ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 06 | June - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

C-SHAPED CANALS IN MANDIBULAR SECOND MOLARS: A CASE SERIES

Dental Science

Ghosh S* Senior Lecturer, Department of Conservative Dentistry and Endodontics, Gurunanak Institute of Dental Sciences. *Corresponding Author

Uke M Consulting Maxillofacial Surgeon, B.R. Singh Hospital, Sealdah, Kolkata.

ABSTRACT

The mandibular molars are more prone to aberrations of canals. They include bifurcation and trifurcation of canals, fusion of roots, extreme canal curvatures and c-shaped canals which makes it difficult to diagnose and manage. The failure to treat them leads to re-infection and persistence of infection in the tooth. Hence, it is of utmost importance for the clinician to know the morphologic variations. The present case series aims to give a clinical insight of such aberrations. The ten cases presents with mandibular second molar with "c" shaped root canal system, which was diagnosed with Radiovisiography. The cases were treated endodontically and successfully managed.

KEYWORDS

mandibular second molar, "c" shaped root canals, two root canals, molars.

INTRODUCTION

A characteristic anatomical variant of the root canal system with a connection of the root canals by a fin or web-like structure forming a C shape at the canal orifice is called a C-shaped root canal system(Fan B *et al*, 2004). Canal configuration has a high prevalence in mandibular second molars (2.7% - 45.5%) (Weine FS, 1998).

The C-shaped canal configuration has racial predilection. Higher incidence reported in countries belonging to the Asian continent like Chinese (31.5%) and Koreans (44.5%) (Seo MS, 2004 and Zhang R *et al*, 2011).

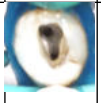
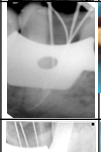
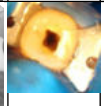
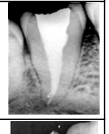
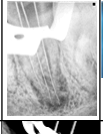
The term "C-shaped canal" was first termed by Cooke and Cox in 1979 to describe the cross-sectional morphology of roots that resembled letter C (Cooke HG *et al*, 1979). During the stage of root development the Hertwig's epithelial sheath determines the shape and the number of roots. It bends in a horizontal plane below the cemento- enamel junction and fuses in the center leaving openings for roots. Failure of fusion on the lingual or buccal root surface is the main cause of C-shaped root which has C shaped canal. But a C-shaped root can also be formed by deposition of the cementum over time and has normal canal configuration (Melton DC, 1991).

The prevalence of C shaped canals in Indian population was observed in a study by Neelakantan et. al., found to be 7.5% of the teeth examined of which 54.84% of the teeth had two apical foramina, and one specimen (3.8%) of the C-shaped roots showed three apical foramina. An analysis by CBCT evaluation showed that 9.7% of second molars and 8% of third molars had C-shaped canals and a prominent buccal groove was seen in these teeth (Haddad GY, 1999).

C shaped root canal system is often difficult to evaluate with pre-operative radiographs. Though it has a typical pulp chamber which is large in the occlusoapical dimension with a low bifurcation, the semicolon-type C-shaped root canals are hard to analyse due to proximity of two roots or a large distal root canal or a narrow mesial root canal and a blurred image of a third canal in-between (Haddad GY, 1999). CBCT plays a vital role in such cases and gives an insight into the canal configuration with the help of 3D imaging. Following root canal diagnosis, the access cavity is often critical to the success of a root canal procedure. The use of an operating microscope results in more effective treatment due to clear visualization of canal orifice thereby aid in effective cleaning and shaping (Kato A *et al*, 2014). Awareness of the complexity of the root canal system will enhance the capability of identification of the variation. The occurrence of "C" shaped root canal is relatively rare and so the purpose of this report is to provide an insight on clinical management of such cases.

CASE REPORT

Ten patients with no relevant medical history in the age group of 20–50 years in whom mandibular second molar were indicated for root canal treatment and who consented for the treatment were selected. For root canal therapy, the tooth was anesthetized using 2% lignocaine containing 1:80:000 epinephrine (LIGNOX 2% a Indoco Remedies Ltd., India) and isolation with rubber dam was accomplished, an access cavity was prepared under Carl Zeiss Magnification Loupes at 2.5X magnification (Germany),. Pulp chamber was irrigated with 2.5% sodium hypochlorite (Vishal Dentocare, Pvt Ltd, Ahmedabad, India). Working length was determined using electronic apex locator (Root ZX, J. Morita CO, Tustin, CA) and radiographs. Cleaning and shaping was done with hand K files (Dentsply Maillefer, Switzerland) and with ProTaper Gold rotary files (Dentsply Maillefer, Ballaigues, Switzerland). After completing the preparation, the canals received a final rinse of 10 ml 17% EDTA (Dentwash, Prime Dental Products Pvt Ltd, India) followed by 10 ml of 2.5% sodium hypochlorite (Vishal Dentocare, Pvt Ltd, Ahmedabad, India) and the canals were dried with paper points (Protaper Universal Absorbent points, Dentsply, Tulsa Dental, United States). Master cone apical fit was confirmed with a radiograph. Sealapex (Kerr, Dental) sealer was mixed according to manufacturer's instructions and applied with a lentulo spiral (Dentsply Maillefer, Ballaigues, Switzerland). The obturation was done with either lateral compaction technique using gutta-percha cones (Dentsply, Tulsa Dental Specialities, United States) or thermoplasticized gutta-percha (Calamus, Dentsply, Tulsa Dental Specialities, United States) or a combination of both. Postendodontic restoration was done after 1 week of obturation using either composite resin (Tetric N-Ceram, Ivoclar Vivadent, Mumbai, India) or Miracle Mix (GC, America).

Patient	Pre-operative	Working Length	Pulp chamber floor	Mastercone	Obturation
A					
B					
C					
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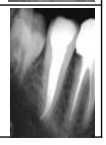
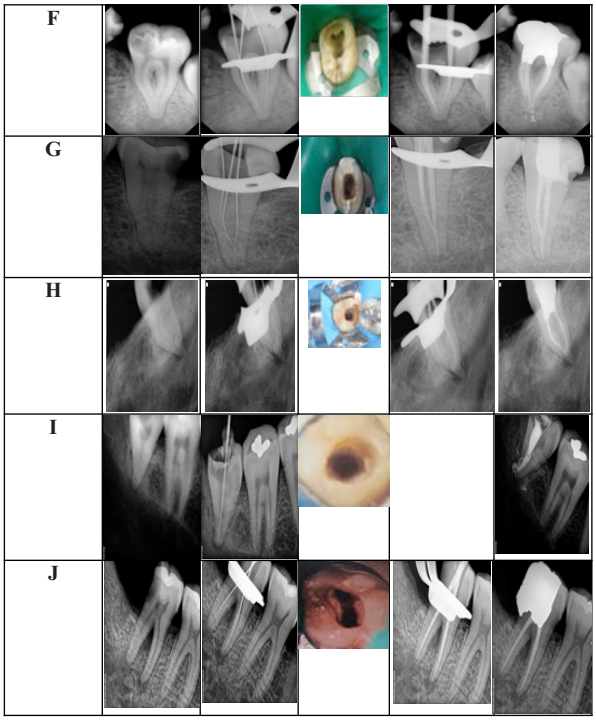
E					



DISCUSSION

The main cause of C-shaped roots is the failure of the Hertwig's epithelial root sheath to fuse on the lingual or buccal root surface, giving rise to a C-shaped canal anatomy. It may also be formed by coalescence because of deposition of the cementum with time. What appears to be C-shaped canals is just a fusion of mesial and distal roots which can happen on the buccal or lingual aspect. The two roots remain connected and the fusion is irregular. The connection of the roots is by an inter-radicular ribbon. It may be a single continuous canal or a "C"-shaped groove with two or three canals (Jafarzadeh H, 2007).

It appears from the available literature that majority of mandibular second molars with C-shaped canal system showed an orifice with an uninterrupted "C" configuration and Jin et al., in 2006, reported an incidence of 44.5% of the continuous C-shaped canal (Fan B, 2004). Radiographically, 30% of mandibular second molars showed type I radiographic image, 40% type II, and 30% type III (Fan B *et al*, 2004).

When considering the C-shaped mandibular second molar, the most studied C-shaped location; it has been documented that this morphologic configuration has significant ethnic variation. In the White population, the incidence ranges from 2.7% to 7.6%; in the Lebanese population, 19.1%, a reported 31.5% in the Chinese population, and 44.5% in Koreans. These types of configurations have a bilateral incidence of 70% (Martins JN *et al*, 2013).

The reported cases in this article represent three different types of C-shaped configurations according to Fan's classification (Figure 1 and 2). The challenge during treatment of such cases is accurate diagnosis and a proper method of cleaning and shaping followed by obturation.

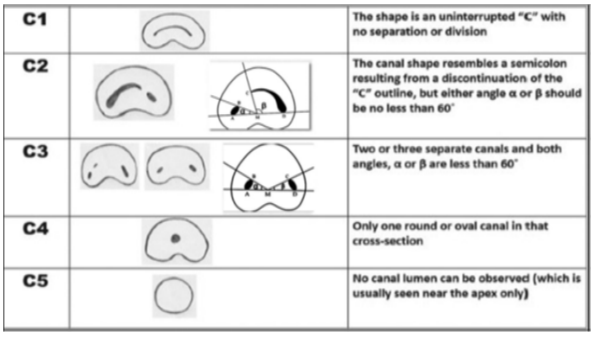


Figure 1: Fan's anatomic classification: (a) Category I- C1, (b) Category II- C2, (c) Category III- C3, (d) Category IV- C4, (e) Category V- C5

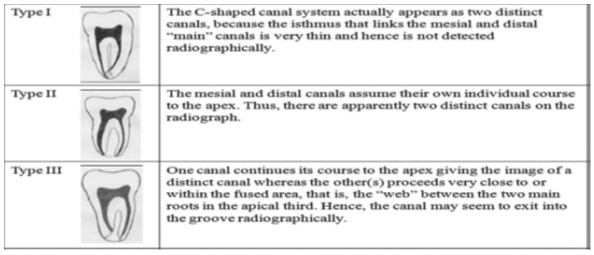


Figure 2: Fan's radiographic classification: (a) Type I, (b) type II, and (c) type III

Various studies show that CBCT; an indispensable tool for the diagnosis of tooth anomalies is far superior to other diagnostic methods as reported by Matherne et al. (2008) CBCT which offers a non-invasive reproducible technique for 3D assessment of root canal systems involves exposure to ionizing radiation. Therefore, it is advised to be used with operating microscope to visualize the internal anatomy in a precise manner to correctly diagnose root canal aberrations. This would also keep the patient's exposure to radiation as low as reasonably achievable (Chhabra S, 2014).

Despite the differences in anatomies in all the five cases, same precautions had to be made concerning the correct cleaning and shaping of the root canal system. Passive ultrasonic irrigation with 5.25% sodium hypochlorite was used to clean the isthmus and grooves; ultrasonic agitation was done to maximize the root canal disinfection (Martins JN *et al*, 2013). A combination of different obturation techniques has been used for a better approach. As long as the basic principles of root canal preparation and crown rehabilitation are followed, the outcomes of the endodontic treatment on the C-shaped anatomies are similar to other anatomies.

CONCLUSION

One of the great challenges faced is diagnosing C-shaped canals and its management. However, with the help of magnification, illumination, and other newer diagnostic methods difficult to detect configurations like C-shaped canals can be treated effectively. Proper access cavity preparation, meticulous mechanical and chemical debridement, and a three-dimensional obturation should be carried out to successfully manage canals with C-shaped configurations.

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