

“C” Shaped Canal Configuration -Dilemma To Endodontist. A Case Report

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Abstract: One of the most important anatomic variations is the “C” shaped configuration of the canal system. C shaped canal presents an extensive complex system and is mostly seen in mandibular second molars. Careful assessment of preoperative radiograph is a key step for its subsequent management, and this assessment might impact greatly on the treatment outcomes. The main anatomic feature of this is the presence of fins or webs connecting individual mesial and distal canals. The C shaped configuration presents a challenge to debridement and obturation.

Key words: C shaped canal, mandibular second molar, warm vertical obturation.

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I. Introduction

A thorough knowledge and understanding of presence of unusual root canal anatomy can contribute to the successful outcome of root canal treatment. One such variation of the root canal system is the C shaped canal configuration, which is termed so because of the C shaped cross sectional anatomical configuration of root and root canal.¹ Instead of having several discrete orifices, the pulp chamber of C shaped is a single ribbon shaped orifice with a 180° arc or more, which in mandibular molars, starts at the mesiolingual line angle and sweeps around the buccal to the end at the distal aspect of pulp chamber. Below the orifice level, the root structure can harbor a wide range of anatomic variation. These can be classified into two basic groups (1) Those with single, ribbon like C shaped canal from orifice to apex and (2) those with three or more distinct canals below C shaped orifice.⁷

C shaped canal was first documented in 1979 by Cooke and Cox.² It is most commonly found in mandibular second molar^{1,2,3} but the C shaped canal configuration also can be found in mandibular premolars⁴, maxillary molars,⁵ and mandibular third molars.⁶

The etiology of C shaped canal is failure of fusion of Hertwig's epithelial root sheath on buccal side which results in formation of lingual groove and failure to fuse on lingual side would result in a buccal groove. This fusion is not uniform and a thin interradiolar ribbon like slit connects the two roots together. Failure of the sheath to fuse on both buccal and lingual sides will result in formation of a conical or prism-shaped root⁸

Melton et al., in 1991 classified C-shaped canals on basis of cross-section.¹¹ Fan et al in 2004 modified Melton's classification into following categories.¹²

- **Category I (C1):** The shape was an interrupted “C” with no separation or division.
- **Category II (C2):** The canal shape resembled a semicolon resulting from a discontinuation of the “C” outline.
- **Category III (C3):** Two or three separate canals (highest incidence).
- **Category IV (C4):** only one round or oval canal in that cross-section.
- **Category V (C5):** No canal lumen could be observed (which is usually seen near the apex only).

This case report presents successful management of unusual case of C shaped canal.

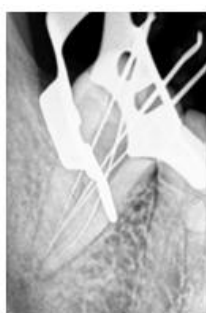
Case 1

A 28 year old male patient reported to department of Conservative Dentistry and Endodontics with the chief complaint of pain in lower right back teeth region since 4-5 days. Medical history of the patient was non contributory. Pain was intermittent in nature and aggravates on taking hot and cold food which persist even after removal of stimulus. Intraoral examination revealed deep mesioproximal caries on 47 (Fig.1a) and tenderness on percussion. Radiographically, a large proximal radiolucency was seen approaching pulp space. Tooth was

conical in shape with fused mesial and distal roots. Endodontic treatment was planned. Local anesthesia (2% lignocaine with 1:80000 adrenaline) was administered and the tooth 47 was isolated under rubber dam. Access opening was initiated using Endo access bur, Fan et al C2 type anatomy was found. In these cases Gates Gildden drills should be avoided. As there is higher risk of root perforation at the thinner lingual walls of shaped during shaping. Working length was determined using apex locator and confirmed radiographically(Fig.1b) canals were cleaned and shaped using Protaper rotary files (Dentsply Maillefer, Ballaigues, Switzerland) upto F2. Irrigation was performed with 5% sodium hypochlorite (Prime Dental products, India) using side vented needle and irrigant was activated using endoactivator (Dentsply).17% EDTA was used to remove smear layer and final flush of normal saline was done. Canals were dried using sterile paper points. Mastercone was selected and confirmed radiographically for sectional obturation.(Fig.1c) Ah plus sealer (Dentsply Maillefer Company , USA) was mixed properly, applied using lenturospiral and obturation was completed with back fill using thermoplasticised gutta percha.(System B Sybron Endo). Post endodontic restoration was done using composite restoration (Filtex Z 350 XT (3M ESPE).)(Fig.1d)



(Fig.1a)



(Fig.1b)



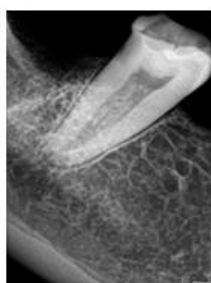
(Fig.1c)



(Fig.1d)

Case 2

A 40 year female patient was referred from department of prosthodontics ,for intentional RCT with 47.(Fig.2a) Medical history of the patient was non contributory. Patient was informed regarding treatment plan . After proper isolation and profound anesthesia an access cavity preparation was performed using Endo Access kit.(Dentsply Sirona) for tooth 47 .Fan et al C4 type anatomy was found Working length was determined by Root ZX apex locator (J.Morita Mfg.Corp.,Kyoto,Japan) which was confirmed radiographically using 10 k file (Mani Japan)(Fig.2b) Cleaning and shaping was performed using Protaper Next rotary files (Dentsply Tulsa) followed by circumferential filling using hand K files. Irrigation was performed with 5% sodium hypochlorite (Prime Dental products, India) using side vented needle and irrigant was activated using endoactivator (Dentsply).17% EDTA was used to remove smear layer and final flush of normal saline was done. Canals were dried using paper points..Mastercone was selected and confirmed radiographically for sectional obturation.(Fig.2c). Ah plus sealer (Dentsply) was mixed properly, applied using lenturospiral and obturation was completed with back fill using thermoplasticised gutta percha.(System B Sybron Endo).Post endodontic restoration was done using composite restoration. (Filtex Z 350 XT (3M ESPE).) (Fig.2d)



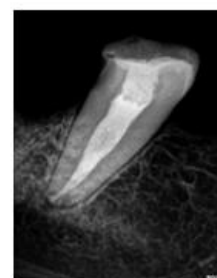
(Fig.2a)



(Fig.2b)



(Fig.2c)



(Fig.2d)

Case 3

A 50 year old male reported to Department of Conservative Dentistry and Endodontics with chief complaint of severe pain in lower right back teeth region since 3- 4 days .Patients medical history is non contributory.On clinical examination mandibular second molar displaced deep distoproximal caries with tender on percussion. Radiographically distoproximal caries is approaching pulp space and tooth is conical in shape.(Fig.3a) Electrical pulp testing showed early pulp response and tooth was diagnosed with irreversible

pulpitis. Endodontic treatment was planned. Local anesthesia (2% lignocaine with 1:80000 adrenaline) was administered and the tooth 47 was isolated under rubber dam. Access opening was initiated using Endo access bur, Fan et al C4 type anatomy was found. Working length was determined using apex locator and confirmed radiographically,(Fig.3b) canals were cleaned and shaped using Protaper rotary files (Dentsply Maillefer, Ballaigues, Switzerland) upto F2. Irrigation was performed with 5% sodium hypochlorite (Prime Dental products, India) using side vented needle and irrigant was activated using endoactivator (Dentsply).17% EDTA was used to remove smear layer and final flush of normal saline was done. Canals were dried using sterile paper points. Calcium hydroxide (RC CAL,Prime Dental products ,India) as an intracanal medicament was used and patient was reappointed after 1week. In the next Mastercone was selected and confirmed radiographically.(Fig.3c) Ah plus sealer (Dentsply Maillefer Company,USA) was mixed properly, applied using lenturospiral, sectional obturation was done and backfill of the canal was done using thermoplasticised gutta percha (System B Sybron Endo). Post endodontic restoration was done using composite restoration (Filtex Z 350 XT (3M ESPE).(Fig.3d)



(Fig.3a)



(Fig.3b)



(Fig.3c)



(Fig.3d)

Case 4

A 42 year male patient reported to Conservative Dentistry and Endodontics with chief complaint of pain in lower left back teeth region. Medical history was noncontributory. There was presence of prolonged sensitivity to hot and cold. Clinically, there was deep mesioproximal caries with tooth 38 and distoproximal caries with tooth 37. (Fig.4a). Radiographically the caries was seen approaching pulp and the tooth was conical shaped. The tooth was non responsive to vitality test and nontender to percussion. The teeth were diagnosed of pulp necrosis and endodontic treatment was planned. Rubberdam isolation was done and access cavity preparation was initiated using Endo access bur Fan et al C4 type anatomy was found wrt 38 and type C2 wrt 37. Working length was determined using apex locator and confirmed radiographically, (Fig.4b) canals were cleaned and shaped using Protaper rotary files (Dentsply Maillefer, Ballaigues, Switzerland) upto F2. Irrigation was performed with 5% sodium hypochlorite (Prime Dental products, India) using side vented needle and irrigant was activated using endoactivator (Dentsply).17% EDTA was used to remove smear layer and final flush of normal saline was done. Canals were dried using sterile paper points. Mastercone was selected and confirmed radiographically.(Fig.4c) Ah plus sealer (Dentsply Maillefer Company,USA) was mixed properly, applied using lenturospiral, sectional obturation was done and backfill of the canal was done using thermoplasticised gutta percha (System B Sybron Endo) for 38 and whole of the canal was obturated with backfilling of thermoplasticised gutta percha (System B Sybron Endo) for 37. Post endodontic restoration was done using composite restoration (Filtex Z 350 XT (3M ESPE).(Fig.4d)



(Fig.4a)



(Fig.4b)



(Fig.4c)



(Fig.4d)

II. Discussion

The C- shaped canal variation is unusual and can lead to difficulties during treatment¹⁴.The mandibular second molar usually have two roots. But there are chances of wide range of variations in root canal configuration.⁹ Also there is possibilities of tooth having single root canal.¹⁰Proper diagnosis as well as categorization based on the classification system is mandatory before treatment.

Treatment of C shaped canal should be accompanied by additional measures for complete debridement and thorough cleaning of complex root canal morphology. Use of magnifying loupes, microscope and CBCT aids in better understanding the canal system in pulpal floor.¹³

Self – adjusting file system can be used which is found to be efficacious in cleaning and shaping of C shaped canals.¹⁵During cleaning and shaping, normal preparation can be done in mesial and distal canals. Nevertheless the isthmus should not be prepared with larger than number 25 files; otherwise, strip perforation is likely to occur. The anticurvature filing method will be useful in these circumstances. Gate _Glidden burs should not be used to prepare the mesiobuccal and buccal isthmus area¹⁶

An increased volume of irrigant and deeper penetration with small instruments using sonics or ultrasonics may allow for better cleansibility in fan shaped areas and web which interconnects the canal.¹¹Obturation of “C” shaped canal requires technique modification . Though the mesiolingual and distal canal spaces can be prepared and obturated as standard canals,sealing the buccal isthmus is difficult if lateral condensation is used so thermoplasticized gutta percha obturation was done.^{7,8}

III. Conclusion

Thorough knowledge of internal anatomy and proper diagnosis is very important for the successful outcome of the treatment as it lead to difficulties in debridement ,filling and restoration. Thermoplasticized gutta-percha technique seems to be useful for filling multiple foramina,or other complex configuration of root canal system and ensure better homogeneity.

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