

# ROOT CANAL CONFIGURATIONS IN PERMANENT MANDIBULAR INCISORS: A CONE BEAM COMPUTERISED TOMOGRAPHY STUDY

<sup>1</sup>NAUMAN BARI KHAN, <sup>2</sup>MUHAMMAD AZHAR, <sup>3</sup>AMIR MUSHTAQ, <sup>4</sup>QAMAR ISHFAQUE, <sup>5</sup>AYESHA RAZA, <sup>6</sup>NABEELA ABASSI, <sup>7</sup>SHIFA MEHMOOD

## ABSTRACT

*The study was carried out to assess various root canal configurations in permanent mandibular incisors of Pakistani population using Cone Beam Computerised Tomography scan.*

*A descriptive retrospective study was planned by using CBCT images of past 01 year, i.e. December 2017 till November 2018. Approval was taken from ethical review committee. Images were assessed for different root canal configurations in permanent mandibular incisors using software NNTVIEWER NewTOM. Data was entered and analyzed using SPSS 20.*

*Total number of 268 mandibular incisors of 67 patients were studied. 64.2% of the images were of male patients while 35.8% were of females. Mean age of the patients was  $48.1 \pm 15.9$  years. All incisors were single rooted. Root configuration of type III was found in 29.9% of central incisors and 34.3% of lateral incisors. The rest of root canals of both central and lateral incisors were of type I. Frequency of occurrence of different root canal configurations were significantly different in central and lateral incisors ( $p < 0.001$ ).*

*All mandibular incisors were single rooted but 35.82% of the patients had more than one root canal in at least one of the mandibular incisors.*

**Keywords:** Mandibular incisors, Root canals, Cone Beam Computerized Tomography (CBCT)

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## INTRODUCTION

For any successful root canal therapy, it is compulsory to have the knowledge of the root canal anatomy of the teeth.<sup>1</sup> One of the biggest challenges in endodontic treatment is complete debridement and sealing off the root canals.<sup>2</sup> Leakage from any of the missed canals has

shown to be the leading cause of the root canal failure<sup>3</sup>. For this, a dentist must have complete knowledge of the number of canals, its location and any variations present in the tooth. Mandibular incisors are generally taken as teeth with single canal and most dentists don't put in much effort to look for any variations present<sup>4</sup>. Mandibular central incisor and lateral incisor have often similar anatomy with very little variations. Weine classified these variations into four types of canal configurations from type I to type IV<sup>5</sup>. In type I, a single canal is present throughout the length of the root. Type II has two independent canals exiting the pulp chamber which merge into one canal near the apex of the root. In type III canal configuration, one canal exits the pulp chamber, but they divide into two separate ones. Type IV has two canals which are completely separated throughout the root's length. Vertucci classified them into 7 types according to their canal configurations.<sup>6</sup> He added type V where one canal divides into two after exiting the pulp chamber. In type VI two canals leaves the pulp chamber, they merge into single canal for a short distance and then once again segregate into two. In type VII, one canal exits the pulp chamber and

<sup>1</sup> **Corresponding Author:** Dr Nauman Bari Khan, BDS, MSc, Assistant Professor, Department of Oral Biology, Army Medical College, National University of Medical Sciences, Rawalpindi, Pakistan. Mob: 0300-9562903 Email ID: nauman@gmail.com

<sup>2</sup> Dr Muhammad Azhar, BDS, Demonstrator, Department of Oral Biology, Army Medical College, National University of Medical Sciences, Rawalpindi, Pakistan.

<sup>3</sup> Dr Amir Mushtaq Baig, BDS, Demonstrator, Department of Oral Pathology, Army Medical College, National University of Medical Sciences, Rawalpindi, Pakistan.

<sup>4</sup> Dr Qamar Ishfaq, BDS, FCPS, Consultant Prosthodontist, Armed Forces Institute of Dentistry, National University of Medical Sciences, Rawalpindi, Pakistan.

<sup>5</sup> Dr Ayesha Raza, BDS, General Dentist, Rawalpindi.

<sup>6</sup> Dr Nabeela Abbasi, BDS, MSc, MHPE, Assistant Professor, Department of Oral Biology, Rawal Institute of Health Sciences, Rawalpindi, Pakistan.

<sup>7</sup> Dr Shifa Mehmood, BDS, General Dentist, Islamabad.

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divides into two and then merges in the middle before dividing again in two canals before leaving the apical foramina. Type VIII has three completely independent canals from chamber till apex of the root.<sup>7</sup>

Different studies have shown variations in canal configuration. Bourah and Bhuyan in 2011 reported 36% of the mandibular incisors have two canals.<sup>8</sup> In one of the studies done in Saudi Arabia on extracted teeth found that 30% of the population had two canals in mandibular incisor.<sup>9</sup>

Peri-apical radiographs and OPG X-rays are the most common diagnostic measures in clinical setups.<sup>10</sup> These X-rays have limitations and often are not reliable due to superimposition of surrounding tissues, distortion in images and magnification reduces reliability of the image.<sup>11</sup>

“Cone Beam Computed Tomography” (CBCT) produces three dimensional images with the advantage of short exposure time, low dose radiation, cost effectiveness when compared to the conventional CT scan.<sup>12</sup> It is already been widely used in the field of implantology, endodontic and maxillofacial surgery.<sup>13</sup> The aim of this study was to investigate the incidence of two canals in permanent mandibular central and permanent lateral incisor in Pakistani population using CBCT.

## MATERIALS AND METHODS

A retrospective study was carried out at radiology department of Armed Forces Institute of Dentistry from December 2017 till November 2018. The consent was taken from the research ethical committee.

The inclusion criteria were “Cone Beam Computed Tomography” (CBCT) images with at least one mandibular central or mandibular lateral incisor with fully matured root, without any pulp stone or calcification of the canals, without any filling or pathology of the apex. Artifacts, bad quality images and any non-Pakistani patients were excluded.

The root and canal configuration of 268 teeth were evaluated using the software NNTVIEWER NewTOM by two experienced examiners at the oral radiology department using a 21-inch screen. The images were observed in coronal, axial and sagittal sections. 0.5 mm slicing was used for each image. Cross section and 3D images were created to confirm the number and configuration of canals.

Root configurations were assessed at axial planes at various sections. Cross-sectional planes with a width of 30 mm and a thickness of 0.5 mm were used to inspect some scans more closely. Vertucci *et. al.* Classification was used to study and classify root canal configurations. SPSS 21 was used for data analysis.

Mean and standard deviation was calculated for age of patients. Percentage and frequencies were calculated for qualitative variables (number of roots and root canals and the type of root canal configuration). Chi-Square and Fisher's exact tests were applied to compare qualitative variables between groups. Independent t-test was used to compare age of patients between different groups.  $p$ -value  $\leq 0.05$  was considered statistically significant.

## RESULTS

A total of 268 mandibular incisors were studied with CBCT. The mean age of the patients was  $48.1 \pm 15.9$  years. Out of 67 patients, 43 (64.2%) were male and 24 (35.8%) were female patients. All mandibular incisors examined had one root. 35.82% of patients had more than one root canal in at least one of the incisors. 70.1% of central incisors had type I while 29.9% had Type III variety of root canal configuration. On the other hand, out of the total number of lateral incisors observed 65.7% had type I and 34.3% had type III variety of root canal configuration. Frequencies of occurrence of different root canal configurations were significantly different in central and lateral incisors ( $p < 0.001$ ) (Table 1). No significant differences were found in number and types of root canals between males and females. No significant association was found between mean age of patients and number and type of root canals.

## DISCUSSION

This retrospective study examined the incidence of two canals in permanent lower incisors using “Cone Beam Computerized Tomography”. The mean age of patients in our study was  $48.12 \pm 15.9$ .

Unaddressed canal in root canal therapy is one of the leading causes of failure of this procedure.<sup>14</sup> The pivotal step in any root canal therapy is to have better understanding of the canal configuration. Also, the clinician must review the radiographs taken from distinct perspectives before accessing the preparation of the cavity and also notice any sudden reduction or attenuation present.

It is necessary to evaluate the epidemiological character of each population and ethics. A better orientation of canal configuration can lead to an increase in therapy success.<sup>15</sup> One of the most common reason for root canal failure is undetected canal. In mandibular incisors lingual canal is often missed

Various studies of the tooth inner and external anatomy showed that anatomical differences can happen in distinct ethnic communities in all groups of teeth with variable incidence.

A study in India found 84% had Type I, 8% had Type II, 4% had Type III, and 4% had Type IV con-

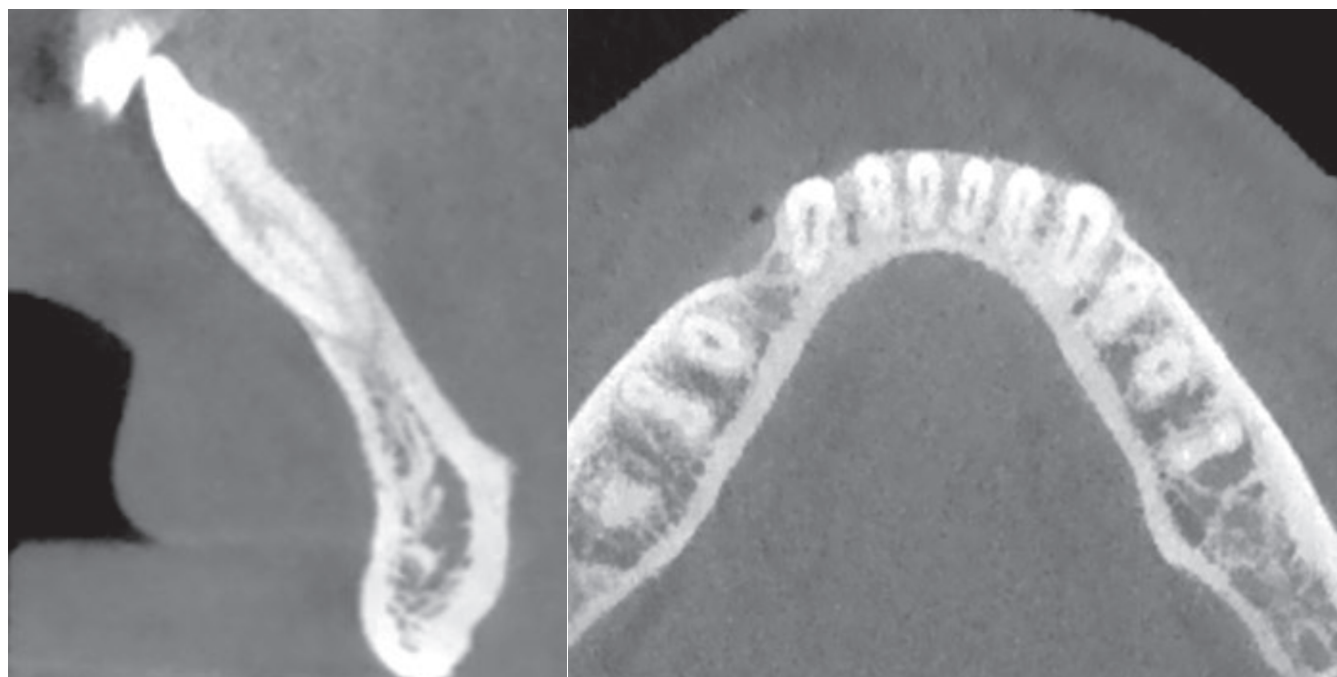


Fig 1: Figure showing Type III canal configuration in lateral incisor using CBCT

TABLE 1: STRATIFICATION OF CENTRAL AND LATERAL INCISORS WITH TYPES OF ROOT CONFIGURATION.

		Lateral Incisor		Total
		Type I root configuration	Type III root configuration	
Central Incisor	Type I root configuration	172	16	188
	Type III root configuration	4	76	80
	Total	176	92	268

p-value < 0.001

figuration (10). A study done with the X-ray method, showed a different finding with 72.4% Type I, 2% Type II, 23.5% Type III, 1% Type IV, and 1.1% Type VI canal configuration.<sup>16</sup> In another study done in Iran they found 83.1% Type I and 16.9% Type II root canal anatomy in permanent lower central incisors.<sup>17</sup> Clearing technique was used by Vertucci wherein he found 70% Type I, 5% Type II, 22% Type III, and 3% Type IV anatomy with 20% lateral canals and 5% apical deltas. A study done in Saudi population using CBCT found out that two canals appeared in 26.3% of mandibular central incisors, 30.8% of lateral incisors.<sup>18</sup> In a study done in Turkey university found out that all central incisors were single-rooted and only 0.1% of lateral incisor were two rooted.<sup>19</sup> In another study done on Israeli population, they found incidence of second canal in 40.5 among central incisor and 37.9 in lateral incisor.<sup>20</sup> Sert et al examined 400 Turkish patients and found 67.5 % of permanent central incisors had more than one root while 63.0 % had more than one root in permanent

mandibular lateral incisor.<sup>21</sup> Incidence of two canals in a study in china found a higher incidence in males when compared to females.<sup>22</sup> While in another study in china by Liu J *et al* found no difference between male and female population.<sup>23</sup> In a study conducted in Pakistan on sectioned extracted teeth, it was observed that only 6% of the population had type III canal configuration other than type I.<sup>24</sup> In our study 35.82 % had type III canal configuration other than type I, which can be related to the use of CBCT. It is interesting to note that no other types were found in our study other than type I and type III. Furthermore, it was observed that mandibular lateral incisors had a greater prevalence of having two root canals as compared to central incisors. More interestingly, lateral incisors also had a greater frequency of having isolated two canals, i.e. when only lateral incisors had two canals while centrals had one. A larger sample size is needed to get more precise data in this region. No significance was found between male and female population.

## CONCLUSION

All mandibular incisors were single rooted but 35.82% of the patients had more than one root canal in at least one of the mandibular incisors.

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### CONTRIBUTIONS BY AUTHORS

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|----------------------|--|
| 1 Nauman Bari Khan:  | Study conception and design; Manuscript writing        |
| 2 Muhammad Azhar:    | Analysis and interpretation of data + Abstract writing |
| 3 Amir Mushtaq Baig: | Data Collection and Image Analysis                     |
| 4 Mohammad Qamar:    | Data and Image Analysis                                |
| 5 Ayesha Raza:       | Helped in Manuscript writing                           |
| 6 Nabeela Abbasi:    | Critical Revision                                      |
| 7 Shifa Mehmood:     | Data Entry   |