the presence of a single root with a linear canal, constricting toward the apex. Slight peri-radicular changes were appreciable.

Intraoral periapical radiograph (Fig. 6a) of tooth revealed deep caries approximating the pulp without any associated periapical change. A detailed examination of the radiograph revealed the presence of a single root with a wide canal. Therefore, C-shaped canal configuration was anticipated. Clinical and radiographical examination revealed irreversible pulpitis due to dental caries.

CBCT image (Fig 7a) also confirmed presence of category IV, single canal wrt 37.

After the administration of local anesthesia, the access cavity was prepared (Fig 7b). The pulp chamber was irrigated with 5% sodium hypochlorite to debride the chamber fully and to identify the nature of the canal system present. In the present case, a single round orifice was located in the middle portion of the floor of the pulp chamber. Working length was determined using apex locator (Root ZX, J. Morita) and confirmed by the radiographs (Fig. 6b).

Cleaning and shaping were done with K-files and apical third was shaped to size 80 with K-files. In between the instrumentation, thorough irrigation with sodium hypochlorite and saline was done throughout the procedure. A ISO #80 GP was selected as a master apical cone to obtain an apical tug back (Fig 7c). The canal was then obturated with AH-Plus sealer using warm vertical condensation technique. A post-obturation radiograph showed a well-obturated canal (Fig 7d).

Discussion

Clinical cases of a C shaped root canal system show that, root canal aberration occurs in a wide variety and variability with a single root canal up to two, three and four separate root canals. The diameter of these root canal themselves varies from very wide to such with a small diameter. The teeth that qualified as having a C- shaped canal system had to exhibit all the following three features: Fused roots, a longitudinal groove on the lingual or buccal surfaces of the root, and at least one cross-section of the canal belongs to the C1, C2, or C3 configuration [9,10]. Clinical recognition of C- shaped canals is based on the definite observable criteria (i.e., the anatomy of the floor of the pulp chamber and the persistence of haemorrhage or pain when separate canal orifices were found [11].

CBCT is gaining popularity and used as an adjunct in diagnoses and treatment planning of C shaped canals [12].

In our case report 1,2 initial evaluation of the radiograph suggested the presence of single root with two wide canals which are centrally located. After access preparation, in case 1, two orifices one large c shaped, and another mesial canal were negotiated giving a semicolon shaped orifice anatomy . These canals joined in apical thirds of the root. While in case 2, two canal orifices joined by were negotiated, which showed presence of a single root canal in middle and apical thirds.

In case 3, single large canal was seen on IOPA which on negotiation yielded a single orifice and canal up to the apical third. The morphological variant of single root and single canal are easily detected in routine radiographs. Regarding the filling of root canal system one method is not enough to seal the endodontic space. Thermo plasticized gutta- percha technique is the recommended technique for such cases. But since most of dental practitioners use only lateral condensation technique, we

used warm lateral compaction for obturation of root canals with good results.

A study by Weine *et al.*, [13] reported that 1.3% of mandibular second molars had single canal configuration. The use of ultrasonics along with conventional therapy would be more effective. An increased volume of irrigant and deeper penetration with small instruments using sonics or ultrasonics may allow for more cleansibility in fan-shaped areas of the C-shaped canal. It should be emphasized that, in C-shaped mandibular molars, the mesiolingual canal is separate and distinct from the apex, although it may be significantly shorter than the mesiobuccal and distal canals. These canals are easily overinstrumented in C-shaped molars with a single apex. [11] In our second case, mesiolingual canal was found to be separate and it was clearly distinct from apex. However, first case reported with a single canal configuration.

Thermoplasticized gutta-percha technique is the recommended technique for canal irregularities. [5,12] Since most of dental practitioners use only lateral condensation technique, we used the same and found excellent results with gutta-percha and AH Plus sealer into the complex anatomy of the canal.

Conclusion

The proper diagnosis plays a key role for the management of C- shaped canals. Depending upon the morphology the management mode can be selected. Due to the unusual anatomy of teeth with C-shaped root canal system, successful cleaning and shaping followed by three-dimensional sealing of aberrant space, it's necessary to know and learn appropriate techniques of irrigation and filling with suitable techniques.

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Legend Figure

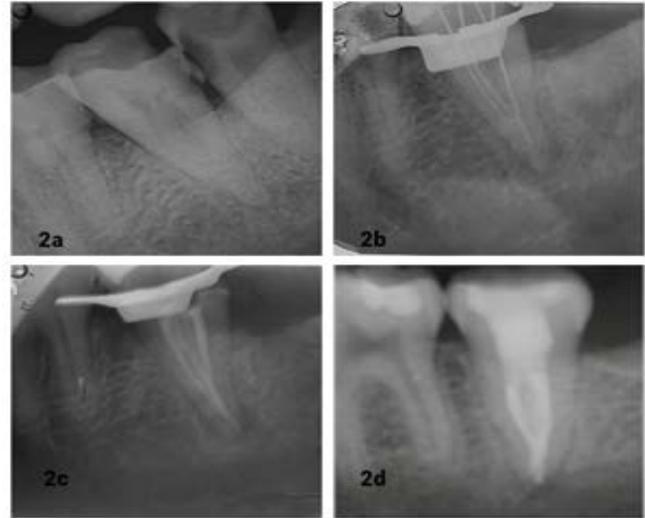


Figure 2: (a) Preoperative radiograph, (b) Working length radiograph, (c) Master cone radiograph, (d) Post obturation radiograph.

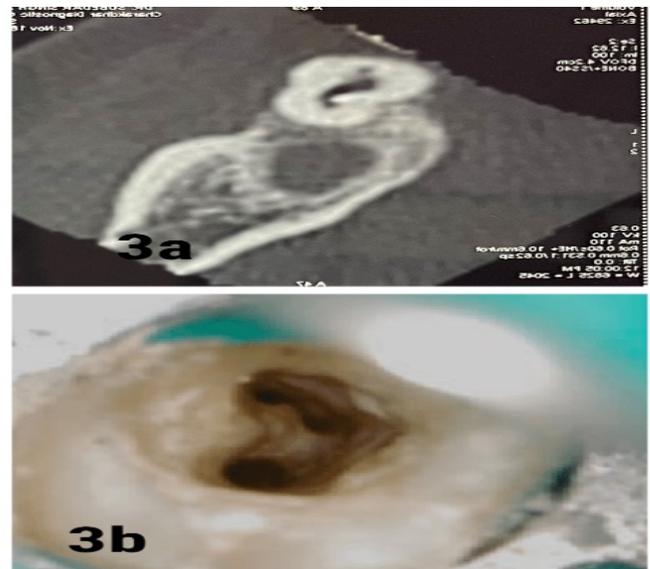


Figure 3: (a) CBCT image Category II C-shaped canal, (b) Access cavity.



Figure 4: (a) Preoperative radiograph, (b) Working length radiograph, (c) Master cone radiograph, (d) Post obturation radiograph.

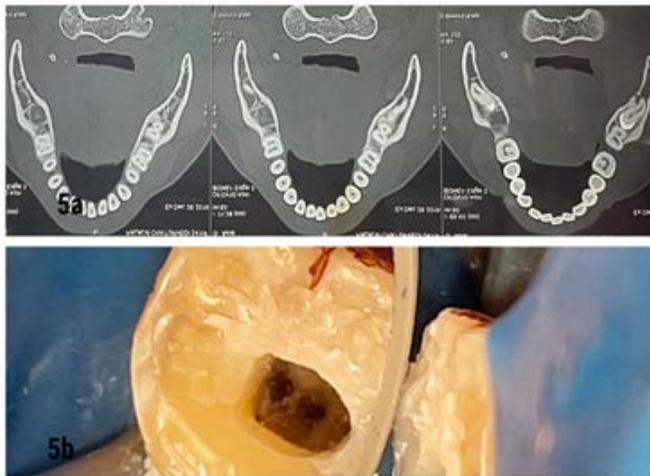


Figure 5: (a) CBCT confirming Category III C-shaped canal (b) Access cavity.

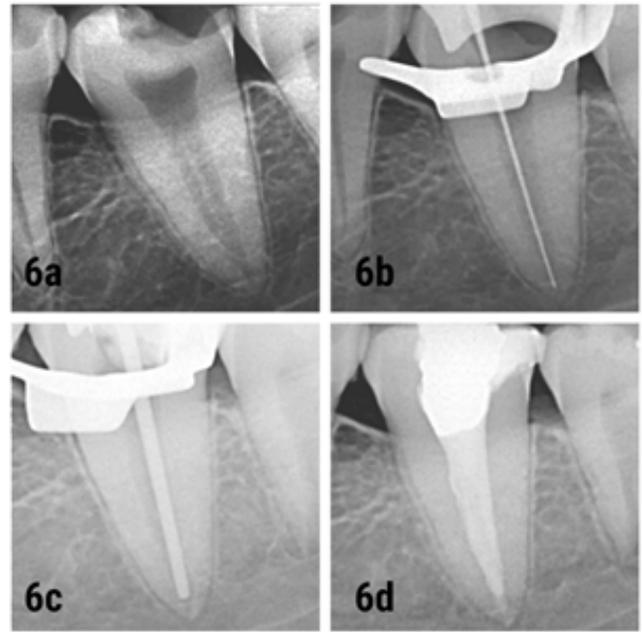


Figure 6: (a) Preoperative radiograph, (b) Working length radiograph, (c) Master cone radiograph, (d) Post obturation radiograph.

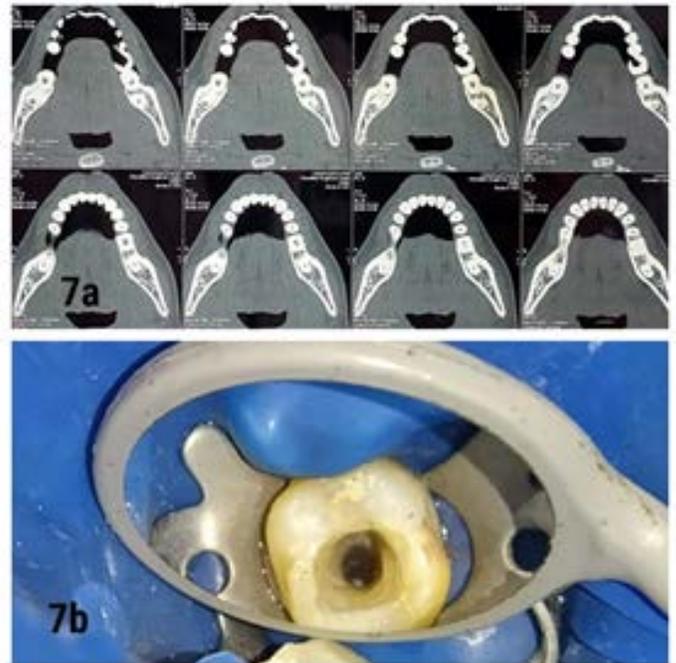


Figure 7: (a) CBCT confirming category IV C-shaped canal (b) Access cavity.