A Cone Beam Computed Tomography Study on the Incidence of Additional Canals of the Permanent Maxillary and Mandibular Molars

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Abstract

Objective: This cross section study was carried out to assess the impact of gender and tooth position distribution of the incidence of additional canals of the permanent maxillary and mandibular molars using cone beam computed tomography.

Patient & Method: In the Iraq/Kurdistan Region- Sulaimani City from private B&R private dental, CBCT images of 160 (90) male and (70) female aged 18-70 years were examined. The numbers of root canals were investigated according to gender and side. The data were analyzed using Pearson’s Chi-square test.

Results: In total of 160 patients, 1,124 teeth were examined consisting of 285 maxillary first molar, 303 maxillary second molar, 261 mandibular first molar upper and 275 mandibular second molar. The prevalence of the MB2 canal of the maxillary first molar in male for the right side is (32.17%) which was significantly higher in female for both sides (P < 0.05). In male, the prevalence of three canals was more than four canals of mandibular first molar with no sides effect while female had more frequency of four canals in right side (38.1%) with no statistically significant. Both maxillary and mandibular second molars had three canals more prevalent than two canals and four canals with no gender and side significance.

Conclusion: The incidence of extra canals of maxillary and mandibular molars shows slight difference between gender and sides.

Keywords: Mandibular and Maxillary molars, Cone beam computed tomography, Gender, Side

Introduction

The success of the endodontic treatment depend on a detailed understanding of the morphology of the root canal system and the number of root canals as adequate chemomechanical preparation and effective obturation of the root canal system are based on knowledge of normal root canal morphology and variations from the normal [1].

A major cause of root canal therapy failure is the inability to understand the internal anatomy of the tooth and subsequent incomplete endodontic treatment [2].

Many studies have examined root and canal morphologies using various methods such as sectioning, canal staining, and tooth clearing techniques, modified canal staining and clearing, conventional radiography techniques, contrast medium-enhanced radiography, and Computed Tomography (CT) scanning [3].

Radiographic imaging is essentially two-dimensional (2D) imaging of a three-dimensional (3D) object. Furthermore, the interpretation of radiographs can be influenced by several confounding factors, including regional anatomy and superimposition of teeth and the surrounding dento-alveolar structures. The structures visualized by radiographs are also subject to geometric distortions. These problems can be overcome by the use of 3D imaging using cone beam Computed Tomography (CBCT) [4].

CBCT scanner produces clear images with higher resolution at a reduced radiation and lower cost when compared to medical CT. It is a more compact, faster and safer version of the medical CT. The time needed for a full scan is typically under one minute and the radiation dosage is several times less than that of a CT scanner [5].

A cone-beam computed tomography has been gaining popularity in endodontics,
covering the broad spectrum of diagnosis of pulpal inflammation leading to periapical pathosis, visualization of canals, vertical and horizontal root fractures, as well as internal and external tooth resorption [6].

It is well known that tooth anatomy varies according to racial origin. Therefore, it is very important to be familiar with variations in tooth anatomy and characteristic features in various racial groups since such knowledge can aid in location and negotiation of canals, as well as their subsequent management [7].

Thus, keeping in mind the importance of additional canals as well the clinical applicability of CBCT, the present study was conducted to study the presence of extra canals of permanent maxillary and mandibular molars according to different gender and sides using CBCT.

Materials and Methods

The investigation was approved by the science ethics committee of University of Sulaimani /College of Dentistry. A total CBCT images of 160 (90) male and (70) female aged 18-70 years were attained from archives of dental imaging private B&R dental center from 2014-2016 in Iraq/Kurdistan Region-Sulaimani City.

Inclusion criteria were permanent maxillary and mandibular first and second molars with fully developed roots and apices, sound tooth structure or with the carious lesion, with direct or indirect tooth restoration, undergo endodontic therapy or not and normal periradicular tissue or with the presence of any pathology.

The CBCT images were taken using GALILEOS Comfort PLUS (Sirona Dental Systems GmbH, Bensheim, Germany) with the following parameters: 15.4 cm Spherical imaging volume, 0.25 / 0.125 mm voxel size (isotropic voxels), 98 kVp, 3-5mA and exposure time of 14s. The CBCT images were analyzed with GALILEOS Implant - implant planning software.

Serial axial views of CBCT images were examined by carefully rolling the toolbar over the pulp chamber by endodontist.

The data were analyzed using descriptive statistics and Pearson’s Chi-square test.

Results

One hundred and sixty CBCT scans were examined for inclusion criteria 90 (56.25%) & male and 70 (43.75%).

The teeth included in our study were 285 maxillary first molar (143 rights & 142 left), 303 maxillary second molar (150 rights & 153 left), 261 mandibular first molar (126 rights & 135 left) and 275 mandibular second molar (138 for each side).

Table 1 shows the frequency of root canal numbers of maxillary first molars according to the gender and sides. The most frequent pattern was four canals 59(41.55%) in male left side and 38(26.57%) in female right side. There is a significant relationship ($P < 0.05$) between gender and the number of canals of right and left maxillary 1st molar teeth.

The frequency distribution of root canal numbers of maxillary second molars according to sex and sides was shown in the Table 2. There is more prevalence for both sides of maxillary 2nd molar with three canals than four canals and two canals, but this difference has no significant relationship with gender and sides ($P > 0.05$).

The mandibular first molar with four canals shows more prevalence 48(38.1%) in the right side female than three canals 35(25.93%) with significant relationship ($P < 0.05$), while in the right and left sides male, the teeth with three canals shows more prevalence 39(30.95%) and 43(31.85%) than four canals but with no statistical significance as shown in Table 3.

Table 4 shows more prevalence of right and left mandibular 2nd molar teeth with three canals than two and four canals, although, this difference has no significant relationship with gender in the right subgroup, but there is significant relation between number of canals and gender in left subgroup ($P < 0.05$).

Discussion

The fine details of the root canal system to study root canal morphology can be visualized by different methods like staining and clearing, however information that is obtained before or during endodontic therapy is more valuable for further dental management [8].
In this study, the impact of sex and sides on the incidence of extra canals of permanent maxillary and mandibular molars using cone beam computed tomography were evaluated.

Matherne et al. [9] found that with digital radiography, endodontists failed to identify at least one root canal in 40% of teeth, despite taking parallel conventional radiographs. Neelakantan et al. [10] reported that CBCT was as accurate in identifying root canal systems as the modified canal staining and tooth clearing technique. The main advantages of CBCT images are that they are nondestructive and allow three-dimensional reconstruction and visualization of the external and internal anatomy of the teeth. Our study shows that the sum of roots and root canals can be visualized clearly in axial sections.

For detection of the second mesiobuccal canal of permanent maxillary first molars, the results showed that CBCT scanning is a reliable method compared to the gold standard (sectioning). Another study stated that micro-computed tomography (µCT) of the canal counts was not different from CBCT results but significantly different from digital periapical radiographies in detection of the extra canals in the mesiobuccal roots of maxillary molars while due to lower radiation dose, reduced exposure time, lower costs, more accurate according to isotropic voxels the use of CBCT preferred than CT [11].

The prevalence of additional canals in maxillary first molars has been reported by many studies. The high frequency 59(41.55) in male and 38(26.57) in female right side of additional MB2 canals in this study is largely consistent with findings from clearing studies of Asian populations from Thailand (65.0%), Japan (58.0%) [12] and Iran (69.23%) [13]. The prevalence of accessory canal of mesiobuccal root of permanent maxillary molars in this study result was lower than that of a Turkish population (93.5%) [14]. This variation may be caused by the differences in sample sizes, methods, and/or regional population diversity.

Regarding the incidence of additional MB2 canals in our sample there is a significant relationship (P < 0.05) between gender and the number of canals of right and left maxillary 1st molar teeth which is consistent with findings of a Brazilian [15] and Malaysia study [16] with more prevalent of MB2 in male than female patient.

Sert and Bayirli [14] conducted a clearing study of human permanent teeth from Turkish patients and concluded that sex was an important factor to consider in the preoperative evaluation of canal morphology for nonsurgical root canal therapy. In contrast, the incidence of additional MB canals disagree with the previous studies by Eftekhar et al. [11] and Neaverth et al. [17] reported that the number of mesiobuccal root canals was not affected by tooth position.

There is more prevalence of right and left maxillary second molar teeth with three canals than four canals and two canals, but this difference has no significant relationship with gender and sides. Our findings are to some extend consistent with studies by Rouhani et al. [18] in Iranian population, Ng et al. in Burmese [19], Alavi et al. [20] in Thai population. Also the results of this study come in accordance with study done by Kalender et al. [21] which evaluated CBCT scans of 290 Turkish Cypriot populations, observed that among the 438 second molars 392 (89.4%) teeth had 3 canals with no sex difference.

While study done by Betancourt et al. [22] reported that the additional MB2 canal of permanent maxillary second molar was identified in 48% of the cases and its location was more frequent in men (63%), and no differences were observed in its appearance in the hemi-arch using CBCT.

Based on our result, there is a significant difference between male and female patients, permanent mandibular first molar with four canals shows more prevalence 48(38.1) in female right side with three canals 39(30.95%) in male patient right side and the result of the present study agree with study done by Abd Latib et al. [16] reported that males are more likely to exhibit these canals than females and comparable with study done by Jang et al. [23] which assessed possibility of fourth canals in permanent mandibular first molars and their morphological characteristics among a Korean population from using cone beam computed tomography scans (CBCTs) and reported with the prevalence of distal root(s) with two canals was 34.2% (267 of 780) and 24.5%, 89 of 397 left and 102 of 383 right were found to have three roots. However, this may prove to be an insignificant finding in a study with a higher sample size.

Scarfe et al. [24] and Weine et al. [25] observed that there are...
many research articles regarding comparison of the prevalence of extra canal between races. Generally, most of the race traits exhibit a significant difference in the occurrence of extra canal, due to the genetic factor and researches are available in proving this statement by using different methods, such as CBCT, staining of the canal or magnification loupes.

In this study, the incidence of MB2 canal and distolinguval canal between races cannot be compared due to insufficient data.

In the present study, 62 (41.33%) of permanent mandibular second molar has three canals with no gender difference and the result agree with study performed by Nur et al. [26] which observed that (90%) of the second molars in a Turkish population using cone-beam computed tomography (CBCT) had one mesial and one distal root, whereas 10% had one root with 90% of the mesial roots had two canals and 10% had one canal with the majority of distal roots had one canal (97%) and 3% had two canals with no statistical gender-related difference (P > 0.05) was detected in the incidence of root numbers of mandibular second molars.

Conclusion

The frequency of the additional four root canals in the maxillary first molars was significantly higher than maxillary second molars and mandibular molars assessed by cone beam computed tomography.

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Conflict of interest: ‘None declared’.

References