Acta Scientific Dental Sciences

Volume 1 Issue 2 June 2017

Case Report

C- Shaped Canal Configuration as an Endodontic Dilemma in Patients Diagnosed with Oral Submucous Fibrosis - Two Case Reports

Manoj Mahadeo Ramugade[1]* and Sneha Pawar[2]

[1]*Associate Professor, Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, St. Georges Hospital Compound, Mumbai, India*

[2]*Assistant Professor, Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, St. Georges Hospital Compound, Mumbai, India*

***Corresponding Author:** Manoj Mahadeo Ramugade, Associate Professor, Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, St. Georges Hospital Compound, P'Dmello Road, Fort, Mumbai.

Received: June 12, 2017; **Published:** July 17, 2017

Abstract

Thorough knowledge of root canal system along with its variations is of paramount importance for successful endodontic management of tooth. Mandibular second molars are known for their unusual anatomy in the form of extra root or root canal, single canal or C-shaped root canal configuration. Cleaning, shaping and obturation of such C-shaped root canal system are critical and challenging tasks especially in patients presented with restricted access to the root canals. This article aims to provide an insight of diagnosis and management of C-shaped canal configuration in two patients with oral sub mucous fibrosis.

Keywords: Mandibular Second Molar; C - Shaped Root Canal; Oral Sumucous Fibrosis

Abbreviations

MB: Mesiobuccal; ML: Mesiolingual; D-Distal; IOPA: Intra oral periapical; OSMF: Oral submucous fibrosis; CBCT: Cone beam computed tomography

Introduction

Endodontic treatment is a triad of access cavity preparation, cleaning- shaping and three dimensional obturation of root canal system. For successful endodontic treatment knowledge of internal and external anatomy of tooth and their variations is required. Considering the human dentition, amongst all teeth third molars are known for their aberrant tooth anatomy whereas, mandibular first premolars have earned the reputation as Enigma to the endodontist. Mandibular second molars also exhibit numerous variations in the anatomy such as single root, single canal, two roots with two or three canals, three roots and canals, taurodontism and C- shaped root canal configuration.

C- shaped root canal system could be described as, cross sectional morphology of root canal in the form of a C, where canals may or may not be separate [1]. Literature showed that C- shaped root canals usually discovered in mandibular second molars, but it also has been reported in maxillary first molars, mandibular first and third molars and mandibular premolars [2-4]. Different theories have been proposed to explain etiology of C- shaped canals such as, failure of fusion of of Hertwig's epithelial root sheath either on buccal or lingual side [5-7] or the irregular fusion of the of Hertwig's epithelial root sheath either due to trauma, radiation, chemical interference or genetics [4,8] or age changes owing to deposition of dentin on the walls of root canal [9].

C- shaped root canal configuration is found to be commonly predilected in Asian population. Prevalence of C- shaped canal system is higher in Korean population ranges from 31.3% - 45.5% whereas it is 0.6%-41.27% in Chinese population [10-15]. C- shaped Canal configuration has high prevalence in mandibular second molars with a percentage ranging between 2.7% - 45.5% [11,16-18]. In Chinese population, mandibular premolars have shown C- shaped canals in 29.7% cases [19-21]. The C- shaped variation in canal anatomy has also been reported in maxillary third molars (4.7%) [22], mandibular third molars (3.5% - 4%) [22,23] mandibular second premolars (1%) [24] and maxillary first molars (0.12%) [25].Zheng Q et al. through his study observed that, C- shaped canal configuration occurred irrespective of gender, age and tooth position. Sabala CL *et al.* reported that, occurrence of C-shaped canals bilaterally in 70% - 81% identified cases [14,26].

In a C- shaped canal configuration, the anatomy of root canal is varied and usually atypical. Clinically, orifice of the canal is presented as a C- shape in the form of a band or an arc associated with a deep semilunar groove connecting the distal, mesiobuccal and mesiolingual canals [1,27,28]. The C- shaped canal opening could

exhibit in different forms as incomplete C or semicolon by union of two canals. It is presented as a union of MB and D canals with the presence of separate ML canal [1,28] or could be as a C-shaped canal with union of ML and D canals and with separate MB canal. Additionally, C- shaped anatomy may be present either half way or the entire course of the root canal.

Different classification systems have been proposed in the literature by Melton *et al*., Fan *et al*., to elaborate unusual variation in C- shaped canal configuration. Melton *et al*. proposed the classification based on the orifice configurations in C- shaped canals.

- **Class I**: A continuous C-shaped canal, with no separation of the canals.
- **Class II:** A semicolon orifices (;), where a C-shaped canal is present buccally or lingually, separated from another distinct canal by a dentine wall.
- **Class III:** Two or more separate canals are present, as in a typical lower molar, with three canal orifices [1,29].

Nomenclature	Description	Clinical appearance
C1	Continuous C-shaped canal	
C2	MB-D canal and an ML canal	
C3a	Two separate canals	
C3b	Three separate canals	
C4	Single round or oval canal	
C5	No canal lumen could be observed (which was usually seen near the apex only)	

Table 1: Fan *et al*. (2004) classification of C-shaped root canal system [27].

Case Report 1

A 28 years old male patient was referred from a private dental practitioner of remote area to the Department of Conservative Dentistry and Endodontics, complaining of severe pain in mandibular right posterior tooth since 1 week with burning sensation in the oral cavity. His medical history was uncontributory and presented with limited mouth opening. He visited to a private dentist, seeking the treatment for decayed tooth # 47. Root canal treatment was initiated in tooth # 47 and analgesics and antibiotics were prescribed to the patient. The patient was then referred to our department for further treatment due to limited access exhibited in restricted mouth opening. On clinical examination, patient presented with pain in tooth # 47 with mouth opening up to 2 fingers. Patient

had history of betal nut chewing for past 9 years and complaining of burning sensation in oral cavity since a year. Clinical examination exhibited palpable fibrous bands over both buccal and lower lip mucosa causing restricted mouth opening. Cheek flexibility of patient measured from the maxillary incisal midline to the cheek retractor during retraction exhibit reduced flexibility to 25 mm. Patient was thus diagnosed with oral submucous fibrosis (OSMF) of lower lip and both buccal mucosa.

Intraoral examination also revealed poor oral hygiene with multiple carious teeth including tooth #47 and root pieces of tooth #46. Previous dentist could not take preoperative IOPA and done the access cavity preparation with great efforts and severe difficulty in tooth #47 for temporary pain relief. Patient was informed about the present condition and the consent was obtained for completion of treatment.

After securing anaesthesia access cavity was modified. Due to difficulty in visibility pulpal floor was examined using magnification under dental operating microscope. The pulpal floor surprisingly showed unusual single canal anatomy extending buccolingually without isthmus suspecting C-shaped canal configuration (Figure 1). Under possible isolation, working length intra oral periapical (IOPA) radiograph was taken (Figure 2). IOPA showed two roots with mesial, distal canals suspecting perforation in the furcation area. Patient was then advised for computed cone beam tomography (CBCT) but he refused to give consent for the same. Thus, the two canals were prepared using flexible NiTi hand files and Protaper universal rotary files. Coronal flaring was done with orifice opener file, Protaper Sx and canal preparation was completed sequentially upto 6% no.20, F1 Protaper file. A confirmatory radiograph was taken with gutta percha cones placed in prepared canals and a No. 20 K-file placed in suspected C- shaped configuration opening (Figure 3). IOPA radiograph confirmed the C-shaped canal configuration and ruled out the suspicion of perforation in furcation area. During entire cleaning and shaping procedure root canals were irrigated using 5% sodium hypochlorite followed by final rinsing with saline. This unprepared part of canal was then prepared with 6% no.20, F1 Protaper file. After NiTi rotary instrumentation, No. 15 K-file was passively inserted and instrumented into the canal to obtain better cleansing. Once cleaning and shaping was accomplished canal was flooded with 5% sodium hypochlorite and agitated with ultrasonic. Obturation was completed with 6% protaper standardized gutta percha as master cones with AH plus sealer. Warm vertical condensation by Walid's technique was done to seal the C-shaped configuration optimally and post-operative radiograph was taken (Figure 4). Patient was scheduled for thorough scaling, restoration of other carious teeth, extraction of tooth #46 and permanent restoration of tooth #46 after a week. Thorough counselling regarding stoppage of betal nut chewing habit and present condition of OSMF with its treatment was done. After extraction, fixed prosthesis was advised to the patient.

Figure 1: Intra Operative Clinical Photograph of Pulp Chamber of Tooth #47 Exhibiting C-Shaped Canal Orifice.

Figure 2: Working Length IOPA Radiograph of Tooth #47.

Figure 3: Master Cone IOPA Radiograph of Tooth #47.

Figure 4: Post Obturation IOPA Radiograph of Tooth #47.

Case Report 2

A 35-year-old, short stature female patient reported to the Department of Conservative Dentistry and Endodontics with complaint of severe pain in mandibular left posterior region since 5 days with restricted mouth opening and burning sensation of oral cavity. Patient has habit of tobacco and betel nut chewing since past 15 years. Intraoral examination revealed carious tooth # 37 and grossly destructed tooth# 36.

Patient has restricted mouth opening up to 2 fingers with palpable fibrous bands on lip commissures, lower lip and buccal mucosa. Cheek and lip flexibility of the patient was observed to be reduced. Electric pulp testing showed delayed response in the tooth # 37 suggestive of pulp necrosis. Tooth #36 showed severe tenderness to percussion test. IOPA radiograph showed grossly decayed #36 and caries involving pulp with 2 roots, mesial and distal in tooth #37 (Figure 5). Extraction of tooth #36 and endodontic treatment in tooth #37 was advised to patient and her informed consent was obtained. Two weeks after extraction of tooth #36, patient was reported for root canal treatment in tooth #37.

Figure 5: Pre-Operative IOPA Radiograph of Tooth #36 And 37.

Restricted mouth opening made the rubber dam application difficult. Thus, under possible isolation access cavity was prepared after securing local anaesthesia. Examination of the pulpal floor showed single C-shaped canal orifice, extending buccolingually without isthmus (Figure 6). Due to limited mouth opening it was difficult to take working length radiograph, thus working length was estimated using electronic apex locator. Root canals were prepared using flexible NiTi files and Protaper universal rotary files, sequentially up to 6% no 20, F1 Protaper file. A confirmatory radiograph was taken using gutta percha cones placed in canals with great difficulty (Figure 7). 5% sodium hypochlorite was used copiously during entire cleaning and shaping procedure. After NiTi rotary instrumentation, No. 15 K-file was passively introduced and instrumented into the canal for better cleansing. Once cleaning and shaping was accomplished, canal was flooded with 5% sodium hypochlorite and agitated with ultrasonic. Final rinsing was carried out using saline. Obturation was done using 6% standardised gutta percha cones and AH plus sealer. Thermo plasticized Walid's technique was used to seal the C- shaped configuration and post-operative radiograph was taken (Figure 8). Patient was motivated to completely stop tobacco and betel nut chewing habit.

Figure 6: Clinical Photograph of Pulp Chamber of Tooth #37 Exhibiting C-Shaped Canal Orifice.

Figure 7: Master Cone IOPA Radiograph of Tooth #37.

Figure 8: Post Obturation IOPA Radiograph of Tooth #37.

Discussion

C- shaped canal configuration is most common variation reported in mandibular second molars. Anatomical irregularities, such as accessory or lateral canals or presence of an apical delta in a C-shaped canal makes it difficult to clean, shape and achieve 3-dimensional seal [5,30]. Internal irregularities like fins, isthmus prevent through debridement with conventional instrumentation leading to endodontic failure. Thus, thorough chemico-mechanical cleansing is vital in successful management of C-shaped canal [12].

The C-shaped canal configuration was observed more commonly in Asian population with higher prevalence in Koreans ranges from 31.3% to 45.5% and 0.6% to 41.27% in Chinese population [10-15].

Mandibular second molars are most commonly associated with presence of C- shaped Canal configuration in 2.7% - 45.5% population [11,16-18]. Majority of studies were carried out in Chinese population regarding presence of C-shaped canals and mandibular premolars have shown C-shaped canals in 29.7% cases [19-21]. The C-shaped variation is also observed in maxillary third molars [22], mandibular third molars [22,23] mandibular second premolars (1%) [24] and maxillary first molars (0.12%) [25] and having no correlation of C-shaped canal with that of gender, age or tooth position.

In our both cases, IOPA showed false pictures of perforation leading to diagnostic dilemma, which could be then the diagnosed as C-shaped canals. General dentist could not able to manage such anatomical variation without knowledge and magnifying tools. Thus diagnosis, preparation and obturation are critical steps in management of such canals. Because of the irregular and wide area of root canal space, sometimes it is doubtful that instruments could reach and clean the entire portion of this irregularity. Role of irrigant with agitation using ultrasonics thus becomes vital in

debridement of such canals [18]. After NiTi rotary instrumentation, K-file could be passively introduced into the canal and instrumented towards the isthmus areas to facilitate its complete debridement [31].

Obturation of C-shaped canals is critical task due to the various intricacies present within the root canal. Cold lateral condensation technique does not allow deeper condensation and penetration of obturating material in the intricacies [18]. Thermo plasticized gutta-percha technique is proved to be advantageous in obturation of such aberrant root canal anatomy. In this technique, the gutta-percha and sealer were placed into the root canal system under a hydraulic force [32]. In our cases, Walid's technique of obturation was used which involves placing the master cones simultaneously in the C-shaped canal. Searing of master cone is done with a large plugger and other master cone is down packed with a smaller plugger. Then the smaller plugger is withheld in place while the other cone is down packed. This creates backpressure on the gutta percha material and improves the seal. In our and like cases, as the pulp chamber present is too apically, bonded amalgam or composite could be a better choice as the final restoration in such teeth [33].

Cases were referred to the Endodontist usually due to canal difficulty or unusual, aberrant root canal anatomy. Cases have higher level of difficulties when they are associated with other anatomic or pathologic factors. OSMF is one of the potentially malignant diseases of oral cavity, characterized by inability to open mouth widely due to formation of thick fibrous bands in the oral mucosa. Prevalence of OSMF in India is documented to be 0.2% to 0.5% [34,35]. OSMF is found in correlation with, betal nut (areca nut) chewing in 73.3% [36] ingestion of chilies or spicy food, autoimmunity, genetic disorder, nutritional deficiency, collagen disorders and changes in salivary composition. OSMF patient usually complains of burning sensation and characterized clinically by blanching and stiffening of oral mucosa, reduced tongue movement with depapillation and progressive reduction of mouth opening [37,38].

Endodontic treatment in OSMF patient becomes challenging task requiring high skills and training. In presented cases, due to inability to place IOPA film in oral cavity properly or radio-visiography sensor and patient's refusal for CBCT complicated the diagnosis and treatment. Using flexible sensors for radiographs and using electronic methods to measure working length could be helpful and better alternative to conventional IOPA in OSMF patients. When conventional radiographs are difficult to take due to limited mouth opening CBCT usually help reveal internal anatomy. Rubber dam application with clamps sometimes obstruct the available working area, thus rubber dam may be stabilized using wedjets or tying floss to concern and adjacent teeth. Using small head handpiece, small length burs, bending hand files at a desirable angle or using flexi files may help in access and canal preparation. For general dentist, it should be remembered that, sufficient time must be given to the OSMF patient to relax their masticatory muscles in between the treatment procedure, which would be more effective in reducing post endodontic pain due to muscle fatigue. Magnifying tools such as loupes or dental operating microscope, enlarges the image without much interference in the operating filed and providing additional advantage of co-axial illumination in restricted mouth opening, thus must be used to manage root canal treatment in OSMF cases. Conclusively, to manage such difficult cases effectively, general dentist may refer the cases to specialist whenever situation demands.

Usually due to restricted mouth opening and presence of burning sensation of oral mucosa, patient neglect oral hygiene practice resulting into poor oral hygiene and multiple carious teeth as observed in our cases. Patients should be instructed to stop betel nut chewing habit and motivated for proper oral hygiene methods.

Conclusion

Endodontic management of C-shaped root canal system demands some modification at every stage of the preparation. Magnification using loupes or Dental Operating Microscope provides valuable information in identification of the anatomy or the variation regarding the floor of pulp chamber and orifice locations [39].

Though treating patients with difficulty in mouth opening are the challenging tasks for the general dentist an Endodontist could manage the cases such as OSMF with C- shaped root canal configuration with ease and practice and thus referral must be made to specialist whenever it is required. Identification, gaining access, cleaning, shaping of root canal and obturation are the critical issues in C-shaped canal configuration with OSMF. Use of ultrasonic instruments to agitate the irrigant, dissolves the pulp tissue from the isthmus area and ramifications thus eliminate microorganisms and prevent re-infection. Obturation using thermo plasticized technique fill the spaces of the lacunae, isthumi and ramifications and achieve three-dimensional seal in C-shaped root canals.

Conflict of Interest

No conflict of interest exists.

Bibliography

1) VIEIRA MVB., *et al.* "C-shaped canal". an anatomical variation. RBO 55.4 (1998): 204-208.

2) COOKE HG and COX FL. "C-shaped mandibular canal configurations in molars". *The Journal of the American Dental Association* 99.5 (1979): 836-839.

3) DANKNER E., *et al.* "Bilateral C-shaped configuration im maxillary first molars". *Journal of Endodontics* 16.12 (1990): 601-603.

4) DEMOOR RJ. "C-shaped root canal configuration in maxillary first molars". *International Endodontic Journal* 35.2 (2002): 200-208.

5) Manning SA. "Root canal anatomy of mandibular second molars. Part II: C-shaped canals". *International Endodontic Journal* 23.1 (1990): 40-45.

6) Haddad GY., *et al.* "Diagnosis, classification, and frequency of C-shaped canals in mandibular second molars in the Lebanese population". *Journal of Endodontics* 25.4 (1999): 268-271.

7) Barnett F. "Mandibular molars with C-shaped canal". *Endodontics and Dental Traumatology* 2.2 (1986): 79-81.

8) Fischlschweiger W and Clausnitzer E. "Root formation in molar teeth of the CD-1 mouse". *Journal of Endodontics* 14.4 (1988): 163-168.

9) Orban B and Mueller E. "The development of bifurcation of multirooted teeth". *The Journal of the American Dental Association* 16.2 (1929): 297-319.

10) Seo MS and Park DS. "C-shaped root canals of mandibular second molars in a Korean population: Clinical observation and *in vitro* analysis". *International Endodontic Journal* 37.2 (2004): 139-44.

11) Yang ZP., *et al.* "C-shaped root canals in mandibular second molars in a Chinese population". *Endodontics and Dental Traumatology* 4.4 (1988): 160-163.

12) Jin GC., *et al.* "Anatomical study of C-shaped canals in mandibular second molars by analysis of computed tomography". *Journal of Endodontics* 32.1 (2006): 10-13.

13) Zhang R., *et al.* "Use of conebeam computed tomography to evaluate root and canal morphology of mandibular molars in Chinese individuals". *International Endodontic Journal* 44.11 (2011): 990-999.

14) Zheng Q., *et al.* "C-shaped root canal system in mandibular second molars in a Chinese population evaluated by cone beam computed tomography". *International Endodontic Journal* 44.9 (2011): 857-862.

15) Wang Y., *et al.* "Incidence of C-shaped root canal systems in mandibular second molars in the native Chinese population by analysis of clinical methods". *International Journal of Oral Science* 4.3 (2012):161-165.

16) Manning SA. "Root canal anatomy of mandibular second molars. Part I". *International Endodontic Journal* 23.1 (1990):34-39.

17) Rahimi S., *et al.* "Root canal configuration and the prevalence of C-shaped canals in mandibular second molars in an Iranian population". *Journal of Oral Science* 50.1 (2008): 9-13.

18) Weine FS. "The C-shaped mandibular second molar: Incidence and other considerations. Members of the Arizona Endodontic Association". *Journal of Endodontics* 24.5 (1998): 372-375.

19) Velmurugan N and Sandhya R. "Root canal morphology of mandibular first premolars in an Indian population: A laboratory study". *International Endodontic Journal* 42.1 (2009): 54-58.

20) Khedmat S., *et al.* "Root canal morphology of the mandibular first premolar in an Iranian population using cross-sections and radiography". *Journal of Endodontics* 36.2 (2010): 214-217.

21) Sandhya R., *et al.* "Assessment of root canal morphology of mandibular first premolars in the Indian population using spiral computed tomography: An *in vitro* study". *Indian Journal of Dental Research* 21.2 (2010): 169-173.

22) Sidow SJ., *et al.* "Root canal morphology of human maxillary and mandibular third molars". *Journal of Endodontics* 26.11 (2000): 675-678.

23) Kuzekanani M., *et al.* "Root and canal morphology of mandibular third molars in an Iranian population". *Journal of Dental Research, Dental Clinics, Dental Prospects* 6.3 (2012): 85-88.

24) Yu X., *et al.* "Cone-beam computed tomography study of root and canal morphology of mandibular premolars in a western Chinese population". *BMC Medical Imaging* 12 (2012): 18.

25) Cleghorn BM., *et al.* "Root and root canal morphology of the human permanent maxillary first molar: A literature review". *Journal of Endodontics* 32.9 (2006): 813-821.

26) Sabala CL., *et al.* "Bilateral root or root canal aberrations in a dental school patient population". *Journal of Endodontics* 20.1 (1994): 38-42.

27) FAN B., *et al.* "C-shaped canal second system in mandibular molars: Part I - Anatomical features". *Journal of Endodontics* 30.12 (2004): 899-903.

28) YANG Z-P., *et al.* "Mandibular C-shaped root canals in second molars in the Chinese population". *Endodontics and Dental Traumatology* 4.4 (1988):160-163.

29) MELTON DC., *et al.* "Histological Anatomical and features of C-shaped canals in mandibular second molars". *Journal of Endodontics* 17.8 (1991): 384-388.

30) Cheung GS., *et al.* "Morphometric study of the apical anatomy of C-shaped root canal systems in mandibular second molars". *International Endodontic Journal* 40.4 (2007): 239-246.

31) Yin X., *et al.* "Micro-computed tomographic comparison of nickel-titanium rotary versus traditional instruments in C-shaped root canal system". *Journal of Endodontics* 36.4 (2010): 708-712.

32) Ruddle JC. "Three-dimensional obturation of the root canal system". *Dentistry Today* 11.3 (1992):28, 30-3, 39.

33) Walid N. "The use of two pluggers for the obturation of an uncommon C-shaped canal". *Journal of Endodontics* 26.7 (2000): 422-424.

34) Khan S., *et al.* "Pathogenesis of oral submucous fibrosis". *Journal of Cancer Research and Therapeutics* 8.2 (2012): 199-203.

35) Yoithapprabhunath TR., *et al.* "Pathogenesis and therapeutic intervention of oral submucous fibrosis". *Journal of Pharmacy and Bioallied Sciences* 5 (2013): S85-S88.

36) Santosh Patil and Sneha Maheshwari. "proposed new grading of oral submucous fibrposis based on cheek flexibility". *Journal of Clinical and Experimental Dentistry* 6.3 (2014): e-255-58.

37) More CB., *et al.* "Proposed clinical classification for oral submucous fibrosis". *Oral Oncology* 48.3 (2012): 200-202.

38) Tilakaratne WM., *et al.* "Oral submucous fibrosis: review on aetiology and pathogenesis". *Oral Oncology* 42.6 (2006): 561-568.

39) BÓVEDA C., *et al.* "Root canal treatment of an invaginated maxillary lateral incisor with C-shaped canal". 30.10 (1999): 707-711.

Volume 1 Issue 2 July 2017