

Change in Morphologic Configuration of C-Shaped Canals in Mandibular Third Molars in an Indian Subpopulation-A Retrospective CBCT Analysis

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Abstract

Aim: Third molar teeth were prophylactically extracted to compensate for the evolutionary reduction in jaw size. However, due to advances in therapeutic options and recent investigative methods, patients are being given an option for varying treatment of the teeth as indicated. They commonly present a wide variety of anatomical variations including multiple canals, isthmi and apical deltas and hence the need to know their varied root canal morphology.

Materials and Methods: In this study, 238 mandibular third molar teeth were investigated by Cone Beam Computed Tomography especially for the presence of C-shaped canals and their configurations analysed.

Results: The population group examined showed a high percentage of C-shaped canals. The presence of these canals was higher in females. A buccal groove was seen in 04 (21.1%), lingual groove in 06 (31.6%) and both the grooves in 09 (47.4%). At the coronal level, 47.4% of cases showed a C4 configuration. The middle third mostly exhibited a C3 (d) configuration with a prevalence of 31.6%. At the apical third, C3 (d) canal morphology was seen in 42.1% of teeth.

Conclusion: A high percentage of C-shaped canals was observed in the population group which warrants advanced diagnostic aids and treatment protocols if these teeth have to be preserved in the oral cavity.

Keywords: Root Canal Morphology; Third Molar Teeth; C-Shaped Canals; Cone Beam Computed Tomography; Prevalence

Introduction

Third molar teeth show a wide variation in occlusal and root canal morphology and are an area of current research interest due to patient and clinician's need to preserve more of the natural dentition in the arch. They are frequently treated by the endodontist for orthodontic, prosthodontic and functional requirements [1,2].

C-shaped canals are an enigma in itself more so in the third molars. They were first reported by Cook and Cox in 1979. The earliest classification of C-shaped canals was proposed by Melton, *et al.* in 1991 based on their cross-sectional anatomy. Fan, *et al.* analysed the C-shaped canal system along their length using micro-CT and modified the classification of the C-shaped canal system into five categories.

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They stated that this type of canal system had to exhibit all of the following three features:

- (i) Fused roots;
- (ii) A longitudinal groove on the lingual or buccal surface of the root and
- (iii) At least one cross-section of the canal belonging to the C1, C2 or C3 configuration [3-5].

This study on mandibular third molars, one of the least examined teeth morphologically observes the prevalence of C-shaped canals, their presenting appearance and configuration patterns along the length of the root by cone beam computer tomographic scans.

Materials and Methods

The approval for the project was taken from The Institutional Ethical Committee of People's College of Dental Sciences and Research Center, Bhopal (Ref. No. PCDS/ACAD/8/2015/063-064).

Source of data: CBCT scans of 238 patients along with the foresigned consent forms were collected from a private CBCT Centre in Bhopal.

Method of collection of data:

Inclusion criteria:

- 1) CBCT scans of mandibular third molars with complete root formation.
- 2) Fused roots, presence of groove and atleast one cross-section with C1, C2 or C3 configuration.

Exclusion criteria: Presence of root canal fillings, a periapical lesion or deep caries associated with mandibular third molars.

The CBCT images were scanned using Kodak CS 3D 9000 Imaging Software and then analyzed.

These scans were taken according to the manufacturer's recommended protocol using a minimum field of view of 40 mm × 40 mm or 60 mm × 60 mm and lowest dose radiation. The images were analyzed with the inbuilt CS3D imaging software (NNT) in a HP workstation (HP Compaq LE 1911) with a 19 inch HP LED screen and a resolution of 1280 × 1024 pixels on a dual monitor. The scans were assessed and evaluated by three endodontists and a trained radiology technician simultaneously and the findings were interpreted.

The canal system was defined as C shaped if the root exhibits all 3 criteria defined by Fan., *et al.*

Images were rotated in the entire axis of all the three planes-coronal, sagittal and axial to confirm the findings [6,7]:

- The frequency of the C shaped canals and the distribution of this frequency with respect to gender, tooth position and root morphology was examined along with the configuration at 3 different levels after which the data was analyzed statistically.
- Frequencies and percentages of variables were calculated. Data was further analysed using Fisher's exact test. P value < 0.05 was considered statistically significant.

Results

Prevalence of C-shaped canals in mandibular third molars was 8.0% among study subjects i.e. 19 patients of the total of 238 were observed C-shaped canals.

Correlation with gender: Of total 96 (100%), 04 (4.2%) males and 142 (100%) females, 15 (10.6%) had C-shaped canals in the mandibular third molars in this population group. Although the presence of these canals was more among the female population studied, no significant difference was noted statistically among males and females.

Root morphology of C-shaped canals in mandibular third molars among study subjects: In the third molar teeth evaluated, buccal groove was seen in 04 (21.1%), lingual groove in 06 (31.6) and both the grooves in 09 (47.4%).



Figure 1: C-shaped canal seen in left lower third molar along with the presence of a buccal and lingual groove.

Cross-sectional canal shapes of C-shaped canals at different levels in mandibular third molar

The coronal level of mandibular third molars observed exhibited varying configurations. 47.4% of cases showed a C4 configuration followed by C3 (d) and C3 (c) which were seen in 31.6% and 10.5% of cases respectively. There was an equal distribution of C1 and C2 types with a prevalence of 5.3% at the coronal level.

The middle third mostly exhibited a C3 (d) configuration with a prevalence of 31.6%, followed by equal percentage of C3 (c) and C4 with 21.1% of cases showing the same. This was followed by C2 and C1 canal types with a percentage variation of 15.8% and 10.5% respectively.

At the apical third, C3 (d) canal morphology was seen in 42.1% of teeth, C3 (c) type in 21.1% of them, C4 variation in 15.8% and C1 and C2 with an equal distribution of 10.5%.

The configuration remained unchanged throughout the entire canal in 5 teeth.

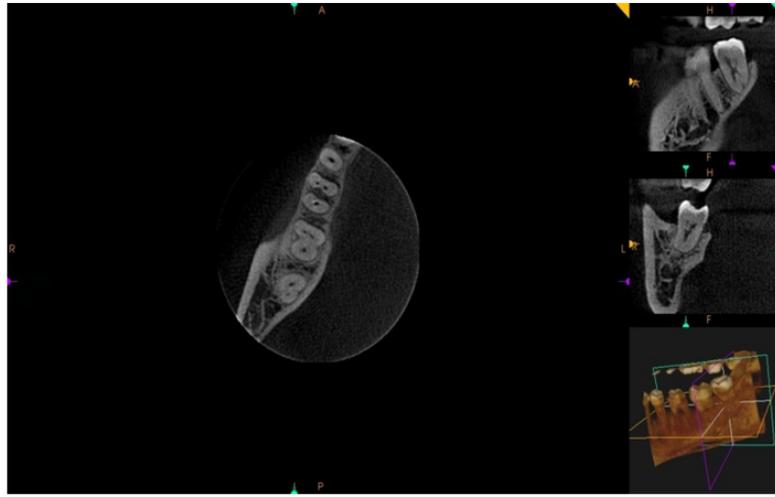


Figure 2: C-shaped canal in the right lower third molar with different configurations at various levels.

Discussion

Variations in root canal morphology are an interesting occurrence in endodontics, and is of anthropological significance for researchers. Many techniques have been used to evaluate root canal anatomy both *in vivo* and *in vitro* [8-10]. In comparing laboratory and clinical findings CBCT has the advantage of being non-invasive and research can be conducted on the scans of patients undergoing exposure for routine diagnostic and therapeutic needs.

Fan's classification was followed in this study in order to categorise the variations.

C shaped canals have observed in other population groups as follows: Sidow, *et al.* in an *in vitro* studied observed that 2.2% of teeth had C-shaped canals [11,12]. In another laboratory investigation on a Thai population, Gulabivala, *et al.* found 10.9% of single rooted mandibular third molars having C-shaped variants [13].

A study by Ahmed in a Jordanian population sample observed 4.3% of C-shaped canals in third molars. It was observed that 8% of the population examined had C-shaped variations which is close to that observed by Gulabivala in the Thai population. In this study, the variation of these canals along their root length was considered. 4% showed a C4 variation in the coronal third, 31.6% showed a C 3(d) variation in the middle third and 42.1% in the apical third also showed a C 3(d) configuration [14].

The presence of buccal or lingual grooves also has clinical significance.

31.6% of the teeth showed a deeper invagination on the lingual aspect whilst 47.4% showed the presence of both buccal and lingual grooves. These grooves represent the areas of incomplete fusion between the mesial and distal roots on the buccal or lingual side hence giving rise to a fin connecting the roots leading to the C-shaped anatomical variation.

Clinical considerations

Diagnosis of C-shaped canals is a challenge during endodontic treatment. Once diagnosed, the cleaning and shaping procedures require utmost care. Access cavity preparations are usually deeply located while exposing all the orifices of the root canals [15].

Use of Ni-Ti hand files in a circumferential filing method and adequate irrigation with ultrasonic agitation debrides most of the fins and otherwise hard to reach ramifications of the canal system. Self-Adjusting file system was introduced in an effort to adapt to the size and shapes of such canals to enhance removal of debris. Rotary files must be used with caution as their large taper can cause strip perforations in the narrow sections of the root canal. Gates glidden drills must also be used judiciously avoiding the isthmus regions of the root canal.

The presence of the deep invagination either on the buccal, lingual or both sides leaves a thin amount of dentine around the root canal. Anti-curvature filing is indicated in these regions and hence it is useful to examine cone beam tomographic slices to observe the location of these deep grooves.

Thermoplasticised gutta percha is recommended for use during obturation with a down pack-backfill method after establishment of a good apical seal which is critical especially in such type of canals. Apical gauging should be done and a custom fit master apical cone should be used since the apical foramen is seldom round in these canals.

Posts rarely if indicated are more appropriate to be placed in the wider and relatively straight distal canal to avoid untoward dissipation of forces. Endodontic surgery is usually contraindicated in such teeth due to the absence of furca wherein hemisection and root amputation procedures cannot be done and the sealing of the remainder of root surface a difficult proposition. Hence if endodontic surgical procedures are required, it should be done extra-orally, retrofilled adequately and the tooth reimplanted [16].

Conclusion

The Indian population group involved in the analysis has a high percentage of C-shaped canals compared to studies conducted in other ethnic groups. Cone beam computer tomography is useful in observing variations of these canals in different regions making clinicians more aware and confident in their treatment approach resulting in predictable treatment outcomes.

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