

Differences on the Root and Root Canal Morphologies between Asian and White Ethnic Groups Analyzed by Cone-beam Computed Tomography

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Abstract

Introduction: Populations from different geographic regions and ethnic backgrounds may present differences in dental morphology. The aim of this study was to compare the differences in root and root canal configurations on Asian and white subpopulations using cone-beam computed tomographic imaging. **Methods:** Information from Asian and white patients was retrieved from 2 cone-beam computed tomographic imaging databases in China and Western Europe. Two calibrated observers collected data regarding the number of roots and Vertucci root canal system configuration for all groups of teeth. A total of 15,655 teeth were analyzed. The z test for independent groups was used to analyze differences between the groups. The significance level was considered at a *P* value < .05. Reliability tests were performed between observers. **Results:** Differences were noted in the number of roots per tooth in 6 groups of teeth. The Asian group showed a higher prevalence of single-root configurations in maxillary first premolars (83.2%) and mandibular second molars (45.4%) when compared with whites with 48.7% and 14.3%, respectively. Moreover, 3-rooted configurations in mandibular first molars were more common in Asians (25.9%) compared with whites (2.6%). Seventeen of the 20 analyzed roots had a higher prevalence of Vertucci type I configuration in Asians. Maxillary first molars with second mesiobuccal root canals were more commonly found in whites than in Asians (71.3% and 58.4%, respectively). A similar situation was found in maxillary second molars. **Conclusions:** The Asian ethnic group presented a higher prevalence of Vertucci type I configuration, whereas the white group displayed a higher number of multiple root canal system morphologies. A clinician should be aware of these differences

when treating patients from these ethnic groups. (*J Endod* 2018; ■:1–9)

Key Words

Anatomy, cone-beam computed tomography, ethnic, morphology, prevalence, root canal

Asians and whites are 2 of the most prevalent ethnic groups worldwide. Several body morphologic differences, such as tibia shaft anatomy (1) and retinal shape (2), and differences in disease prevalence, such as peripheral arterial disease (3), between these groups have been previously documented. In the available literature, only 1 article from Guo et al (4) mentioned differences regarding root canal system anatomy between both ethnic groups. Guo et al performed an evaluation of maxillary first molar morphology in a North American subpopulation. One of the variables analyzed in the study was the difference among 5 ethnic groups (black, Asian, Hispanic, white [non-Hispanic], and other) regarding the presence of the second mesiobuccal (MB2) root canal and morphology. Statistical differences were not identified regarding the presence/absence of the MB2 root canal among ethnic groups. However, differences were found in the mesiobuccal root canal morphology. Asians presented a higher prevalence of Vertucci type I (35.0%) and type IV (45.0%) configurations when compared with the white group (type I: 23.4%, type IV: 36.3%). The opposite was also reported regarding Vertucci type II, which was more commonly found in whites (36.3%) compared with Asians (15.0%). Another recent study from von Zuben et al (5) compared mandibular second molar C-shaped root canal system morphology prevalence among 9 geographic regions. Although not clearly linking any geographic region to a specific ethnic group, the authors found a statistically higher prevalence of mandibular second molar C-shaped morphologies in China (44.0%) when compared with any other region. This study included 3 Western European countries (Portugal [8.3%], Spain [11.0%], and England [7.8%]) with a high white prevalence.

Studies comparing root canal morphologies of different regions in the globe are very rare. To the best of the authors' knowledge, with the exception of the study by von

Significance

Asians and whites present differences in the root and root canal system configurations. Whites are more prone to present multiple root canal systems, whereas Asians are more prone to present 3-root configurations and C-shaped root canals on mandibular first and second molars, respectively.

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Clinical Research

Zuben et al (5), only the article by Torres et al (6) compared root canal anatomy of the mandibular first and second molars between Belgian and Chilean subpopulations. The authors did not evaluate statistical significances between groups. However, strong prevalence differences were found in the Vertucci type II configuration in the distal root of mandibular first molars, which was present in 5.0% of Belgians and 18.9% of Chileans.

Another morphologic characteristic that is usually associated with Asian populations, with a traditionally higher prevalence when compared with other populations, is the presence of a second distal root in mandibular first molars. This anatomic feature prevalence may be as high as 22.3% in Korea (7), 25.6% in Taiwan (8), and 29.7% in China (9), whereas in other regions, it may be as low as 0.5% (Turkey) (10), 0.8% (Spain) (11), and 2.2% (Portugal) (12). Although this difference seems notorious, there is no available scientific study performed with calibrated observers from a single research group that compared both ethnic groups. This characteristic or any other feature from any other tooth, with the exception of the maxillary first molar as reported by Guo et al (4), has ever been reported. The possible root canal morphologic differences between these 2 ethnic groups, although stated as possible, were not yet addressed in the literature. Moreover, keeping in mind that root canal therapy requires a full debridement and disinfection of the root canal system, knowing the root canal configuration prevalence when treating these patients is important. The aim of this study was to compare the differences in root and root canal configurations in Asian and white subpopulations using cone-beam computed tomographic (CBCT) imaging.

Material and Methods

CBCT examinations of 790 patients were collected from 2 existing databases in 2 health centers in Suzhou (China) and Lisbon (Portugal). CBCT scans from patients that would physically fit in the Asian ethnic group profile in Suzhou and in the white ethnic group profile in Lisbon were selected. The scans were performed for several reasons other than this study. One single observer in each region analyzed the examinations retrospectively. Although the CBCT machines were different in both regions, a Kodak scanner (Kodak 9500; Carestream, Atlanta, GA) in Suzhou and a Planmeca scanner (Planmeca Promax; Planmeca, Helsinki, Finland) in Lisbon, they both share the same voxel size (0.20 mm) and field of view (full arch). All the CBCT examinations were analyzed with proper visualization software. Although the visualization software was different in both regions, they presented similar functions that allowed an equal methodology of assessing the CBCT scans. Table 1 summarizes both CBCT characteristics and settings.

Teeth with previous endodontic treatment, third molars, teeth with immature apices or root resorptions, and scans with image artifacts were excluded. All included teeth were analyzed in 3 planes (ie, coronal, sagittal, and axial), and, in order to facilitate the interpretation of root canal anatomy, both observers were allowed to change the software visualization settings.

A total of 15,655 teeth were included in this study. The analyzed teeth were divided into 2 major groups, Asians and whites, depending on the region of origin. The Asian sample included 3330 teeth

from 120 patients (54 men and 66 women with an average age of 28 years), whereas the white sample included 12,325 teeth from 670 patients (243 men and 427 women with an average age of 51 years).

According to previous studies (12), for each tooth, the following information was recorded:

1. The number of roots
2. Root canal system configuration according to Vertucci classification (13) (in the molar teeth, each root was evaluated individually)
3. The total number of root canals per root (they were classified as having "1 root canal," "2 root canals," or "3 root canals" depending on the root canal Vertucci classification)
4. Exclusively for mandibular molars, the presence of C-shaped configurations, according to Fan et al's criteria (14), was also recorded

Statistical Analysis

The collected data were introduced into SPSS software (Version 22; IBM Corp, Armonk, NY). The primary outcomes were root canal configuration and the number of roots, whereas the predictive variable was ethnicity. The proportion of each anatomic configuration for each group of teeth was calculated as well as the lower and upper limits of the 95% confidence interval (CI) for each proportion. The *z* test for proportions was used to analyze differences between ethnicities for each group of teeth. For all compared groups, a *P* value < .05 was considered significant.

The Cohen kappa test was used to determine both interrater (2 raters) and intrarater reliability. For the interrater test, the CBCT images of the same 140 teeth were evaluated by the 2 observers. For the intrarater test, the observer from Suzhou performed the evaluation of 112 teeth (which represents 3.36% of the total Asian sample, corresponding to the 4 initial patients), whereas the observer from Lisbon performed the evaluation of 589 teeth (which represents 4.78% of the total white sample, corresponding to the initial 32 patients). These teeth were evaluated twice with a 1-month interval between observations. Both reliability tests were performed for all evaluated teeth (all Vertucci configurations) and for the same group of teeth in which the Vertucci type I configurations would be excluded (non-type I Vertucci configurations) so the reliability for more complex anatomic configurations could be determined also.

For the purposes of this study, the observers were considered reliable for both inter- and intrarater reliability tests if the obtained kappa coefficient of agreement was equal or superior to 0.81 (almost perfect agreement). Table 2 summarizes the reliability tests results.

Results

Root Morphology

Six of the 14 groups of teeth that were analyzed presented significant differences between ethnic groups regarding the number of roots per tooth. Four of those 6 groups of teeth presented a significantly higher number of single-root configurations in the Asian

TABLE 1. Cone-beam Computed Tomographic (CBCT) Characteristics and Geographic Location to Each Ethnicity

Ethnicity	Location	Observer	CBCT Model	CBCT voxel size	CBCT FOV	CBCT settings	Visualization software
Asian	Suzhou (China)	Y.G.	Kodak 9500	200 μ m	Full arch	90 kV, 10 mA, 10.8 seconds	CS 900 3D imaging
White	Lisbon (Portugal)	J.M.	Planmeca Promax	200 μ m	Full arch	80 kV, 15 mA, 12.0 seconds	Planmeca Romexis

FOV, field of view.

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