



Management of ‘C’ Shaped Canals: A Case Series

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ABSTRACT

Introduction

The clinical effectiveness of endodontic treatment is heavily influenced by a thorough understanding of the anatomical changes and root canal structure. "C-Shape" refers to the anatomical configuration of the root and root canal, which is C-shaped in cross-section. "C"- shaped canal system is a special anatomical variation. According to reports, lower second molars seem to exhibit it the most frequently, while this aspect of root canal anatomy can be found

in a variety of teeth. This article discusses the variations in C-shaped canal morphology and endodontic management.

Case Report

This article describes the management of different C-shape root canal configurations using cold lateral condensation and thermoplasticized obturation techniques. 1st case concerns the management of the mandibular second molar with c shaped canal

(uninterrupted c morphology-c1) in a 43-year-old female. 2nd case concerns managing the mandibular second molar with c shaped canal (c2 morphology) in a 22-year-old female. 3rd case concerns managing the mandibular second molar with c shaped canal (c3 morphology) in a 26-year-old female. 4th case concerns managing the management of mandibular second molar with c shaped canal (c4 morphology).

Conclusion

A combination of thermoplastic obturation and advanced irrigation techniques can be used to manage the intricate details and varied morphology of C-shaped canals. For their effective management, it is crucial to be aware of any potential anatomical variations.

Keywords

'C' Shaped canal, Root canal treatment, Thermoplastic Obturation.

INTRODUCTION

To be successful in root canal therapy, one must have a thorough understanding of the root canal anatomy and its variations as well as clinical expertise in diagnosis and planning.¹ The C-shaped canal configuration is just one example of a root canal system variant. The term "C-Shape" refers to the anatomical configuration of the root and root canal, which is C-shaped in cross-section.² This condition was described for the first time in literature by Cooke and Cox in 1979.³ Failure of Hertwig's epithelial root sheath to fuse on lingual or buccal root surface is vital reason for C-shaped configuration. C-shaped root canals can be formed by coalescence because of deposition of the cementum with time.⁴⁻⁶ The C-shaped canal configuration has racial predilection. The higher incidence reported in countries belonging to the Asian

continent like Chinese (31.5%) and Koreans (44.5%).^{7,8} The 'C' shaped canal configuration may also occur in mandibular premolars, maxillary molars and mandibular third molars but has a high prevalence in mandibular second molars (2.7% - 45.5%),⁹.

The C-shaped canal configuration presents with variations in both the number and location of the canal(s), as the canal(s) courses from the coronal to the apical third.¹⁰ The two basic variations are (a) single, ribbon-like, C-shaped canal extending from orifice to the apex and (b) 3 or more canals exiting below the C-shaped orifice.¹¹ Presence of thin slits which connects root canals causes obstacles for proper disinfection and obturation of canal space.¹²

The irregular areas in C-shaped root canals retain remnants of soft tissues along with infected debris. So, it is important to perform appropriate biomechanical preparation for successful outcomes. This case report presents the management of 4 C-shaped canal configurations in mandibular molar teeth.

CASE 1: MANAGEMENT OF MANDIBULAR SECOND MOLAR WITH C-SHAPED CANAL (UNINTERRUPTED C MORPHOLOGY-C1)

A 43-year-old female patient reported to our department with a chief complaint of pain in lower left back tooth region of the jaw. Examination showed deep dental caries on tooth 37 and tenderness to percussion. Radiographically, a large coronal radiolucency was seen in tooth 37 involving the pulp space along with an associated periapical radiolucency. Tooth was conical in shape with fused mesial and distal roots. After proper isolation and anesthesia, an access cavity was prepared and C1 type canal anatomy was found.

After working length determination, canal was prepared by circumferential filing with hand K files

(Dentsply Maillefer, Switzerland) followed by ProTaper rotary files (Dentsply Maillefer, Switzerland) up to F3 followed 5% sodium hypochlorite (Acrylates, India) and normal saline was used as an endodontic irrigant which was activated by manual dynamic agitation technique.

EDTA is used as a final irrigant. Calcium hydroxide (RC Cal Prime Dental Products, Thane, India) was placed as an intracanal medicament. After 1 week, fit of the master cone was checked and the obturation was performed according to technique suggested by Barnett et al., Post endodontic restoration with composite was done.

Figure 1: Molar of 1st case



CASE 2: MANAGEMENT OF MANDIBULAR SECOND MOLAR WITH C-SHAPED CANAL (C2 MORPHOLOGY)

A 22-year-old female patient reported to our department, complaining of pain in the lower right back tooth region of the jaw on chewing. Examination showed deep caries on tooth 47 with a slight tenderness on percussion. The tooth showed delayed response to cold test and electric pulp test (EPT). Radiographically there was radiolucency of the pulp. Root was in conical shape. There was fusion of mesial, distal roots with a radiolucent line between the roots. Diagnosis was irreversible pulpitis with apical periodontitis. Root canal treatment (RCT) was planned. Access cavity was prepared under microscope. C canal configuration was detected using

distal canal that is extending bucco linguallly The cleaning and shaping of the canal were done by hand K files and gold rotary files.. Normal saline and 5.25% sodium hypochlorite were used for irrigation. EDTA is used as a final irrigant. Calcium hydroxide dressing was done. The patient was asymptomatic after 7 days. Obturation was done by wave compaction technique, choosing 30 sizes, 4% master cone on both canals. Pen tip was inserted into canal orifice and activated to remove gutta percha that is excess. Heat was inactivated and firm pressure was maintained on pen tip for around 5 -10 seconds. After gutta-percha mass was cooled, heat application given for 1 second separated the pen tip from gutta-percha. Remaining canal was back filled with thermoplasticized gutta

percha by using a Woodpecker obtura gun. Post endodontic restoration with composite was done.

Figure 2: Molar of 2nd case



CASE 3: MANAGEMENT

A 26-year-old female patient visited our department complaining of pain. Examination showed a deep carious lesion with tenderness on percussion. The radiograph had shown a radiolucency using pulpal involvement and fused mesial and distal roots. Diagnosis was irreversible pulpitis and apical periodontitis. Access cavity was prepared after appropriate anaesthesia. Working length was determined after which the cleaning and shaping was

performed using Protaper gold rotary files till F2. Irrigation was done using 5.25% Sodium hypochlorite and normal saline. EDTA is used as a final irrigant. The obturation was carried out with single cone technique in both mesio buccal and mesio lingual canals and lateral condensation in the distal canal using AH-Plus endodontic sealer (Dentsply Maillefer). Taking the saddle shaped anatomy of the pulpal floor as a retentive feature composite post endo restoration was done.

Figure 3: Molar of 3rd case

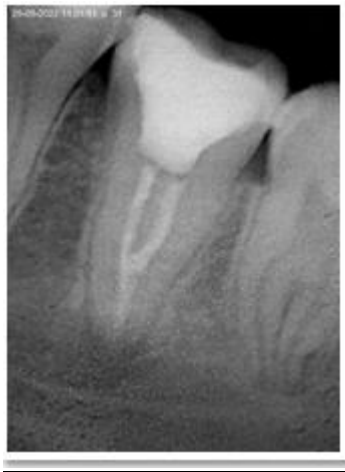


CASE 4: MANAGEMENT OF MANDIBULAR SECOND MOLAR WITH C SHAPED CANAL (C4 MORPHOLOGY)

A 36-year-old female patient presented to our department with a complaint of pain in the lower inserted into canal orifice and activated to remove gutta percha that is excess. Heat was inactivated and

firm pressure was maintained on pen tip for around 5 - 10 seconds. After gutta-percha mass was cooled, heat application given for 1 second separated the pen tip from gutta-percha. Remaining canal was back filled with thermoplasticized gutta percha by using a Woodpecker obtura gun. Post endodontic restoration with composite was done.

Figure 2: Molar of 2nd case



CASE 3: MANAGEMENT

A 26-year-old female patient visited our department complaining of pain. Examination showed a deep carious lesion with tenderness on percussion. The radiograph had shown a radiolucency using pulpal involvement and fused mesial and distal roots. Diagnosis was irreversible pulpitis and apical periodontitis. Access cavity was prepared after appropriate anaesthesia. Working length was determined after which the cleaning and shaping was

performed using Protaper gold rotary files till F2. Irrigation was done using 5.25% Sodium hypochlorite and normal saline. EDTA is used as a final irrigant. The obturation was carried out with single cone technique in both mesio buccal and mesio lingual canals and lateral condensation in the distal canal using AH-Plus endodontic sealer (Dentsply Maillefer). Taking the saddle shaped anatomy of the pulpal floor as a retentive feature composite post endo restoration was done.

Figure 3: Molar of 3rd case



CASE 4: MANAGEMENT OF MANDIBULAR SECOND MOLAR WITH C SHAPED CANAL (C4 MORPHOLOGY)

A 36-year-old female patient presented to our department with a complaint of pain in the lower right back tooth region. Her Medical history was noncontributory. Radiographically disto proximal radiolucency was seen involving pulp. The radiograph also showed a single conical root.

Access was prepared after adequate anesthesia with rubber dam. The pulp floor had single oval canal

which was located in the center of the pulp chamber. Working length was determined. Cleaning and shaping were done with Protaper rotary files (Dentsply, Maillefer) till 30.6%.

The pulp chamber was irrigated with 5.25% sodium hypochlorite and normal saline, EDTA is used as a final irrigant. and the obturation was done using warm vertical condensation technique (Woodpecker guttapercha obturation system) with AH-Plus endodontic sealer (Dentsply Maillefer).

Figure 4: Molar of 4th case



DISCUSSION

This case series describes the treatment of four mandibular second molars with a C-shaped root canal system. The radiographic and clinical diagnosis can help in identifying and negotiating the C-shaped anatomy despite the unusual morphological C-shaped canal variation. Specific clinical findings, such as the peculiar anatomy of the pulp floor, persistent hemorrhage or pain when individual canal orifices are seen, and narrow root grooves causing localized periodontal disease, can be used to diagnose such teeth.¹¹ Accurate diagnosis can also be made by various radiographical techniques such as cone beam computed tomography (CBCT), spiral CT, microCT to avoid difficulties during treatment.¹³ According to Fernandes M. et al., recognizing a C-shaped canal configuration before treatment can help with effective management, preventing irreparable harm that could put the tooth in serious danger.¹⁴ The radiograph of a C-shaped molar may show a large, deep pulp chamber. The occlusoapical dimension of the pulp chamber in teeth with C-shaped canals may be large with a low bifurcation.¹⁴

Particular attention should be given to the "isthmus" (Grocholewicze et al. 2009),¹⁵ "trough" (Barnett 1986),⁶ and "fin" when cleaning a C-shaped root canal morphology. (Bolger and Schindler 1988).¹⁶ Larger than no. 25 files should not be used to prepare the isthmus; otherwise, strip perforation is likely to occur. Small amounts of dentin between the internal canal system and the external surface of the root, particularly on the lingual side, increase the risk of strip perforation.¹⁷ It is advised to use the anticurvature filing technique to stay clear of danger areas, which are frequently present at mesiolingual walls.¹⁸ Recent research on mandibular molars with C-

shaped roots showed that manual K-file instrumentation (41.6%) had a lower percentage of uninstrumented canal areas than NiTi rotary instrumentation (59.6%). After that, hand files can be used with assisted ultrasonic activation, particularly for the isthmus area.¹⁹

Due to an increased irrigant volume and deeper penetration with the use of small instruments, sonic or ultrasonic activation enhances cleansibility in fan-shaped regions of the C-shaped canal.^{10,20} In case 1 Manual Dynamic Activation (MDA) is a simple, fast and cost-effective method to agitate irrigants inside root canal system. A 2 mm in-and-out movement inside the irrigating solution is used with the master cone grasped 1 mm set back from the working length. According to the study done by Khare M et al, the effectiveness of PUI and MDA is equivocal in lateral canal irrigation.²¹ Biomechanical preparation with Self - adjusting file system is also found to be efficacious C-shaped canals.²² The success rate of endodontic treatment has been further improved by recent developments in irrigation and disinfection, including the Gentlewave system and photoactivated disinfection (PAD).^{23,24}

Obturation of C-shaped canals may require technique modifications. According to Herbert Schilder, Deeper penetration of the condensation instrument in various sites is required if the cold condensation technique is used for obturation. As with standard canals, the mesiolingual and distal canal spaces can be prepared and obturated.²⁵ However, if lateral condensation is the only technique used, sealing the isthmus is challenging. Barnett advised doing this before seating the master cone in the mesial canal by inserting a large diameter file in the farthest portion of the canal. The distal canal's master cone is then seated after the

file is removed, and the middle section of the C-shaped canal is then filled with accessory cones.⁶ Warm vertical condensation and thermoplasticised obturation techniques are the other methods of choice for the three-dimensional obturation of the C-shaped canals.

The pulp chamber's floor is deep, which can help with ample retention from the available undercuts during post-endodontic preparation. In these teeth, chamber-retained composite or endocrown are preferable options.¹⁴ The mesial buccal and lingual canal walls of Cshaped canals are extremely narrow, which increases the risk of root perforation during shaping and post space preparation procedures. As a result, placing a post or antirotational pins in the mesiolingual and mesiobuccal regions of a C-shaped root canal can result in perforation; therefore, if a post is necessary, its width should be kept to a minimum and it should be positioned in the distal canal.^{11,26}

In this case series, the management of the cases were done using different treatment protocols which includes Circumferential filing to prevent strip perforation using hand files followed by use of rotary files along with activation of irrigants using MDA and PUI. The combination of vertical compaction and thermoplasticised obturation techniques enables complete filling of the canal anatomy.

CONCLUSION

This case series presents the uncommon anatomy of the mandibular second molars with different 'c' shaped canal anatomies. Careful inspection of the tooth under dental operating microscope and the correct choice of cleaning and shaping technique suitable for this uncommon root canal anatomy helps in achieving success in the treatment.

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