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ORIGINAL ARTICLE

Frequency of two canals in mandibular central incisors in Karachi Pakistan: An in-vitro study.

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ABSTRACT… Objective: To determine the frequency of two canals in mandibular central incisors using a radiographic technique in a sample representing Karachi Pakistan. **Study Design:** Cross-sectional in Vitro study. **Setting:** Hamdard University Dental Hospital. **Period:** January, 2022 to July, 2022. **Material & Methods:** According to inclusion criteria 187 extracted mandibular central incisors were collected, flushed under running tap water. 10% formalin was used as storage media afterwards. The attached periodontal tissues and calculus remaining after extraction were removed using a 1/2 Gracey Curette. Number 2 round bur was used in a high speed hand piece to initiate access chamber opening of the pulp chamber. Irrigation was done with 2.5% sodium hypochlorite to make the pulp chamber clearly visible. Detection and negotiation of second canal were performed by using Dental Operating Microscope. No. 15 K-files were introduced into the main canals. Two peri-apical radiographs were exposed at different angulations using DIGORA OPTIME for confirmation. Data was analyzed by using SPSS version 23. **Results:** Mean age of the patients included in the study were 37.12±12.81 years. According to gender distribution there were 101 (54%) males and 86 (46%) females. Outcome concludes that in mandibular central incisors frequency of two canals was 28.3 %. **Conclusion:** Presence of two canals in mandibular central incisors among Pakistani population in our study was 28.3%. When endodontic therapy is commenced on these teeth, dentist must consider the possibility of existence of second canal and exercise caution.

Key words: Mandibular Central Incisors, Morphological Variation, Root Canal Treatment.

INTRODUCTION

Basic aim of providing endodontic therapy to the patients is complete debridement of the root canal and development of an impervious seal at the apex with an inert filling material.[1,2] Command on the anatomy of root canals and its frequent variations is an essential pre-requisite for success during root canal treatment procedures.[3,4,5,6] Difficulties during and after root canal treatment procedure usually evolves due to inadequate anatomical knowledge of root canals thus ends up in sub-optimal chemo-mechanical cleaning of the root canal system hence leads to poor treatment outcomes.[2,5] Failure of endodontic treatment mainly occurs in mandibular central incisors due to incompetency of operator to identify and clean second root canal, mostly lingual canal.[7] Oversighting a second canal often results in persistence of infection as when only one canal is catered, the pulpal tissue residing in the second canal eventually becomes infected and can generate noxious by product leading to secondary or persistent infection.[7,8] Thus it is imperative for the dentist to be familiar with knowledge of number of canals and divisions which would in turn help locate and negotiate them and aid in their successful management.[8,9]

Mandibular central incisors are dimensionally narrow and small teeth and are least commonly affected by caries due to the presence of smooth surfaces of teeth both labially and lingually which usually bath in salivary gland secretions and become less prone to caries.[10,11] Variations in root canal anatomy of all teeth are often overlooked as many dentists assume a standard number of root

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canals while performing the root canal treatment, which may consequently lead to missed canals or endodontic treatment failure.[12]

Recent studies have revealed variations in the anatomy of root canals present in different mandibular anterior teeth.[2,3,8,9,13,14,15,16] Thus the rationale for this study was to explore the occurrence of the second canal in the extracted permanent mandibular central incisors using Dental operating microscope and Digital radiography in Pakistani Population so as to assist the dental practitioners in performing endodontic treatment with improved knowledge of anatomical variations that exist among permanent mandibular central incisors.

OBJECTIVE

This study aims to evaluate the frequency of second canal in mandibular central incisors using radiographic technique in a sample representing Population of Karachi Pakistan.

MATERIAL & MEHTODS

A cross- sectional in-vitro study was conducted at Hamdard University Dental Hospital for a period of 6 months from January '2022 to July '2022. The Institutional Board of Ethical Review Committee provided the ethical approval. Non probability convenient sampling technique was employed. Open Epi version 3 software calculated the sample size n = 187 at 95% confidence level using 39% frequency of two canals with margin of error 5%.[13] Inclusion criteria was extracted permanent right and left mandibular central incisors with sound roots from both genders. Teeth with fractured roots (horizontal or vertical), calcified canals, endodontically treated teeth and teeth with immature apex or signs of resorption were excluded from this study.

During extraction patients' age and gender was noted. After performing extractions, the samples were flushed with running tap water and 10% formalin served as storage medium. Number 2 round bur in a high speed hand piece initiated the access chamber opening which was extended lingually underneath the cingulum to avoid missing any lingual canal orifice. 2.5% sodium hypochlorite was used to irrigate the pulp chamber. Paper points were used to dry the pulp chamber.

After access cavity preparation and main canal negotiation, the second canal was detected using Dental Operating Microscope under magnification of 25 X with the adjunctive use of DG16 endodontic explorer and No. 15 K-files. Peri-apical radiographs were exposed from different angulations (standard angulation i.e. 90º and altering horizontal angulation from distal aspect i.e. 30º) using DIGORA OPTIME for confirmation of the number of second canals. SPSS version 23 software was used for data analysis. Endodontic configuration of the studied teeth was further explored using Weines'classification[6] (Figure-1). Stratification was used to control effect modifiers like age and gender. Difference was evaluated by applying chi square test and the p-value <0.05 was taken as significant.

Figure-1. Weine Classification

RESULTS

187 patients were assessed in this study. 37.12±12.81 years were the calculated mean age of the patients. Figure-2 depicts the age distribution of patients presenting two canals. According to gender distribution 101 (54%) teeth were males and 86 (46%) were females in our study. Single canal was seen in 134 (71.7%) patient and two canals in 53 (28.3%) patients (Table-I). According to Weine classification, we further explored the endodontic configuration of the studied teeth and found 71.7% of samples had one canal and one apical foramen, 26.2% with two canals and one apical foramen, 1.6% had two separate canals and two separate apical foramina and 0.5% had one canal dividing into two apical foramina. (Table-II) No statistically significant difference was noted (p value = 0.20) for the presentation of two canals between males and females (Table-III).

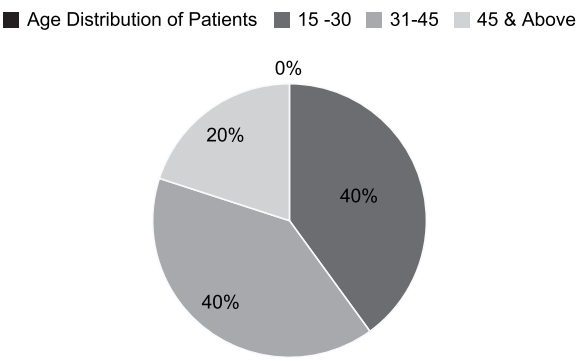

Figure-2. Age Distribution of patients presenting two canals

No. of Canals	No. of Teeth (%)
Single canal	134 (71.7%)
Two Canals	53 (28.3%)

Table-I. Distribution of canals in mandibular central incisors

No. of Canals	No. of Teeth (%)
Type I	134 (71.7%)
Type II	03 (1.6%)
Type III	49 (26.2%)
Type IV	01 (0.5%)

Table-II. Distribution of canals in mandibular central incisors according to weine classification

		Gender		Total	P-Value
		Male	Female		
Frequency of Two canals in mandibular central incisors	Yes	33	20	53	0.20
		62.2%	37.7%	100.0%	
	No	68	66	134	
		50.7%	49.2%	100.0%	
Total		101	86	187	
		54.0%	46.0%	100.0%	

Table-III. Gender distribution of two canals in mandibular central incisors

DISCUSSION

Root canal anatomy and its frequent variations should be known by the operator as an essential pre-requisite for attaining success during root canal procedures. Mandibular incisor teeth also present morphologic diversity of root canal system. Presentation of a second canal is a frequent possibility in mandibular central incisors.[2] Failure of recognizing and unawareness of which can lead to missed canal and as a consequence complications can arise during endodontic treatment of these teeth.[1,2,6] In our study, 28.3% of investigated mandibular central incisor teeth were found to have a second canal. No significant gender association was found to be present in our study.

Endodontic morphology of mandibular incisors has been studied frequently in literature.[2,3,5,7,8,9,14,15] Overall second canal frequency in mandibular central incisor was noted between 0.4 - 45%.[14] Whereas, existence of a second canal in mandibular lateral incisors was shown between 5 - 43 %.[14] Researchers employed different methods of studying the internal morphology including Peri-apical radiography, CBCT analysis, coloring and decalcification and clearing techniques.[5,9,14,15]

Reported literature (Table-IV) shows a lack of consistency in the frequency of second canals in mandibular incisors. The differences may be related to study design (in vivo versus in vitro), technique of canal identification (radiographic examination/ sectioning / clearing). This can also be attributed to geographical position and/ or racial divergence.[16] Thus it is pertinent that the operator must not oversight the possibility of existence of a second canal while performing endodontic treatment in a mandibular central incisor, failure of which can result in persistent or secondary infection.

The highest reported frequency of second canal in mandibular central incisors through CBCT analysis was in Italian population.[17]Obino et al evaluated 487 teeth through CBCT and found 45% of the mandibular central incisors to have a second canal.[17] The high frequency might be attributed to the possible geographic location. Our reported frequency is closer to the Portuguese population where Martin et al noted 27.4% existence of second canal in the mandibular central incisors.[18] In mandibular central incisors low frequency of second canals is noted in Chinese population which is found to be 0.4%.[19]

In literature, most studies investigated the root canal anatomy of mandibular central and lateral incisors together.[3,5,8,9,14,20] In Pakistani population Mir HA[20] evaluated the root canal morphology

of mandibular incisors through CBCT and found 26.2% of the investigated teeth had two canals. In their study[20] 23.5% of the mandibular central incisors had two canals which is slightly lower than our reported results. Reported literature shows that mandibular central incisors less frequently present a second canal than mandibular lateral incisors.[21,22] Sheikh MA[13] and Moorpani P[23] studied the endodontic morphology of lateral incisors in Pakistani population and found the frequency of second canal 39% and 33.1% respectively which is higher than our finding of 28.3% second canals in mandibular central incisors.

In our study, among the noted 28.3% second canals in mandibular central incisors, Weine type III was found to be the most common presentation having two separate portals of entry and exit i.e. separate orifices and apical foramina. Whereas, Perlea P[5] noted Weine type II to be more prevalent in their study. Weine type IV in which single canal divides into two portals of exit presents with comparatively greater degree of treatment difficulty. In our study, it was found to be present with a frequency of 0.5%.

Limitation of our study is limited sample size. Future studies exploring the frequency of a second canal existence should be carried out with a larger sample size among different ethnicities of Pakistani population so as to give the dental clinicians better knowledge and insight for treating accordingly without procedural errors.

CONCLUSION

To conclude we can state that the frequency of two canals in mandibular central incisors among Pakistani population in our study was 28.3%. No significant gender association was found to be present in our study related to the frequency of presentation of a second canal. Thus it is pertinent that the operator must not oversight the possibility of existence of a second canal while performing endodontic treatment in a mandibular central incisor, failure of which can result in persistent or secondary infection.

Author(s)	Year	No. of Teeth	Study Method	Study Place	Study Results (Two Canals)
Gengoclu N[15]	2000	40	Obturation, coloring and decalcification	Saudi Arabia	30%
Lin Z[21]	2014	1412	Radiological (CBCT)	China	25.5%
Han et al[25]	2014	1286	Radiological (CBCT)	China	15.7%
Liu et al[26]	2014	768	Radiological (CBCT)	China	8.9%
Zhao et al[27]	2014	1566	Radiological (CBCT)	China	6.7%
Zhengyan et al[28]	2015	3375	Radiological (CBCT)	China	3.8%
Kayaoglu et al[29]	2015	1983	Radiological (CBCT)	Turkey	14.9%
Silva et al[30]	2016	200	Radiological (CBCT)	Brazil	35.5%
Haghanifar et al[31]	2017	317	Radiological (CBCT)	Iran	16.7%
Martínez et al[32]	2018	174	Radiological (CBCT)	Belgium	38.5%
Martins et al[18]	2018	1203	Radiological (CBCT)	Portugal	27.4%
Martins et al[19]	2018	240	Radiological (CBCT)	China	0.4%
Martínez et al[32]	2018	171	Radiological (CBCT)	Chile	21.6%
Shemesh et al[33]	2018	1472	Radiological (CBCT)	Israel	40.5%
Mirhosseini et al[22]	2019	681	Radiological (CBCT)	Iran	23.9%
Obino et al[17]	2019	487	Radiological (CBCT)	Italy	45%
Mir HA[20]	2020	100	Radiological (CBCT)	Pakistan	23.5%
Kanyılmaz AN[34]	2021	487	Radiological (CBCT)	Turkey	40.4%
Nivedhitha[35]	2021	200	Radiological (CBCT)	India	29%
Alaboodi RA[36]	2022	464	Radiological (CBCT)	Saudi Arabia	29.3%

Table-IV. Studies on root canal morphology of mandibular central incisors

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3	Fariha Irfan	Planning manuscript, interpretation of survey detail.	
4	Hina Hammad	Analysis of survey data, Data collection.	
5	Abdur Rehman	Data collection, Interpretation of survey data.	
6	Syed Abrar Ali	Reviewing of final manuscript, Manuscript writing, data analysis.	