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Endodontic management of a C-shaped root canal using thermoplasticised obturation with a modified gutta-percha cartridge design. Case report

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Abstract

The C-shaped canal configuration is a developmental anomaly that results from the Hertwig epithelial sheath's inability to fuse with the buccal or lingual root or its inadequate development during the root embryological stage. Cone beam computed tomography (CBCT) is recommended to evaluate this highly complex anatomy. The irregular root canal spaces and their varying configuration makes it difficult to achieve a 3-dimensional seal. This case reports the non-surgical management of a tooth diagnosed with symptomatic irreversible pulpitis with apical periodontitis having a C-shaped canal configuration using a modification of the warm gutta-percha obturation technique. The cartridge of material was modified by creating notches on the lateral aspect under the dental operating microscope, enabling the lateral flow of the obturating materials into the inaccessible areas of the canal.

Introduction

The heterogeneity of the anatomy of the root canal system poses a constant challenge to endodontic diagnosis and therapeutics. Detailed knowledge of root canal anatomy is important to ensure successful treatment.

One such variation creating difficulty during endodontic intervention is the C-shaped canal. The first documentation of C-shaped roots and root canals was in 1908 and 1911 by Keith and Knowles during the examination of skeletal remains of Netherland race members (Keith and Knowles 1911; Keith 1913). The variant was first documented in the endodontic literature by Cooke and Cox in 1979 in 3 case reports (Cooke and Cox 1979). The prevalence of C-shaped canals is said to be highest in Asian populations, varying from 3-93.1% and the number of canals range from 1 to 3 (Manning 1990; Fan et al., 2004; Peiris et al., 2008). The wide irregular canals with thin root walls, presence of grooves, and transverse anastomoses often make the cleaning and shaping as well as obturation extremely difficult (Cooke and Cox 1979; Manning 1990).

Mechanically activated Irrigation (mechanical, acoustic, or ultrasonic) is recommended over manual irrigation in order to clean inaccessible regions of the intricate C shape anatomy (Fan et al., 2009). The most used endodontic irrigant is sodium hypochlorite because of its ability to dissolve tissue and kill microorganisms

(Zhender 2006). In some cases obturation with warm condensation of gutta-percha (GP) have been recommended (Liewehr et al., 1993).

The present paper reports the non-surgical endodontic management of C-shaped canals using a modified obturation technique. The modification allows the adequate flow of obturating material to the canal's wide lateral areas.

Case report

A 16-year-old Indian female reported in January 2022 to the Department of Conservative Dentistry and Endodontics, with the chief complaint of pain in the mandibular right posterior region for the last 2 months. The pain was sudden in onset, dull aching in nature, and moderate in intensity and only relieved with medication (paracetamol 650 mg). However, the pain became severe in the previous two days. Restorations had been placed ten days ago in both mandibular first molars.

On examination, the mandibular right second molar (tooth 47) showed a large carious lesion on the distoocclusal aspect and the tooth was tender to vertical percussion. A sensibility test using Endo-Frost cold spray (Roeko; Coltene Whaldent, Langenau, Germany) elicited pain lasting more than 20 seconds. The patient was carrying a panoramic dental radiograph from her previous dental visit which showed a radiolucency involving enamel and dentine, and periapical widening (Figure 1). A diagnosis of symptomatic irreversible pulpitis with apical periodontitis secondary to deep dentinal caries was made.

Nonsurgical root canal treatment was performed under a surgical microscope (EXTARO 300, Zeiss, United States) after receiving informed consent. Anaesthesia was achieved by an inferior alveolar nerve block using 2% lidocaine with 1:80,000 epinephrine (Lignospan Special, Septodont, Maharashtra, India). After obtaining isolation under a dental dam caries excavation followed by access opening was done with a number 2 endo-access bur (Dentsply Maillefer, Ballaigues, Switzerland). A large C-shaped canal was identified with a continuum between the mesiobuccal and distal canals (Figure 2). A thin layer of dentine was present separating the mesiolingual canal from the C-shaped canal. The pulp was extirpated using a No. 20 barbed broach (Dentsply Maillefer, Ballaigues, Switzerland). To determine the course of the canal, a CBCT image with a small fov (5 × 5) was taken. This revealed a C-shaped canal with

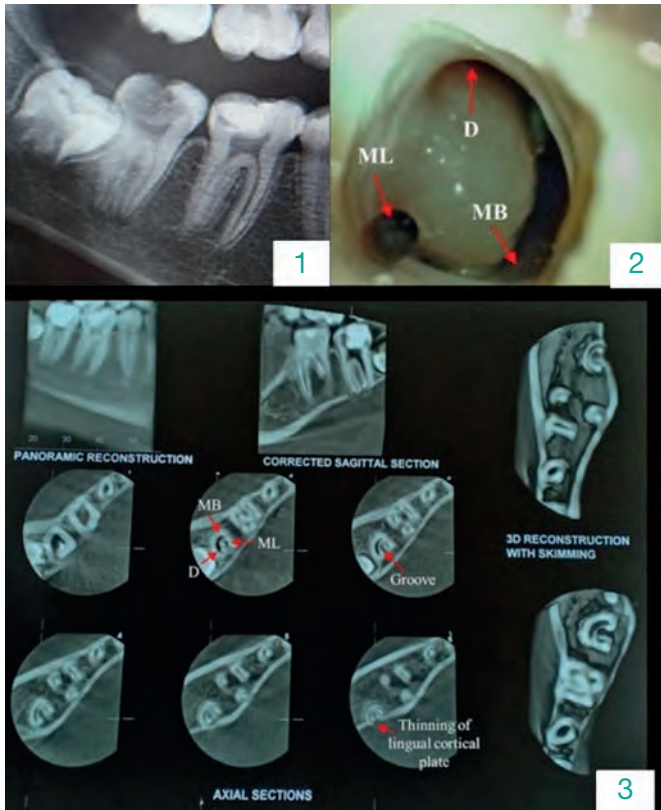


Figure 1. Preoperative radiograph.
Figure 2. Access cavity under a microscope (20x).
Figure 3. Intraoperative CBCT confirming C-shaped anatomy.

a separate mesiolingual canal and thinning of the lingual cortical plate at the apex of the mandibular right second molar (Figure 3).

Working length determination was done using an apex locator (Root ZX mini, JJ Morita, Japan). The mesiolingual canal was enlarged using the ProTaper Gold rotary file system to size F2 (Dentsply Maillefer) and the C-shaped canal was prepared with stainless steel hand files to apical size 35, 2% using circumferential filing to prevent lateral perforation. The canal was irrigated using normal saline, a 3% solution of sodium hypochlorite (Hyposol, Prevest Denpro Ltd, India), and 15% EDTA (Glyde File-Prep RC Conditioner, Dentsply Maillefer, North America) alternatively. Irrigant activation was with ultrasound. The final rinse was performed with normal saline. For adequate disinfection, a dressing of calcium hydroxide (AveuCal, Dental Avenue, India) for ten days was used and the tooth temporised using Cavit (3M ESPE, St Paul, MN, USA) and a glass ionomer cement. In the next appointment the calcium hydroxide was removed and the canal was thoroughly dried with paper points. For obturation, the mesiolingual canal was coated with calcium hydroxide-based sealer (Sealapex, SybronEndo, USA) using a lentulo spiral (Dentsply Maillefer) and lateral compaction of GP. The apical seal was achieved using sectional obturation

for the C-shaped canal running from mesiobuccal to distal. The rest of the canal was obturated with a warm vertical compaction technique of thermoplasticised GP (Calamus Dual 3D Obturation System, Dentsply Maillefer). To ensure the lateral flow of GP, the cartridge was modified. Two lateral holes were created on the sides of the cartridge using a thin needle bur at distances of 3 mm and 5 mm from the tip under the microscope (Figure 4). After completion of root canal treatment, a nanohybrid bulk-fill resin composite restoration (Sonicfill, KaVo Kerr) was provided. Since a 2-dimensional radiograph can be misleading a post-obturation CBCT was taken to determine the flow of GP and sealer throughout (Figure 5).

Some 12 months postoperatively the patient was recalled for clinical and radiographic follow-ups (Figure 6). There were no periapical changes. The tooth was asymptomatic and functional, and the patient reported no recurrence of pain or swelling.

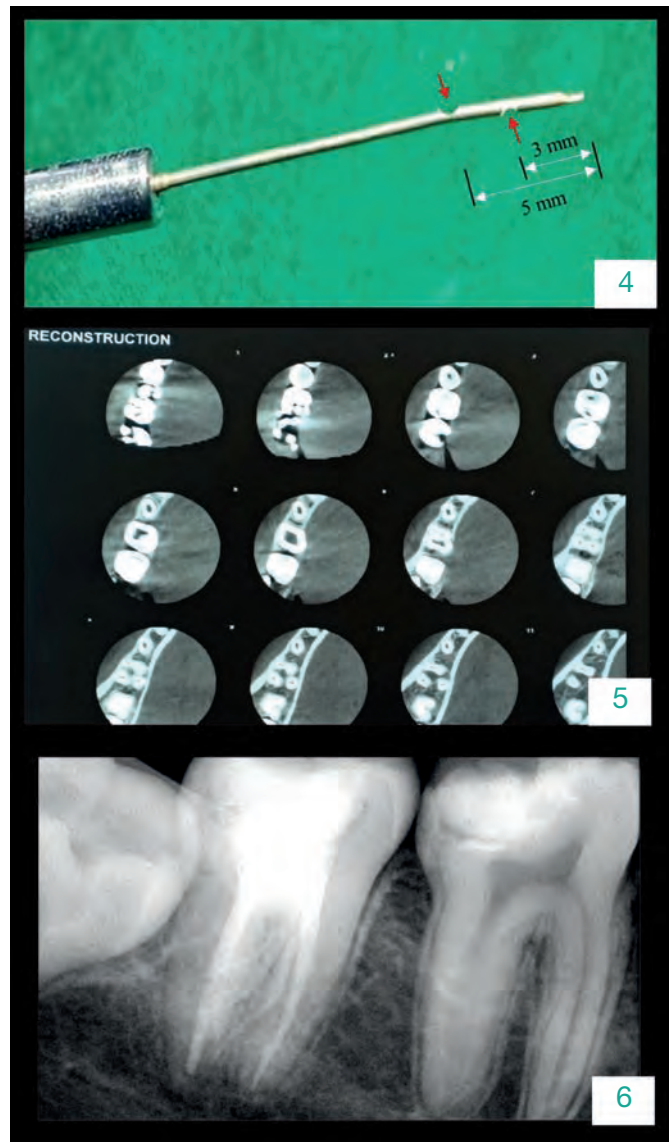


Figure 4. Cartridge modification.
Figure 5. Postoperative CBCT.
Figure 6. 1-year follow-up intraoral radiograph.

Discussion

To make diagnosis and treatment planning easier, various classifications of C-shaped canals have been proposed. Melton et al. established a classification system based on the canal's cross-sectional shape: continuous C-shaped (C1), semicolon (C2), and distinct canals (C3) (Melton et al., 1991). Fan et al. updated Melton's classification by requiring this sort of canal system to have all three of the following characteristics: Fused roots, a longitudinal groove on the lingual or buccal surface of the root, and at least one cross-section of the canal in the C1, C2, or C3 configuration (Fan et al., 2004). The existence of a fin or web connecting the separate canals is the most distinguishing feature of C-shaped canals. Thorough cleaning and 3-D obturation present various challenges. It may be more efficient to combine ultrasonics with traditional treatment (Cheung and Cheung 2008). The importance of using chemical agents for disinfection in the treatment of C-shaped root canal systems cannot be overstated, in addition to the use of sonication and ultrasonication (Yin 2010). Authors have recommended using calcium hydroxide as an intracanal medication for 7-10 days (Ricucci et al., 1996; Walid 2000). In fan-shaped regions of the C-shaped canal, more irrigation volume and deeper penetration with small instruments using activation may improve cleansability (Melton et al., 1991). For canal abnormalities, thermoplasticised GP or using carrier-based GP is advised (Collins et al. 2006). Bogen and Kuttler (2009) have suggested the use of complete or partial MTA as obturation material. In the present case, a type II C-shaped configuration (Melton) with a diagnosis of irreversible pulpitis was treated. A modification in the use of thermoplasticised technique for filling the canal space was advocated. The lateral

notches made on the cartridge may improve movement of the thermoplasticised GP in inaccessible areas.

The microscope helped to achieve precision during the procedure by providing a bright and enlarged view of the irregular canal spaces. While CBCT is not used for routine endodontic cases, in highly complex anatomy it results in a better understanding by providing a 3-dimensional view.

Creating lateral notches on a thin cross-section of the cartridge involves the risk of breakage and should be done under the operating microscope. Studies are required to determine the efficacy of the proposed modification in the obturation of oval and wide irregular canals.

Conclusion

Endodontic treatment of the C-shaped canal configuration presents numerous difficulties. An operating microscope is recommended, and CBCT helps to determine the course of the canal(s) throughout the root length. The proposed side-vented design of the cartridge if incorporated while manufacturing could prove to be beneficial. Further studies are required to evaluate the efficacy of this method in other complex anatomy and compare it with existing techniques.

Declaration of patient consent

The authors certify that they have obtained all required patient permission documents. The patient has provided his agreement for photographs and other clinical information to be reported in the journal.

Conflict of Interest

There is no conflict of interest.

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Book reviews

The Ortho-Perio Patient: Clinical Evidence & Therapeutic Guidelines

Edited by Theodore Eliades, Christos Katsaros (Editors), 2019. Quintessence Publishing. ISBN: 978-0-86715-679-9. Contains 224 pages. Price, US\$128.00.

This book is written by leading specialists in the field and is revised by two orthodontic scholars. It provides a broad analysis of the topic from both the periodontal and orthodontic perspectives. The text is divided into 3 main sections with 13 chapters.

The first section introduces the fundamentals of oral physiology. The opening chapter gives an overview on the biology of tooth movement. This is followed by three other chapters on microbial colonization of teeth and orthodontic appliances, changes in microbiota during orthodontic treatment and pellicle organization and plaque accumulation on biomaterials.

In the second section, periodontal considerations for orthodontic patients are presented. This section

expands on the periodontal exam, aetiology and treatment of recession, soft tissue augmentation and periodontal implications for expansion and crown lengthening. It provides an excellent chapter on management of impacted maxillary canines and using 3D simulation.

The final section focusses on orthodontic considerations for the periodontal patient. Three main topics are covered: the effect of orthodontics on the periodontal tissues, orthodontic mechanics in patients with periodontal disease and orthodontic treatment for patients with severe periodontal disease.

Overall, this book is logically laid out and easy to read. The content of each section is evidence-based, with the relevant citations available at the end of each chapter. The controversial concepts are discussed rationally from both sides. The information provided serves as a great resource for orthodontists, periodontists and general dental practitioners with a special interest in orthodontics and periodontics.

Saeideh Nobakht (Dunedin)