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Evaluation of Root and Root Canal Morphology of Mandibular Second Molars Among Jodhpur Population Using CBCT

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ABSTRACT

Aim: The aim is to use cone-beam computed tomography (CBCT) to evaluate the prevalence and anatomical features of C-shaped canals in permanent Mandibular second molars amongst members of a Jodhpur population.

Materials and Method: A total of 211 extracted Mandibular second molars in Jodhpur population were collected from the Jodhpur dental college general hospital, Jodhpur. To integrate the sample positions, the teeth were mounted in molds made of modeling wax in a row of 7 or 8. Teeth were so arranged as to maintain the apices of the roots of each row in a single plane and so that all the teeth (7-8 teeth) can come in 1 CBCT. Mounted teeth were scanned with a Kodak 9000 3D CBCT scanner with exposure parameter of 66 KV and 8mA along with an exposure time of 10.8 seconds.

Results: The results showed that Out of 211 teeth, 9 teeth (4.3%) were single rooted, 202 teeth (95.7%) were two-rooted. In this study, according to Melton's classification, 31 teeth (14.6%, n = 211) had C-shaped canal in mandibular second molar. Of these, 10 teeth (32 %,) had the configuration of Type I, 15 teeth (48%) had Type II, 4(12%) had TypeIII A, 8(25%) had Type III B, 4 teeth (12%) had Type IV configuration.

Conclusion: Present study concludes that there was significant prevalence (14.6%) of C-shaped canals in the mandibular second molars. CBCT scans allow the identification of anatomic features and variations of the root canal system.

Keywords: Cone-beam computed tomography, Mandibular Molars, Morphology, Root canal configuration.

INTRODUCTION

The knowledge of both normal and unusual configuration of the pulp and possible variation is essential for accomplishment of endodontic treatment and lack of such knowledge may lead to treatment failure.[1,2] The C-shaped canal configuration is one of anatomical variation seen in mandibular second molars and can cause serious difficulties in endodontic treatment. The number of studies demonstrated that C-shaped canals in mandibular second molar vary in numberand shape along the root length, making cleaning, shaping, and obturation of these teeth difficult.The main anatomical feature of C-shaped canals is the presence of a fin or web connecting the individual root canals[3].

Cooke and Cox (1979)[3] firstly recognized this anatomical variation and was named as C-

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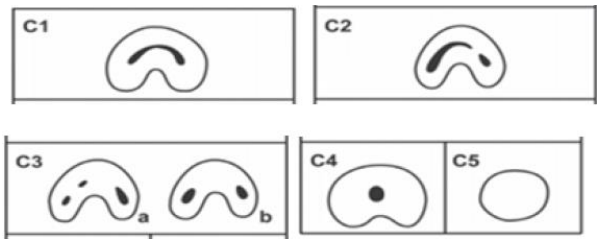

Fig 1: C Shaped canal configuration.

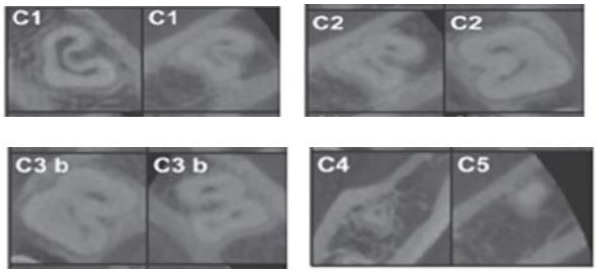

Fig 2: Cross-sectional CBCT images of different types of C-shaped canal configurations, at different root levels.

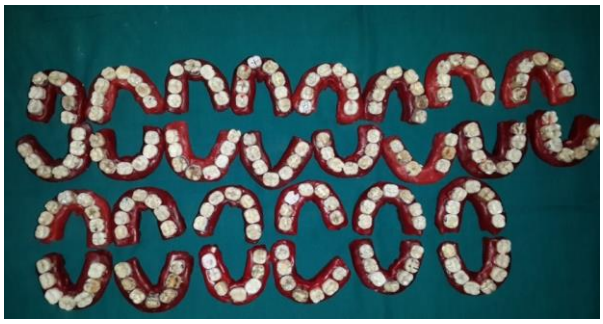

Fig 3: Mandibular 2nd Molars arranged in arch.

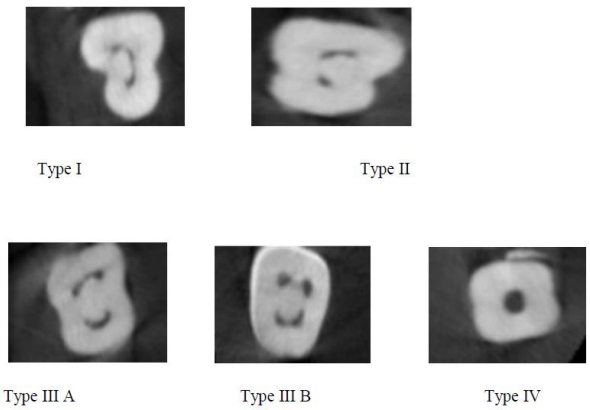

Fig 4: Various C – shaped canals found in this study.

shaped because of cross sectional morphology at the root and root canal, which resembles the English letter C in shape. In its place of having numerousseparate orifices the pulp chamber of C-

Table 1: Number of roots in mandibular 2nd molar (n = 211).

Total number of tooth	Number of roots	Percentage
211	1 root- 9 teeth 2 root -202 teeth	4.3% 95.7%

Table 2: Frequency of C - shaped in mandibular 2nd molar (n = 211).

Total number of teeth	Presence of C-shaped canals	Percentage
211	Type I- 10 teeth Type II-15 teeth Type III A-4 teeth Type IIIB-8 teeth TypeIV-4 teeth	32% 48% 12% 25% 12%

Table 3: Number of canals in mandibular 2nd molar (n = 211).

Total number of tooth	Number of canals	Percentage
211	**Mesial** 1 canal- 0 2 canals-204 teeth 3 canals-7 teeth **Distal** 1 canal-42 teeth 2 canal-164 teeth 3 canals-5 teeth	 0% 96.5% 3.5% 19.9% 77.7% 2.3%

shaped molar is a ribbon shaped orifice with a 180º arc starting at the mesiolingual line angle and curving around the buccal side.[4]

Melton et al (1991)[5] classified the C-shaped canals into three types.

Type I: The continuous C-shaped canal.

Type II: The semicolon shaped canal.

Type III: Two discrete and separate canals.

He further added that C-shaped canals could vary in number and shape along the length of the root.

Subdivision-I: C-shaped orifice in the coronal third that divides into two or more discrete and separate canals that join apically;

Subdivision-II: C-shaped orifice in the coronal third that divides into two or more discrete and separate canals in the mid root to the apex;

Subdivision-III: C-shaped orifice that divides into two or more discrete and separate canals in the coronal third to the apex.

A .Classification of C-shaped canal configurations.[6] (Fig 1)

- ✓ C1: an uninterrupted "C" with no separation or division,
- ✓ C2: a canal shape resembling a semi-column resulting from the discontinuation of the "C" outline,
- ✓ C3: three (a) or two (b) separate canals,
- ✓ C4: only one round or oval canal in the cross-sectional image,
- ✓ C5: no observable canal lumen (usually only found near the apex).

B. Cross-sectional CBCT images of different types of C-shaped canal configurations, at different root levels (Fig 2)

Although traditional radiographs are useful in preoperative assessment of canal anatomy, they are unlikely to show the extent of canal complexities[7].Recently CBCT was reported to be sufficiently precise to perform morphological analyses. Several studies conducted on the frequency of C-shaped canals in mandibular second molar in different population and reported its occurrence from 2% to 40%. There is lack of research on the C-shaped canal configuration in Indian population.

To obtain the three dimensional canal anatomy non destructively, a CBCT scan is done to scan the tooth and produce the root and canal cross-section images, based on which the 3D canal morphology could by reconstructed by using a specialized software.[8]

CBCT technology uses isotropic voxels, which are equal dimensions in all three planes of space, enabling accurate linear geometric and three-dimensional measurements of the data acquired.[9, 10,11,12,13] CBCT is also a non-invasive method that allows accurate information to be obtained without requiring the tooth to be extracted for analysis.[14]

The aim of this study was to assess the frequency of C-shaped canal in Jodhpur population, which is important to increase the quality and success of endodontic treatment in C-shaped molar teeth.

MATERIALS AND METHOD

This descriptive type of study was performed at the Department of Conservative Dentistry and Endodontics, Jodhpur dental college general hospital, Jodhpur.The study was conducted on 211extracted mandibular second molar teeth.

Inclusion Criteria:

· Human mandibular second molars extracted due to periodontal reasonswith intact roots and fully formed apices.

Exclusion Criteria:

- ✓ Fractured teeth
- ✓ Grossly carious teeth with root resorption
- ✓ Teeth with incomplete root formation
- ✓ Endodontically treated teeth

Data Collection Procedure:

A total of 211 extracted mandibular second molars in Jodhpur population were collected from the dental hospitals.

The identification of mandibular second molar was confirmed by two independent observers had more than 10 years clinical experience in tooth morphology/ endodontics.Extracted teeth were stored in 10% formalin (for 2 weeks) for disinfection and all attached soft tissue and calculus were removed using an ultrasonic scaler.All the samples were then rinsed with tap water and dried with air.As this study was carried out on extracted teeth, gender, and age of the patient were not recorded.To integrate the sample positions, the teeth were mounted in molds made of modeling wax in a row of 7 or 8.Teeth were so arranged as to maintain the apices of the roots of each row in a single plane and so that all the teeth (7-8 teeth) can come in 1 CBCT. (Figure 3)

Mounted teeth were scanned with a Kodak 9000 3D CBCT scanner with exposure parameter of 66 KV

and 8mA along with an exposure time of 10.8 seconds.

The following observations were registered:

- ✓ Number of roots.
- ✓ Number of root canals per root.
- ✓ Presence of C-shaped canals.

RESULTS

Total 211 extracted mandibular second molar teeth were selected based on inclusion and exclusion criteria.Out of 211 teeth, 9 teeth (4.3%) were single rooted, 202 teeth (95.7%) were two-rooted. (Table 1).

In the current study, according to Melton's classification, 31 teeth (14.6%, n = 211) had C-shaped canal in mandibular second molar (Table 2). Of these, 10 teeth (32 %,) had the configuration of Type I, 15 teeth (48%) had Type II, 4(12%) had TypeIII A, 8(25%) had Type III B, 4 teeth (12%) had Type IV configuration. The results of present study showed that 204 teeth had 2 mesial canals and 7 teeth had 3 mesial canals whereas 42 teeth had 1 distal canal, 164 teeth had2 distal canal and 5 teeth had 3 distal canals. (Table 3)

DISCUSSION

C-shaped canal is one of the most challenging situations while during performing endodontic treatment. It wasactually Keith (1908) who first described this unusual anatomical variation and later Cook and Cox (1979) demonstrated it more clearly and also described its various categories. The C-shapedconfiguration of the root canal develops as result of partial or complete merging of roots. As this merging process does not necessarily involve all the roots so resulting in the development of a shape resembling a large letter "C", but it can also resemble a small letter "c", which can be found in one or both canals.[15]

According to Cooke & Cox (1979) it was difficult to detect C-shaped canals on the preoperative radiograph. So, in current study an in-vitro method was selected to investigate the C-shaped canal in mandibular second molars. All root canals that conformed to the general structure of a 'C' and occurred in a C-shaped root were described as C-shaped root canals. Morphological variation in the anatomy of the root canal system should be considered at the beginning of root canal treatment. It is generally accepted that a major cause of root canal treatment failure is an inability to locate and adequately treat all canals of the root canal system[16].Many methods are used to investigate the root canal anatomy in vitro and in vivo.

An ideal technique is one that is accurate, simple and nondestructive. Based on all of these factors, radiography has been opted for as the most practical and frequently used method to predict the root canal anatomy. Radiographically, a tooth with a C-shaped canal system always has a fused root with a longitudinal groove in the middle of root[17].

However it is difficult to detect the canal systems of mandibular molars with conventional radiography because the images of the root overlap especially in C-shaped roots, where the radiographic images may appear in diverse manners, depending on the exact nature and orientation of the root. CBCT makes this canal system more predictable, and is a good option clinically speaking, because it can detect C-shaped canal configurations.Therefore, this study used CBCT to evaluate the canal systems of 211 mandibular second molars in Jodhpur population to identify the prevalence of C-shaped canals. C-shaped canals present a complex and irregular space containing potentially infected soft-tissue remnants or debris that may escape normal cleaning and filling procedures. Therefore, when C-shaped canals are identified, they may be debrided and obturated precisely to achieve successful root canal treatment.

It is well known that the prevalence of C-shaped canals is race dependent and more common in Asians.[18]The prevalence of a C-shaped canal in mandibular second molars has been estimated to range from 2.7% to 44.5%, depending on the population and ethnic group:

- ✓ 2.7%–7.6% for American [19,20]
- ✓ 8% for Turkish[21,22]
- ✓ 10.6% for Saudi Arabian[23]
- ✓ 19.1% for Lebanese[24]
- ✓ 31.5% for Chinese[25]

- ✓ 32.7%–44.5% for Korean populations [26,27].
- ✓ 13% for asian population[28]

In the present study different types of C-shaped canals were found according to the modified Meltons method.[29](Fig 4)

CONCLUSION

CBCT scans allow the identification of anatomic features and variations of the root canal system. There was significant prevalence (14.6%) of C-shaped canals in the mandibular second molars in the present study. C-shaped canal systems varied considerably in regard to anatomical configuration, with a higher prevalence of three and two canals.CBCT can be a useful clinical tool for performing endodontic diagnosis and treatment when conventional radiographic views produce limited information and further radiographic details are required for endodontic diagnosis and treatment planning.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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