Research Article

Cone-Beam Computed Tomography study of Root and canal morphology of Mandibular incisors in a selected Iranian population

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ABSTRACT
The aim of this study was to evaluate the root canal morphology of mandibular incisors by CBCT in northern Iranian population and indicate the thinnest area around root canals. We evaluated CBCT images of 193 central incisors and 184 lateral incisors. By evaluating three planes axial, sagittal and coronal of each tooth we determined the number of root canals and prevalence of Vertucci configurations. We also determined the minimum wall thickness of root canals by measuring buccal, lingual, distal and mesial wall thicknesses of each canal in levels with 2mm intervals from apex to orifice. 136 central incisors had one canal and 56 had two canals and 143 lateral incisors had one canal and 41 had two canals. The most common prevalence of vertucci type in mandibular incisors was type I and type III. Mesial and distal walls had the highest frequency as the thinnest wall in all levels of the root canal with mostly less than 1 mm thickness. Vertucci type I and III were the most prevalent configurations in mandibular incisors. mesial and distal walls had the highest frequency as the thinnest walls in all levels of root canals.

Keyword: CBCT, Mandibular, Incisors, Morphology

INTRODUCTION
Today by progression in modern dentistry, endodontic treatment has an effective and important role in teeth preservation (1). cleaning and shaping of the root canal system has great importance on root canal treatment (RCT) and reaching maximum success (2,14).the result of successful endodontic treatment depends on knowledge, correct sight and awareness of root canal anatomy and careful, conservative and meticulously performed cleaning and shaping procedures (15). lack of knowledge about root canal anatomy and its variations in configuration may lead to root canal treatment failures as perforations(3). the morphology of root canal systems varies greatly in different races and also among different individuals within the same race, thus it is important to be aware of variations in tooth anatomy and its features in various racial groups because this knowledge help clinician to locate and manage canals during root canal treatment (4). there are different reports about variation of mandibular incisors canals, due to method of study and racial differences. Most failures in mandibular incisors root canal treatment are related to presence of uncleaned canals, specially in
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Davood Torang, et al.

lingual region (5). Radiographic imaging is necessary in diagnosis, treatment and follow up after endodontic treatment (6,16). CBCT is a medical imaging technique based on cone beam concentrated on a 2-dimentional detector.

Food and drug association (FDA) approved first CBCT system for using in dentistry in America in 2001(7). Mandibular incisors usually have a dentinal bridge in pulp chamber that divides the root into two canals. However, these two canals mostly join together and end in the same apical foramen (8,15). Awareness of root surface anatomy and its concavities and dentin thickness, specially in danger zone can enable dentists to encounter effectively with accidents which may lead to failures (9).

The aim of this study was to evaluate three-dimensional CBCT images of 377 fully erupted mandibular incisors of 100 patients referred to radiology clinic in Babol within 1 year.

MATERIALS AND METHODS
All CBCT images were performed by Newtom 5G (QR s.r.l, Verona, Italy). We evaluated fully erupted mandibular incisors without any endodontic treatment. Samples including 193 central incisor (120 female, 73 male) and 184 lateral incisor (111 female, 73 male). CBCT cross-sections had 1 mm thickness and were taken from 1 mm segments of the canal from apical to coronal. Teeth were categorized by patients’ gender, tooth side (left or right), number of root canals and root canal morphology based on Vertucci classification (figure 1).

To evaluate the CBCT images we used NNT 3D software. Each teeth were evaluated in three axial, sagittal and coronal planes. We determine the number of root canals we evaluate axial plane from apex to orifice. The prevalence of Vertuccis Types (figure 1) were determined by evaluating sagittal and axial plane. To determine the minimum wall thickness of buccal, lingual, mesial and distal wall of root canals, wall thickness of each canals were measured in levels with 2 mm intervals from apex to orifice (figure 2).

Statistical analysis: data was analysed by SPSS 20. We used X2 and T-test for statistical analysis and P-value less than 0.05 were considered as a significant difference.

Figure 1: Vertucci root canal classification

Figure 2: Six levels of mandibular incisors canal with 2 mm intervals from apex to orifice
RESULTS
In this study that was performed on 193 central incisors (120 female, 73 male) and 184 lateral incisors (111 female, 73 male) to determine type and number of root canals among 193 central incisors 136 (70.4%) teeth had one canal and 41 (22.2%) teeth had two canals. The percentage of different vertucci type was present in Table 1.

There was no significant difference between males and females in central and lateral incisors. The most prevalent vertucci type in central and lateral incisors were type I and then type III. (Table 1)

Table 1: prevalence of different types of vertucci in mandibular incisors

<table>
<thead>
<tr>
<th>Tooth</th>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
<th>Type IV</th>
<th>Type V</th>
<th>Type VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>136</td>
<td>15</td>
<td>35</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>70.4%</td>
<td>7.7%</td>
<td>18.1%</td>
<td>3.1%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lateral</td>
<td>143</td>
<td>4</td>
<td>36</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>77.7%</td>
<td>2.1%</td>
<td>19.5%</td>
<td>1.08%</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Because of high prevalence of vertucci type I and III in mandibular central and lateral incisors root, we represented the thinnest thickness of different levels of these types.

In these teeth the highest frequency of the thinnest wall in all levels was related to distal followed by mesial wall with the mean of less than 1 mm thickness in levels 1-4. In level 5 the mean reached about 1 mm and in level 6 it was more than 1 mm (Figure 3).

Figure 3: frequency of the thinnest walls around mandibular incisors canal and their thickness in each levels, circles indicate frequency of teeth.
incisors root had been represented in different levels, these means in lateral incisors were a little more than central incisors and both of them had been increased from level 1 to 6 (figure 5).

**Figure 4:** frequency of the thinnest walls around mandibular incisors canals with vertucci type I and III in each levels, circles indicate frequency of teeth.

**Figure 5:** mean of the thinnest walls thickness in mandibular incisors root in different levels

DISCUSSION

In this study CBCT images were used for evaluating morphology of canal in mandibular central and lateral incisors in 100 patients who referred to radiology clinic in Babol (Iran).

In many studies samethis study vertucci configuration had been used for evaluating morphology of root canal system. During this study there was one canal with mostly type I vertucci configuration in mandibular central and lateral incisors. Mesial and distal walls had the
most frequency as the thinnest region among root canals in all levels. 
In this study vertucci type I and then type III were the most common types of canal in central incisors. these findings were in line with the study by Amir Sobhani et al. (2013) on 400 CBCT radiography from permanent incisors and canine. 632 central incisors .614 lateral incisors and 608 canine were assessed , all of central and lateral incisors had one root and most of them had one canal (70.6-72.7%).vertucci type I was the most common prevalence of vertucci type (70.6-72.7%)(3).
In a study by Sushamp.jaju et al. (2013) on indian individuals who had undergone CBCT radiography for dentalimplant , anatomical variations of mandibular incisors root were assessed. They concluded that vertucci type I and III were the most common types of canals configuration in mandibular central and lateral incisors which is similar to current study(10).
In another study by Mohammadi et al. (2006) on 68 mandibular incisors which were selected after access preparation,,root canal cleaning, decalcification and clearing , they concluded that 55.9% of canals join together before apical foramen , thesefindings were different from this study due to racial differences and methodological approach (11).
In a study accomplished by Chankhit Sathorn et al. (2005) on 10 central and lateral incisors for assessing morphology of root surface , they found that mesial and distal walls was under high stress because of their thin thickness .these findings are similar to this study(12).of course number of specimens in chankhit sathorn et al. study was not sufficient hence this study didn’t have sufficient accuracy. In another study by Arland Limong et al. (2007) on 40 mandibular central and lateral incisors which were extracted for measuring amount of dentin in root canals walls,they concluded that distal wall in both teeth has less dentin than mesial wall . these results was in line with current study(13).

CONCLUSION
Vertucci type I and III were the most prevalent configurations in mandibular incisors .mesial and distal walls had the highest frequency as the thinnest walls in all levels of root canals , therefore it should be considered during endodontic treatment .

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