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Research Article

CORRELATION BETWEEN INTER-ORIFICE DISTANCE AND ROOT CANAL CONFIGURATION IN MANDIBULAR SECOND MOLAR IN MEERUT DISTRICT POPULATION –A CBCT BASED EVALUATION

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ABSTRACT

Aim & Objective: The aim of the present study was to evaluate the root canal morphology of the mesial root of two rooted mandibular second molars in Meerut district (U.P.), population and predict the co-relation between the inter-orifice distance and the canal configuration.

Method: Randomized data of patients who were advised CBCT for a purpose other than this study was collected from the Department of Oral Medicine & Radiology. A total of 174 scans were observed, in which the mesial root of 207 mandibular second molars were evaluated for the study. The samples were viewed in axial, sagittal as well as coronal planes to determine the root canal configuration and measure the inter-orifice distance between the mesio-buccal and the mesio-lingual canal for all the samples.

Result: The most common canal configuration observed was Vertucci's Type IV followed by Vertucci's Type II. Type II canals had a smaller mean inter-orifice distance (2.14mm) There was a significant correlation between the inter-orifice distance and root canal configuration in all the observed samples.

Conclusion: Vertucci’s Type IV is the most common canal morphology found in the mesial root of mandibular second molar and the inter-orifice distance can be used as a reliable predictor of canal morphology. Canals with smaller inter-orifice distance had a tendency for Type II configuration.

INTRODUCTION

One of the most common causes of endodontic treatment failure is inadequate diagnosis and treatment planning of the treated tooth, due to lack of comprehensive knowledge about the morphological characteristics and frequent variations of the entire root canal system (Weine*et al*., 1972). The first published literature indicating wide variation in the anatomy of the root canal system can be dated back to 1842, when Carabelli in his first comprehensive and systematic description, published drawings of sectioned teeth (Carabelli *et al*., 1842). Various methods have been introduced since then to predict and determine the anatomy and morphology of the root canal. These include knowledge gained from the textbooks and use of clinical methods like guided exploration, visualization-endogram,fiberoptic-endoscope, dental operating microscope, radiography, and cone beam volumetric tomography (CBCT) and various in-vitro methods like clearing technique, and sectioning followed by visualization under a scanning electron microscope (SEM) or stereomicroscope (Neelakantan *et al*., 2010). The root canal system can vary greatly in different populations and also among different individuals within the same population, therefore awareness about variations in anatomy can help the clinician to locate and manage canals during root canal treatment (Gulabivala *et al*., 2001, Weine *et al*., 1988, Al-Qudah *et al*., 2009, Dermibuga *et al*., 2013).

Peri-apical radiographs can only give limited information regarding the morphology of the canals, the degree of curvature in a buccolingual plane, and whether two canals within one root stay separate or merge (Patel *et al*., 2009). An excellent tool to provide a three-dimensional view of tooth is Cone beam computed tomography (CBCT), also known as dental volumetric tomography, which has gained wide acceptance in dentistry in the last ten years although there are issues like radiation exposure and high cost associated with it (Plotino *et al*., 2006).

Since these advanced imaging techniques may not always be feasible, various clinical predictors could aid in a better understanding of anatomy. One such predictor can be the inter-orifice distance, which can be used in cases of multi-rooted teeth or root with multiple canals.Cimilli*et al.* (2006)in their study used inter-orifice distance between the mesiobuccal and mesiolingualcanal orifice as a predictor for thecanal curvature in mandibular first molars.However there is lack ofevidence in

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literature as to whether the relative location of canal orifices in a root could have some predictive value regarding configuration of these canals.

Thus the aim of the present study was to evaluate themorphology of root canal system in the mesial root ofmandibular second molars with two roots in Meerut district population and evaluate the relationship of inter-orifice distance betweenmesio-buccal and mesio-lingual canals with the configuration of the canals.

MATERIAL AND METHOD

Randomized samples of healthy adult residents of Meerut district, who had undergone CBCT for various clinical indications such as trauma, orthodontics, presence of periapical pathology, implant planning, assessment of impacted teeth and endodontic purposes were selected. A total of 174 patients' scans with207 samples of two rooted mandibular second molars were observed.

Complete diagnostic CBCT images without any artifacts were used for the study. Inclusion criteria was two rooted mandibular second molars with fully mature apices and patient's age ranging between 18-50 years. Exclusion criteria was teeth with open apices, presence of resorption or calcification, previous root canal treatment, C-shaped canals, fractured teeth, and images with distortion or artifacts. The images were taken with the following CBCT settings: 85 kVp, 9.0 mA, 6mA, 5x5cm field of view, 0.2 mm^3 voxel size, and 0.25 mm slice thickness. The analysis of the CBCT data was done using Galaxis and Sidexis software on a 32 inch Dell LCD screen having a resolution of 1280x1080p. The assessment of samples was done in axial, sagittal, and coronal planes. The contrast, brightness, and magnification were adjusted whenever required.Sagittal sections of the samples were observedfor number of canals and their configuration (according to Vertucci &Gulabivala classification). Canals exhibited Type I, Type II, Type IV Vertucci and Type II Gulabivala configuration. Vertucci's Type I configuration was defined as one canal extending from the pulp chamber to the apex (1-1), Vertucci's Type IIconfiguration was defined as two separate canals at the level of the floor of pulp chamber which merge to form a single canal before reaching the apex(2-1), while Vertucci's Type IVconfiguration was represented as two canals running separately from orifice to apex (2-2).GulabivalaType IIwas defined as three separate canals with two of them joining into one during its course to exit as two root canals (3-2). Axial sections of samples were analysed to calculate the inter-orifice distance of MB and ML canals. To measure the inter-orifice distance, a point was marked at the centre of each canal orifice(at the level of the pulp chamber floor) and the distance between the two points was measured by drawing a line between them using the measuring tools of the software on the sagittal section(Figure 1). The level at which the canals became confluent was marked andthe distance of this point from the root apex was calculated to determine the occurrence of confluence in apical, middle or coronal region.

***Statistical Analysis**:* All the statistical analysis was performed using R Console software (Rcmdr Version 2.6-2). Paired sample t-tests were used for inter-group comparisons of inter-orifice distance and type of canal configuration. Median value was calculated for both the groups. Differences were considered significant if $p < .05$.

RESULTS

Out of 207 samples, the number of samples withType I, Type II, Type IV Vertucci's and Type II Gulabivala configuration in themesial root of mandibular second molar in Meerut population was 20(10%) , 65(32.5%), 103(51.5%) & 12(6%) respectively. The mean inter-orifice distance for Type II configuration was 2.33± 0.33 mm while for canals with Type IV configuration, it was 3.44±0.344 mm. The chi-square showed a statistically significant difference ($p<0.05$) between the values of inter-orifice distance in Type II and Type IV canal configuration (Table 1).

Table 1 Table showing the mean and median values obtained from Chi-square test.

		Frequencies			
Median= 3.125		Type II	Type IV	chi square	p value
Inter-orifice distance	> Median	0	84	106.019	0.000
	<= Median	65	19		

p value < 0.05 was considered significant.

Table 2 Table showing group statistics after using t-test.

	Canal Configuration	N	Mean	Std. Deviation	Std. Error Mean	t-test	p-value	CI
Inter-orifice distance	Type II	65	2.3329	0.33544	0.04161	-20.616	0.000	-1.21948±1.00632
	Type IV	103	3.4458	0.34409	0.03390			

p value < 0.05 was considered significant.

Using the t–test, median value for the inter-orifice distance was calculated to be 3.125 mm. All the values below the median value showed Type II canal configuration, while those above it showed Type IV configuration (Table 2). Another interesting finding was that in all the samples with Type II configuration, the merging of canals was most frequently observed in the apical third part of the root.

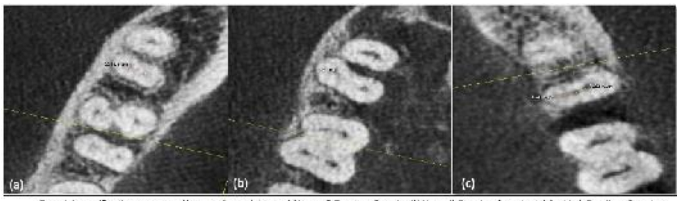

Figure 1

DISCUSSION

In the present study, mandibular second molars were studied as they present a wide variety of variations in canal morphology. Although CBCT is a useful tool but it may not be possible to perform 3-D imaging in every clinical case due to economic constraints or undue radiation exposure. In this context, knowledge of clinical predictors could help in better understanding of the canal anatomy and cantherefore, help the clinician to reduce the chances of procedural errors such as canal transportation, ledge formation, extrusion of the debris, instrument separation, etc (Ng *et al*., 2011).That's why CBCT was used as a tool in this study to analyse, comprehend, and provide a comprehensive report on morphology of the root canal system of mandibular second molars in Meerut district population.

The aim of this study was two-fold, the first aim was to evaluate the canal configuration in the mesial root of mandibular second molar and the second aim was to establish a correlation between the inter-orifice distance and the type of canal configuration.

In the present study, out of 207 mandibular second molars that were observed, the majority showed three canals (90.5%) with two canals in the mesial root, and the most commonly observed configuration in mesial root being Vertucci's Type IV canals (62%) followed by Type II (28%).

These findings corroboratewith those of Neelakantan *et al.* (2010) who conducted a study on root canal morphology of mandibular second molars which were collected from dental practitioners across the Indian subcontinent and concluded that the most common configuration observed in the mesial root of mandibular second molar was Type IV (76%).Similar findings was reported by Weine *et al.* (1988) who observed in their study that the mandibular second molar commonly has two roots. The mesial root most frequently has two canals and two separate apical foramina representing Vertucci’s type IV configuration; the distal root having one canal and one apical foramen. Al-Qudah & Awawdeh (2009) also observed Type IV to be the most common canal configuration in Jordanian population. Similar results were found by Nur *et al.* (2014) & Demirbuga *et al.* (2013)in the Turkish population. However, in contrast, Gulabivala *et al.*(2001) and Vertucci *et al.* (1984)revealed in their studies that mandibular second molar has three canals but tends to have only two apical foramina indicating Type II being the most prevalent in the studied population. Pineda and Kuttler (1972) reported Type I to be the most frequent canal configuration in the mesial root of the second molar tooth in Caucasian population. These variations may be due to the difference in the studied population type, ethnicity and genetic differences (Manning, 1990).

The inter-orifice distance between the mesiobuccal and the mesiolingual canal of the mesial root was measured using the software tools and their relation with canal configuration was established. It was observed that the samples having a mean inter-orifice distance of approximately 2.33 mm showed confluence in the apical third of the root canal representing Vertucci's Type II configuration while the canals with a mean inter-orifice distance of 3.44mm did not show confluence in the apical third representing Vertucci's type IV configuration (Table 1). Hence the patternobserved was that, in samples with smaller inter-orifice distance, the possibility of merging of two canals in the apical third of the root was high, indicating the confluence of the mesiobuccal and mesiolingual canals. Similar results were observed by Kim *et al.* (2018) in mandibular first molars where they measured the inter-orifice distance between the mesio-buccal & mesio-lingual canal as well as the disto-buccal &disto-lingual canaland the findings of the study showed that increased inter-orifice distance was associated with a high prevalence of two separate foramina in both roots of mandibular first molars .These findings corroborate with those observed in mandibular second molars in our study too. There are other studies by Cimilli*et al.* (2006)which have shown the inter-orifice distance as a useful tool to predict the degree of canal curvature in the mesial root of mandibular first molar.[12]

CONCLUSION

Hence,within the limitations of the study, it can be concluded that in Meerut district population, Vertucci's Type IV is most common canal morphology in mesial root of two rooted mandibular second molar followed by Vertucci's Type II. Also, the inter-orifice distance can be used as a reliable predictor of canal morphology, a smaller inter-orifice distance (<3.125mm) is more predictive of Type II configuration. However, there is a need for further research in different population groups with larger sample size to validate the findings of this study.

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