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Evaluation of Root Canal Morphology of Mandibular Central and Lateral Incisor in Mosul City by Using CBCT

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Abstract

Background and Objectives: Missing canals is the fundamental cause for the treatment ruin of the endodontic lower incisor, notably the lingual canal. Using computed tomography using a cone beam (CBCT), we sought to identify the architecture incisors' root and the canals numbers of the mandible.

Methods: A total of 220 participants were enrolled in the present study. Using Vertucci system to assess root canal shape of the central and lateral incisors of the jaw by characterizing CBCT images taken.

Results: Type one has shown that the number of teeth with central incisors are 377 (152 male; 225 female teeth, lateral incisors 358(169 male; 183 female). Type two has shown that the number of teeth with central incisors are 5 (2 male; 3 female) teeth, lateral incisors 3(1 male; 2 female).

Conclusion: Teeth morphology variation was sex dependent and endodontic treatment should be directed during assessing anterior tooth roots.

Keywords: CBCT; Root Canal; Morphology; Anatomical Variation; Anterior Teeth

Introduction

Root canal shape has an anatomical variation that is important for successful root canal therapy, in which complete debridement and occlusion of root canal systems are dependent on it. Because cannot be properly exposed the existing canals, dug, and sealed, root canal therapy frequently fails [1].

Due to the risk of root canal deviation or perforation, further preparation, post-core and crown restorations serve as examples of correct root canal form. The dentist can thus distinguish between the various root canal shapes and their anatomical differences. Understanding root canal composition (RCC) is necessary for treatment implementation as it aids in creating a suitable plan and, as a result, avoids potential technical problems at all phases of treatment [2-4].

Root canal morphologically divided into these categories types: I (1), II (2-1), III (1-2-1), IV (2), V (1- 2), VI (2-1-2), VII (1-2-1-2), and VIII (1-2-1-2) [5,6]. Several methods, including the clearing method, cross-section technique, dental anatomy, or, depending on the extracted tooth, Cone

beam tomography, and conventional radiography have both been used to evaluate the formation of root canals (CBCT). Numerous innovative endodontic research has been incorporated since CBCT was developed, and 3D technologies like CBCT have many benefits [7].

Computed tomography with cone beam (CBCT) scans gives the best portrayal of solid tissues in three dimensions (3D), allowing for a higher-quality diagnosis of a variety of illnesses [8]. The primary benefits of using three-dimensional (3D) imaging over conventional radiography are that it is non-invasive, minimizes overlapping of the oral anatomy and other structures, exposes users to less radiation, and is more affordabl [9].

When estimating and treating complex endodontics, CBCT imaging is used to spot irregularities in the curvature root and the canal of the root system, as well as hidden supplementary canals in teeth or teeth with complex or deformed shapes [10]. In total, the central and lateral incisors of the lower jaw contain one root and canal. Sometimes these teeth could have two canals or roots [11]. Depending on a person's race, gender, and ethnicity, the canal morphology of the mandibular central and lateral incisors can vary greatly. The incisors of the central and lateral mandibular may have additional canals [1].

The lower jaw's anterior teeth share a similar morphology with only one root canal per tooth and are often single-rooted. However, studies have shown that the presence of second (forked) canals and lateral canals may make the root canal anatomy of the lower incisors more difficult [12]. The morphological differences between Mosul citizens' lower central incisors and lateral incisors, as well as the association between these characteristics and gender, were shown in this study using conical beam computed tomography.

Materials and Methods

Techniques and resources: The local Institutional Review Board's ethical handling guidelines were followed by all of the research's methodologies. No ethical approval was required because the only data used in this type of study are those from the files.

The equipment used: The CBCT device used is a CS 81003D Digital Imaging System (Carestream, USA) with the following specifications: 150 voxels, 85 kvp, 200 ma, 15.0 sec of exposure, and 2858 m Gy. In this study, The Al Noor Dental Hospital received 3D CBCT scans of 780 fully loose central and lateral incisors from 104 men and 116 females with a mean of 34.58 years (range 18 – 75). The ages of the participants ranged from 18 to 75. The medical centre in Mosul for two years.

The required CBCT scans in patients for a variety of reasons, including determining the amount of available bone for placement implant, before surgery, checking the root apex and its connections to important anatomical tissues to check for various injuries, tumours, and dental fractures, and decayed teeth's positions before orthodontic treatment, as well as assessing the teeth following root canal therapy. At least one permanent, lateral incisor in the jaw was a requirement for inclusion in the primary images.

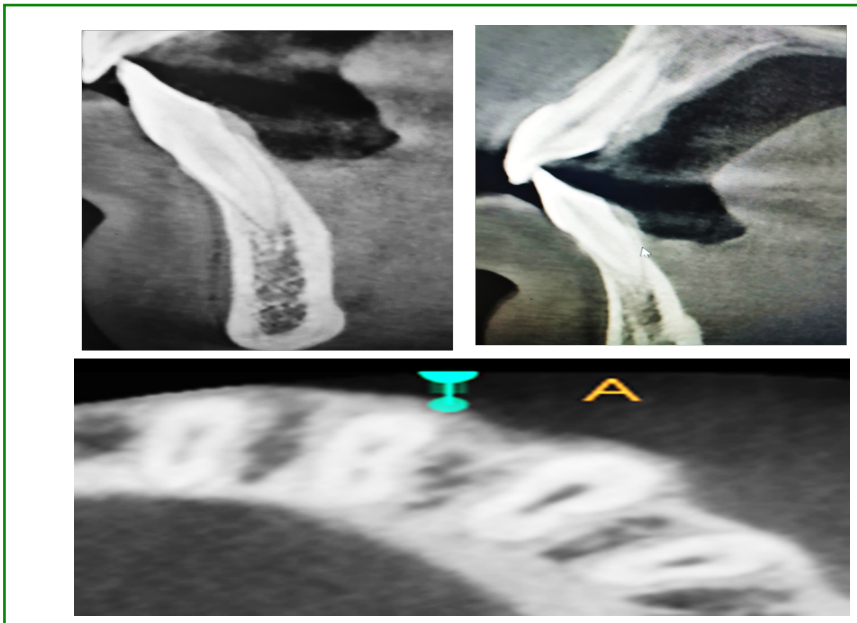

Figure 1: Coronal and cross-section, axial view for one patient (CBCT imaging).

These additional requirements for inclusion were: 1) All of the teeth are visible. 2) The roots have reached their full size; 3) they are free of radiologically visible apical lesions. Having no lateral incisors, completely formed roots, external or internal root resorption, endodontic therapy, or any prosthetic restorations. The teeth that were blurry or malformed, had crowns or abutments, had periapical lesions, or showed any physiological or pathological activity, such as root resorption, poor root growth, or fractures, were eliminated from CBCT visualization. The mandible's central and lateral incisors were seen in high-quality CBCT images to have completely loose roots, untreated root canals (Figure 1), no coronal or postoperative restorations, no periapical lesions, and no root resorption. We recorded information on the patient's gender, the quantity, and the characteristics of the canal root. Serial axial and coronal CBCT images were examined for alterations associated with the permanent central and lateral mandibular teeth from the pulp chamber to the peak, rolling the instrument.

In accordance with Vertucci's classification, channel formations have been divided into the following five categories. The number of roots and the channel composition according to this categorization were seen and noted. Additionally, the patient's age and gender were noted. Vertucci identified the following categories: Type I: a solitary pulp chamber exit; Type II: Before reaching the apex, two distinct channels that emerge from the pulp chamber combine; Type III: Two channels that diverge from the pulp chamber's single channel and ultimately reunite there; Type IV: Two distinct channels extend from the pulp chamber to the apex. Type V: The pulp chamber retracts into a single channel, which then separates into two independent channels with obvious apical foramina.

According to Pecora, et al. the root number was calculated at the plane axial in the manner described below: Uni-rooted teeth are those that have one or two distinct root discrete canals that, despite being fused, appear to have two roots. Multi-rooted teeth are those having several roots, three independent roots, or those below the chamber pulp (Figure 2).

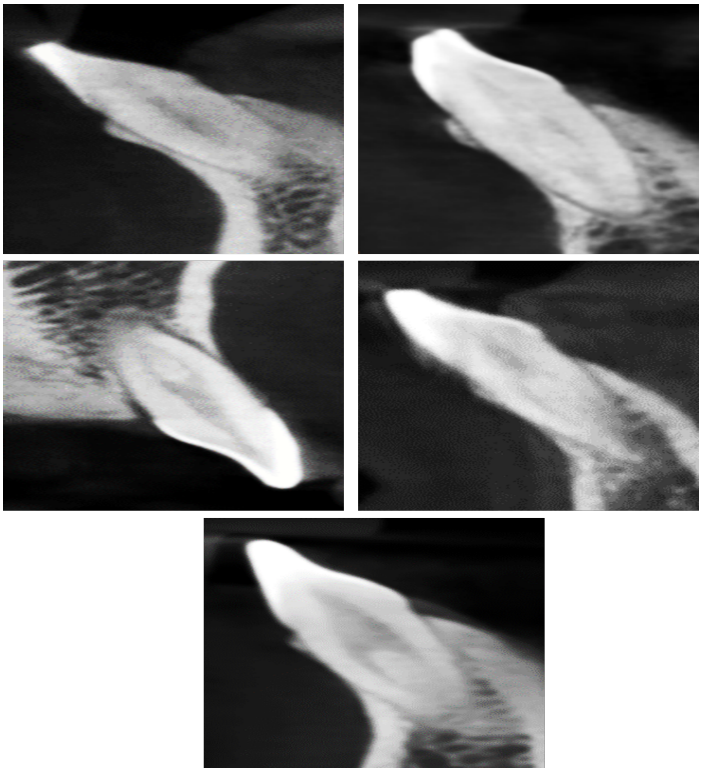

Figure 2: Configurations of canals. Types I through IV, the left to the right

Statistical analysis: the Chi-squared test and the t-test were used to assess the data in the SPSS program. The cutoff for statistical significance was set at 0.05. The correlations between the sex and the number of roots and canal shapes were identified and evaluated using the Chi-square test.

Results

In order to compare the number of incisors between the two mandibular areas, 780 teeth, including 377 mandibular central incisors and 352 mandibular lateral incisors, were

counted from 220 people, 104 males, and 116 women, with a mean age of 34.58 years (range 15 to 75 years) (Table 1).

Root	One Root	Two Roots	Chi-Square	p value
Central incision	377	33	2	0.157
Lateral incision	352	18		

Table 1: Comparison between Central and Lateral Incisor According to the Numbers of Roots

According to the Table 2, the lower jaw's central incisor has one root more than the lower jaw's lateral incisor, which has one root more than the latter. The central incisor also has two more roots than the latter, which has two roots [13].

Based on the configuration of the mandibular central incisor canal, Vertucci distinguished between the central and lateral mandibles, and when comparing the two, we found that the central incisor of the first type has 377 teeth while the lateral incisor has 352 teeth, and the second type has five teeth in the central incisor but only three teeth in the lateral incisor. The mandibular central incisors, which have 21 teeth, have more variances in canal shape than the mandibular lateral incisors, which have 15 teeth. For the mandibular central incisor, Type IV and Type V were 4 and 3 respectively, however, there are no cases known for the mandibular lateral incisor (Table 2).

Types	Central incision	Lateral incision
I	377	352
II	5	3
III	21	15
IV	4	0
V	3	0
Chi-Square	5.442	5.443
p value	0.002*	0.002*
* Significantly in P ≤ 0.05.		

Table 2: Comparison between Central and Lateral Incisor According to Shape of Canal.

Vertucci's classification of canal shape, shown in Table, indicates that there is a substantial variation between the lateral and central incisors [14].

The canal shape differs significantly between males and females, according to the Vertucci type of central incisors; the P-Value for males is 0.001* and for females is 0.003*, as shown in Table 3.

According to the Vertucci type of lateral incisors, The canal shape differs significantly between males and females; the P-Value for males is 0.001* and for females is 0.002* as shown in Table (3).

Central Incisor		Types	Lateral Incisor	
Male	Female		Male	Female
152	225	I	169	183
2	3	II	1	2
4	17	III	6	9
2	2	IV	0	0
2	1	V	0	0
5.463	5.427	Chi-Square	5.45	5.43
0.001*	0.003*	p value	0.001*	0.002*
* Significantly in P ≤ 0.05.				

Table 3: Vertucci type of central and lateral incisor.

The root number of the central incisor appears not to be different between males and females, as indicated in Table 4. Men have 152 teeth with one root and 13 roots, compared to women's 225 teeth with one root and 20 roots. Males have 169 teeth with one root and 11 teeth with roots, compared to 183 roots and 7 roots for females.

The number of roots in the lateral incisor doesn't quite appear to differ between males and females, as indicated in Table 4.

	Root	Male	Female	Chi-Square	P value
Central Incisor	One Root	152	225	2	0.175
	Two Roots	13	20		
Lateral Incisor	One Root	169	183	2	0.17
	Two Roots	11	7		

Table 4: Comparison between male and female according to number of roots in the central and lateral incisor.

Discussion

This investigation used CBCT imaging to offer in-depth details on the root and canal morphology of 780 central and lateral mandibular incisors in the Mosul population. All canals must be identified, found, cleansed, shaped, disinfected, and blocked for endodontic therapy to be effective [14]. CBCT was chosen as the study's evaluation instrument because it is a high-resolution technology that permits 3D imaging and visualization of the exterior and internal architecture of the teeth [15].

Root canal bifurcation can be seen clearly in CBCT images, providing information for quantitative assessment [16]. This study is congruent with another study showed that highlights these root morphological distinctions and their relevance to regional population diversity. We found that most permanent inferior incisors only had one root [17]. Studies carried out in many nations, and even in various parts of the same nation, have revealed diverse root morphologies. Studies on the Turkish population have revealed that between 36% and 85 per cent of lower incisors have just one root canal [6, 18].

The current study supported earlier results showing that the prevalence of two canals of root in the central mandibular incisors and lateral was, respectively, between 13 and 20% and 11 to 7% [19]. These results are similar to those of Caliskan, et al. [20] who recorded that 80.39% of the canines' mandibular and 68.64% of the mandible's incisors the central and lateral had canal of type one in Turkish. The distribution data in this study confirmed that 90% of the central mandibular incisors have a canal of type I morphology.

These findings concur with those made by Altunsoy, et al. [4] who discovered that the type 1 canal of the jaw centers the temporomandibular joint. Males' lower jaws were 80.7% of the whole and females' lower jaws were 88.2% of the total. Males' mandibular canines were 91.6% of the total and females' were 94% of the total. Due to structural variations, single-channel lower incisor prevalence varies greatly among different population [21]. About 40% of the lateral and central maxillary incisors have a root canal system. (The most common type of canal was type III.) Long oval canals are typically present in the central and lateral incisors, which only have one root canal [22].

According to some, differences in inspection methods, classification schemes different findings from the morphological study may be due to factors such as data sets, different ethnicities of dentition sources, and sample size [23]. According to the current clinical study's findings, 1.21% of the mandible's central incisors have a type II canal form, with females having 4% and males having 3.17%. These findings are in contrast to the research of the Turkish population, which found that the incisors of the central and the lateral had a significant prevalence of second channels (68% and 63%, respectively) [24].

This investigation also discussed the variations between the sexes. Both lateral and central incisors showed a larger proportion of females with two canals, and these results are consistent with research on the Caucasian population [25]. However, these findings did not agree with those of Lin, et al. [26], who discovered that men were more likely than women to have multiple ducts. In addition, research on gender differences in mandibular incisors in the Chinese population revealed that men had a much higher prevalence of the second duct.

When one canal divides into two smaller canals, this is known as a root canal bifurcation. Before CBCT was used in clinical practice, 'rapid interval' evidence—where the root canal suddenly stenosis or even disappears on periodical radiographs—was used to infer the existence of bifurcated canals [27,28]. These methods could potentially finds applications in non-invasive treatment of multiple enamel hypoplasia [29].

Conclusion

CBCT is a straightforward, high-resolution, and trustworthy method for examining root canals and their morphology. The teeth root number and forms of canal root creation are all covered in detail, although developmental anomalies and micro-canal architecture are not included. The quantity and development of root canals differed according to sex. A clinically helpful tool for endodontic diagnosis and therapy is CBCT. The results of this study can be used by dentists to further their understanding of the root canal morphology of anterior teeth in Mosul residents. According to shape canal Vertucci's classification, the male and female canal forms and the incisors of lateral and central differ significantly from one another.

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