Prevalence and Configurations of C-Shaped Canals in Permanent Mandibular Second Molars in a Saudi Arabian Population: A CBCT Study

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ABSTRACT

Objective: To evaluate the prevalence and configurations of C-shaped canals in permanent mandibular second molars using cone-beam computed tomography (CBCT).

Material and methods: CBCT images of 171 patients comprising 326 permanent mandibular second molars were evaluated for the presence of C-shaped root canals. Of the 171 CBCT images examined, 16 had a unilateral intact molar, and 155 had bilateral molars in which the distribution of unilateral and bilateral occurrences of C-shaped canals was analyzed respectively. Chi-square test was used to correlate the prevalence of the C-shaped canals with gender and age, and also to correlate the number of the canals with the direction of the root grooves.

Results: A total of 12.57% of teeth and 18.71% of patients showed a C-shaped canal. No significant difference in the distribution between the gender and age groups was noted. Majority of the C-shaped molars had three (36.58%) followed by two (31.70%) canals, mainly with root grooves in a buccal direction (80.48%) in comparison to lingual (19.51%).

Conclusion: The prevalence of C-shaped canals in the mandibular second molars was 12.57% with varying anatomical configuration, majority of these were having three and two canals and most of the teeth the C-shaped canals were grooved in the buccal direction.

KEY WORDS

mandibular second molar, morphology, Cone-Beam Computed Tomography

INTRODUCTION

The variability of the root canal anatomy poses clinical challenges for endodontic therapy, so adequate preoperative knowledge of pulpal anatomy and its variations are necessary for successful outcome of endodontic therapy. The structural changes of the root canals throughout the length of a root present major difficulty for extensive debridement and proper obturation of the root canal⁵,⁶. C-shaped canals are among these anatomical variations that were first introduced by Cooke and Cox in 1979⁷. The C-shaped canal system may be observed in upper molars, upper and lower bicuspids, but most frequently found in mandibular second molars⁸. The C-shaped canals manifests as the presence of a fin or web joining individual mesial and distal canals, leading the canal axial section to resemble a C-shape, and which hinders thorough cleaning, shaping, and obturation⁹,¹⁰. Thus, correct diagnosis and identification of the C-shaped root canal before endodontic therapy is an essential step to facilitate more effective management of the teeth. The variation of C-shaped root canal system appears to be genetically determined, and its relationship with ethnic origin has been proposed in the literature⁶. There are different methods for studying the morphology of human permanent teeth in vitro and in vivo. It has been suggested that specific radiographic characteristics could help predict the existence of C-shaped root canal systems⁵. A previous study conducted among a Saudi Arabian population evaluated the root canal configuration of mandibular second molars scheduled for root-canal treatment by examining clinically and radiographically⁴. Cooke and Cox proposed that it is impossible to diagnose C-shaped canals based on pre-operative radiographs⁷ and other studies showed that only a small percentage of C-shaped mandibular

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second molars were recognized on radiographs. With this background, we carried out this study to evaluate the prevalence and configurations of C-shaped canals in the permanent mandibular second molars of a Saudi Arabian population by using cone beam computed tomography.

MATERIALS AND METHODS

This retrospective observational study was carried out in College of Dentistry, Jouf University, Kingdom of Saudi Arabia. Ideal quality CBCT scans, with field of view in which the mandibular second molars could be seen were interpreted. All the mandibular second molars with fully developed roots and without periapical pathologies were included. Teeth with root canal therapy, root canals with open apices, resorption of grooves, and without periapical pathologies were included. CBCT scans, with field of view in which the mandibular second molars and without periapical pathologies were included. The observer reliability was very good, with Kappa values of 0.94 and 0.82 for intraoperator and interoperator agreement respectively. The findings were analyzed using the computer program, SPSS 21.0.

In this study the occurrence of C-shaped canals in permanent mandibular second molars in a Saudi population was found to be 12.57%, as mentioned in table 3. The frequency of C-shaped canals in mandibular second molars by age is mentioned in table 2. The association between the age groups and gender (p > 0.05) (Table 1). The frequency of C-shaped canals in mandibular second molars by age and sex difference (p < 0.05) as mentioned in table 3.

An awareness and understanding of root canal morphology can contribute to the successful result of root canal therapy. Numerous methods were employed in different studies to evaluate the morphology of human teeth. Some studies were carried out on extracted or endodontally treated teeth. Anatomical changes in roots of a tooth may be identified by careful interpretation of the radiographs. Even though radiography is the more popular method till date evaluate the morphology of human teeth but their value in diagnosing C-shaped canals is not universally accepted, this might be due to the resultant two-dimensional image of the teeth and superimposition. CBCT is the newer imaging modality which provides three dimensional imaging with more accuracy and specificity without superimposition.

In this study the occurrence of C-shaped canals in permanent mandibular second molars in a Saudi population was found to be 12.57%, but this finding was less than the frequency reported by Ladeira et al., (4.6%) in Israeli population using CBCT. As compared to our study, a lower value (10.6%) was noted by the previous study carried out by Al-Fouzan in Saudi Arabian population by clinical and radiological examinations methods, this discrepancy may be explained by difference in the sample size and the technique used.

With the use of conventional methods a varying percentage of C-shaped canals were reported in different populations, Gulabiwala et al., reported 3% to 6% in Srilankan population by using clearing technique and Peiris et al., reported 10% in Sudanese and Peiris et al., reported 7.55% in Indian, Ahemad et al., reported 10% in Sudanese and Peiris et al., reported a frequency of 3% to 6% in Srilankan population by using clearing technique.

Wang et al., observed a high frequency of 34.64% of C-shaped

DISCUSSION

Table 1. Frequency of C-shaped canals in mandibular second molars by gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>C shaped canal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>5.82</td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
<td>6.74</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>12.57</td>
</tr>
</tbody>
</table>

P = 0.6123, non-significant

Table 2. Frequency of C-shaped canals in mandibular second molars according to different age groups

<table>
<thead>
<tr>
<th>Age group</th>
<th>C shaped canal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>19-28</td>
<td>6</td>
<td>1.84</td>
</tr>
<tr>
<td>29-38</td>
<td>21</td>
<td>6.44</td>
</tr>
<tr>
<td>39-48</td>
<td>10</td>
<td>3.06</td>
</tr>
<tr>
<td>49 and above</td>
<td>4</td>
<td>1.22</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>12.57</td>
</tr>
</tbody>
</table>

P = 0.8237, non-significant

Table 3. Correlation between number of canals and direction of root grooves

<table>
<thead>
<tr>
<th>Direction of grooves</th>
<th>Direction of root grooves</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buccal</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Lingual</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>31.70</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>36.58</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>80.48</td>
</tr>
</tbody>
</table>

P = 0.0364, significant
CBCT Study of Prevalence of C-Shaped Canals

In this study, a prevalence of 12.57% of C-shaped canals in the mandibular second molars was observed, with no significant age and gender predilection. The C-shaped canal systems varied considerably with regards to anatomical configuration, with a notable prevalence of three and two canals and in majority of the teeth the C-shaped canals were grooved in the buccal direction.

REFERENCES