Analysis of the Length and Types of Root Trunk and Length of Root in Human First and Second Molars and to the Actual Measurements with the 3D CBCT

Ibrahim A Al-Zoubi, Santosh R Patil, Kazuo Takeuchi, Neeta Misra, Yuzo Ohno, Yoshihiko Sugita, Hatsuhiko Maeda and Mohammad Khursheed Alam

Abstract: To assess the length and types of root trunk and length of root in a Saudi Population and to correlate the actual measurements with the CBCT measurements. A total of 206 molars were used in this study. CBCT were obtained and subsequently patients were subjected for extraction as the tooth were having poor prognosis. The measurements were carried out on CBCT by using the accompanying software and the actual measurements were carried out with a digital vernier caliper. The mean and SD scores were calculated for actual length of root trunk and length of root and from CBCT method in maxillary and mandibular 1st and 2nd molar in Type of root trunk. Then the actual and CBCT length of root trunk and length of root were compared dependent t test. The statistical significance was set at 5% level of significance (p>0.05). In maxillary arch, the type A root trunk was observed in 55.88% and 39.06%, type B in 44.11% and 59.37% of first and second molars respectively. Type A root trunk was observed in 75.0 % and 55.18%, type B in 25.0% and 44.87% of mandibular first and second molars respectively. The difference between the actual length and CBCT length of root trunk was statistically non-significant (p>0.05) and no significant difference is observed between actual length of root and length of root measured by CBCT (p>0.05). Knowledge of the types of root trunk type dimension may aid the dental practitioner in diagnosing and planning the treatment of molars with furcation involvement. CBCT may lend comparatively discriminative dimensions of the periodontal defect similar to that of actual measurements.

Key Words: Permanent molar, Furcation involvement, Root trunk, CBCT

Introduction

Exhaustive learning of anatomy of root is obligatory in periodontal treatment as it is closely related with the endowment of a precise diagnosis and the preferred management option to administer excellent indelible prognosis of the teeth.

Approach to the furcation area is arduous for dental practitioners, hence the compelling instrumentation of furcation defects can have been a test for dental specialists because of the constrained availability through the furcation as well as the convoluted morphological variations of molar teeth. Furthermore, the anatomy of the furcation area gives a favorable condition for bacterial plaque confinement, and influences emphatically the pathogenesis of periodontal decimation. Consequently, teeth with furcation association in periodontal ailment have been observed to have a poorer periodontal prognosis than teeth without furcation involvement.

Root trunk measurements play an imperative part in the periodontal disease process because of its prominent and considerable relation to both prognosis and treatment of the tooth. Both, the length and type of the root trunk is one of the vital anatomical components which make molars exceptionally vulnerable to periodontal disease. Teeth having short root trunks are known to impact the pathogenesis of furcation involvement but known to have a favorable prognosis after treatment since minimal periodontal annihilation has apparently ensued.

Along these lines, the dental practitioner must have a careful comprehension of furcation anatomy to precisely survey etiological components, analyze the furcation involvement and manage this condition properly.

Radiographic imaging assumes a critical part in diagnosing periodontal diseases as they display the amount and nature of injury caused to the alveolar tissues. Various intraoral and extraoral imaging techniques are accessible to aid the diagnosis and treatment plan for the patient with periodontal diseases. Some of the routinely used radiographs are periapical, bitewing, periapical and panoramic views. One of the limitations of these views is that they only provide a 2D representation of 3D object. To overcome the inherent difficulties of IOPA, 3-D image analysis employing cone beam computed tomography (CBCT), a relatively latest imaging method is advised. When compared with conventional radiographic images, CBCT images reveal minimal distortion and overlapping. The objective of this study was to assess the length and types of root trunk and length of root in a Saudi Population and to correlate the actual measurements with the CBCT measurements.
Material and Methods

The present study was carried out after obtaining clearance from the institutional ethical committee. Patients having tooth which were indicated for extraction, provided the tooth structure is sound, were included in the study. In the present study, 206 extracted molars were analyzed after obtaining the consent. These teeth comprised 68 maxillary first molars, 64 maxillary second molars, 96 mandibular first molars and 78 mandibular second molars. Patients having medical conditions which are contraindications for extraction like thyrotoxicosis, patients with immediate post radiation therapy and those undergoing extraction of grossly destructed tooth were excluded from the study. CBCT were obtained using Scannor 3D; Soredex, Tuusula, Finland with 6 mA and 89 kVp the evaluation was carried out with the dedicated software (NewTom 3G: NNT, QR SRL; Scannor 3D: OnDemand®, Cypermed Inc., Irvine, CA) and subsequently patients were subjected for extraction. The extracted teeth were retained in 10% formalin and the surface was cleaned with curetages and ultrasonic scaling. The actual measurements of the teeth were carried out with a digital vernier caliper. Evaluation of the maxillary and mandibular molars comprise, the root length and vertical height of the buccal root trunk (The perpendicular distance in the furcation area from the tangent connecting the most prominent portion of the tooth crown and the buccal cortical plate). The types of root trunk were classified as types A, B and C according to the ratio of root trunk height to root length described by Hou and Tasi10. All the measurements were recorded in millimeters.

All the measurements were carried out by two experienced observers having more than five years of experience in the field of dental surgery. To check the intraobserver variations, the same examiners repeated measurements after 14 days.

Statistical analysis

The distribution and prevalence of the different types of root trunk were analyzed. The mean and SD scores were calculated for actual and CBCT length of root trunk and length of root in maxillary and mandibular 1st and 2nd molars in root trunk A and B. Then the actual and CBCT length of root trunk and length of root were compared in mandibular 1st and 2nd molar in Type of root trunk A and B by dependent t test. The statistical significance was set at 5% level of significance (p<0.05). The reliability of measurements was evaluated by kappa statistics.

Results

The reliability was very good, with Kappa values of 0.93 for intraoperator agreement and of 0.82 for interoperator agreement.

In the present study, the type A root trunk was observed in 55.88%, type B in 44.11% of maxillary first molars, similarly the type A root trunk was noted in 39.06%, type B in 59.37% and type C in 1.56% of maxillary second molars. Type C was not observed in any maxillary first molars. Among the mandibularis first molars, 75.0 % of teeth were seen with type A, 25.0% of teeth seen with type B and in mandibular second molars, 55.18% of teeth were seen with type A , 44.87% of teeth seen with type B. None of the mandibular molars were seen having type C root trunk (Tables 1 and 2).

The actual mean length and CBCT mean length of type A root trunk in maxillary first molars was 2.76±0.59 and 2.70±0.58 respectively and in type B the actual mean length was 3.70±0.59 and CBCT mean length was 3.56±0.54. In the second molars, the actual and CBCT mean length of type A root trunk was 4.71±1.21 and 4.94±0.76 respectively and in type B the actual mean length was 5.64±1.20and CBCT mean length was 5.75±0.76 (Tables 1 and 2).

In the mandibular teeth, the actual mean length and CBCT mean length of type A root trunk in mandibular first molars was 2.67±0.61 and 2.76±0.60 respectively and in type B the actual mean length was 4.32±0.57 and CBCT mean length was 4.16±0.52. In the second molars, the actual and CBCT mean length of type A root trunk was 2.67±0.61 and 2.76±0.60 respectively and in type B the actual mean length was 4.32±0.57 and CBCT mean length was 4.16±0.52 (Tables 1 and 2).

The difference between the actual length and CBCT length of root

### Table 1: Types of root trunk in relation to the length of root trunk and root in maxillary molars

<table>
<thead>
<tr>
<th>Type of tooth</th>
<th>Length of root trunk</th>
<th>Paired t</th>
<th>p-value</th>
<th>Root length</th>
<th>Paired t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual mean±SD (mm)</td>
<td>CBCT mean±SD (mm)</td>
<td></td>
<td>Actual mean±SD (mm)</td>
<td>CBCT mean±SD (mm)</td>
<td></td>
</tr>
<tr>
<td>Maxillary A</td>
<td>35 (50.76)</td>
<td>2.76±0.59</td>
<td>2.70±0.58</td>
<td>0.8296</td>
<td>0.4121</td>
<td>11.23±1.53</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>38 (46.11)</td>
<td>3.70±0.59</td>
<td>3.56±0.54</td>
<td>1.8331</td>
<td>0.0748</td>
</tr>
<tr>
<td>Mandibular A</td>
<td>25 (39.06)</td>
<td>4.71±1.21</td>
<td>4.94±0.77</td>
<td>-1.1164</td>
<td>0.2714</td>
<td>11.97±2.34</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>38 (59.37)</td>
<td>5.64±1.20</td>
<td>5.75±0.76</td>
<td>-0.5235</td>
<td>0.6037</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>1 (1.56)</td>
<td>5.92</td>
<td>5.88</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 2: Types of root trunk in relation to the length of root trunk and root in mandibular molars

<table>
<thead>
<tr>
<th>Type of tooth</th>
<th>Length of root trunk</th>
<th>Paired t</th>
<th>p-value</th>
<th>Root length</th>
<th>Paired t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual mean±SD (mm)</td>
<td>CBCT mean±SD (mm)</td>
<td></td>
<td>Actual mean±SD (mm)</td>
<td>CBCT mean±SD (mm)</td>
<td></td>
</tr>
<tr>
<td>Mandibular A</td>
<td>72 (75.00)</td>
<td>2.60±0.57</td>
<td>2.54±0.56</td>
<td>1.6262</td>
<td>0.2714</td>
<td>11.65±1.99</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>24 (25.00)</td>
<td>4.31±1.33</td>
<td>4.17±1.32</td>
<td>1.6102</td>
<td>0.6037</td>
</tr>
<tr>
<td>Mandibular B</td>
<td>43 (55.18)</td>
<td>2.67±0.61</td>
<td>2.76±0.60</td>
<td>-1.1411</td>
<td>0.2714</td>
<td>12.37±2.70</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>35 (44.87)</td>
<td>4.32±0.57</td>
<td>4.16±0.52</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
The length of buccal root trunk of the mandibular second molar in this study was statistically non-significant (p=0.05).

In maxillary first molars, the actual mean length and CBCT mean length of roots with type A root trunk was 11.23±1.53 and 11.00±1.72 respectively and in type B the actual mean length was 11.71±1.53 and CBCT mean length was 11.60±1.43. In the second molars, the actual and CBCT mean length of roots with type A root trunk was 11.97±2.34 and 12.16±2.54 respectively and in type B the actual mean length was 12.45±2.34 and CBCT mean length was 12.14±2.49 (Tables 1 and 2). In mandibular first molars, the actual mean length and CBCT mean length of roots with type A root trunk was 11.65±1.99 and 11.86±1.69 respectively and in type B the actual mean length was 13.72±2.24 and CBCT mean length was 13.74±1.94. In the second molars, the actual and CBCT mean length of roots with type A root trunk was 12.37±2.70 and 12.50±2.56 respectively and in type B the actual length was 11.86±1.91 and CBCT length was 12.10±2.69.

No significant difference is observed between actual length of root and length of root measured by CBCT (p>0.05) (Tables 1 and 2).

Discussion

It has been reported that in the mandibular and maxillary molars, the vestibular furcation is the most commonly affected and the buccal root trunk is typically shorter and more inclined towards developing early furcation involvement and attachment loss. Because of these facts, in only the length of the buccal surface is measured the present study.

In maxillary first molars, the prevalence of root trunk type A and B was 55.88% and 44.11% respectively, in contrast to this Hou and Tsai observed the prevalence of type A in 64.3% and type B in 34.3% of first molar teeth whereas Dababneh et al., reported, the prevalence of type A in 39.1% and type B in 60.9% of maxillary first molars. In maxillary second molars the prevalence of type A was 39.06% and type B was 59.37% but Hou and Tsai noted 40.6% of type A and 52.1% of type B in maxillary second molars.

Likewise, in mandibular first molars, the prevalence of root trunk type A and B was 75% and 25% respectively, a similar results were obtained by Dababneh et al., who reported the prevalence of type A in 73.4% and type B in 26.6% of maxillary second molars. In contrast to this Hou and Tsai observed the prevalence of type A in 98.6% and type B in 1.4% of first molar teeth. In mandibular second molars, the prevalence of type A was 55.18% and type B was 44.87% in contrast to our study, Hou and Tsai noted 60.8% of type A and 37.1% of type B in maxillary second molars.

In the present study except in one maxillary second molar, none of the other molars were observed with type C root trunk. Dababneh et al., observed root trunk type C in 3.3% of the upper molar while and none was noted in mandibular molars. Hou and Tsai observed type C in 11.9% of upper first molar teeth and 1% of lower first molar teeth which was comparatively higher than this study.

Root trunk length and type is the major anatomical variable which makes molars exceptionally liable to periodontal disease. It has been observed that shorter root trunks impacts the pathogenesis and makes the tooth more vulnerable to furcation involvement. The observations of this study revealed that, the actual mean length of 'buccal root trunk of maxillary first molars was 3.23mm which was lower than the values observed by Porciúncula et al., Dababneh et al., Gher and Dunlop, who observed that this length was 3.50mm, 3.97mm and 4.2mm respectively. In the mandibular first molar, the actual mean length of buccal root trunk was 3.45mm and in contrast to this a lower value were observed by Gher and Verino, and Mandelaris et al., who noted that the mean root trunk length was 3mm and 3.19mm on the buccal aspect. The length of buccal root trunk of the mandibular second molar in this study was also more when compared with that of Mandelaris et al.,

The length of the root is precisely associated to the amount of attachment supporting the tooth. Awareness of the root length is a basic component that permits a precise diagnosis, prognosis, and treatment planning of a furcationally involved tooth. The mean root length for maxillary and mandibular first molars in this study was 11.47mm and 12.21mm respectively and the mean root length for maxillary and mandibular second molars was 12.68mm and 12.11mm respectively. Dababneh et al., observed that the mean root length for maxillary and mandibular first molars was 12.6mm and 13.7mm, which was higher than the present study.

One of the objectives of this study was to compare the actual and CBCT measurements of root and root trunk and we found no significant differences in both the measurements. This observation was in accordance with Kim et al., who reported that the no differences were observed in crown and root length of CBCT measurements when compared with direct measurements. Sherrard et al., compared CBCT images and periapical radiographs of extracted porcine teeth to evaluate the accuracy and reliability of CBCT measurements and observed that the CBCT measurements of the total tooth and root lengths were not significantly different from the actual lengths. Lund et al., calculated the length of the root and the marginal bone level and reported that CBCT provided an enhanced level of measurement reproducibility.

In the present study, we adapted the classification pattern that considers the length of the RT contrasted with total root length and the types of root trunk were classified as types A, B and C. It has been also observed that these have effect on furcation involvement and attachment loss. Hue and Tasi observed an increased missing rate, guarded prognosis, and limited antiphon to periodontal therapy for teeth with a long root trunk length (type C). Knowledge of the types of root trunk type dimension may aid the dental surgeons in diagnosing, planning the treatment and prognosis of molars with furcation involvement and CBCT may lend comparatively discriminative dimensions of the periodontal defect similar to that of actual measurements.

Competing interest

The authors have declared that no competing interest exists.

References