Internal Morphological variability of mandibular premolars in North Indian Population

ABSTRACT

AIMS: THE CURRENT STUDY AIMS TO INVESTIGATE THE ROOT CANAL MORPHOLOGY OF ROOT CANALS OF MANDIBULAR PREMOLAR TEETH VIA CONE-BEAM COMPUTED TOMOGRAPHY (CBCT) AMONG A SAMPLE OF THE NORTH INDIAN POPULATION.

STUDY DESIGN: RETROSPECTIVE OBSERVATIONAL STUDY

PLACE AND DURATION OF STUDY: DEPARTMENT OF CONSERVATIVE DENTISTRY AND ENDODONTICS.

METHODOLOGY: A TOTAL OF 240 CBCT IMAGES WERE EXAMINED IN THE STUDY. THE MANDIBULAR PREMOLARS WERE IDENTIFIED, AND CANAL CONFIGURATIONS WERE CLASSIFIED ACCORDING TO VERTUCCI CLASSIFICATION. ROOT CANAL CONFIGURATIONS WERE INVESTIGATED USING A CHI-SQUARE TEST.

RESULTS: OF THE TOTAL 240 MANDIBULAR PREMOLARS, VERTUCCI TYPE I WAS FOUND IN 86.66% IN MANDIBULAR FIRST PREMOLARS FOLLOWED BY TYPE V (8.33%) AND TYPE IV (5%). VERTUCCI TYPE I WAS FOUND IN 96.6% IN MANDIBULAR SECOND PREMOLARS FOLLOWED BY TYPE V (1.66%), TYPE III (0.8%) AND TYPE VIII (0.8%).

CONCLUSION: THE ROOT MORPHOLOGY OF MANDIBULAR PREMOLARS IN THE NORTH INDIAN POPULATION DEMONSTRATED A HIGH DEGREE OF VARIABILITY. HOWEVER, THE CLINICIAN SHOULD BE AWARE ABOUT THE POSSIBLE ANATOMIC VARIATIONS OF THESE TEETH AND THEIR RELATIONSHIP WITH THE ADJACENT ANATOMIC STRUCTURES WHILE PLANNING AND PERFORMING ENDODONTIC, RESTORATIVE, PERIODONTAL, AND SURGICAL PROCEDURES.

Keywords:mandibular premolars, CBCT, root canal morphology, North Indian Population

1. INTRODUCTION

"Knowledge of the morphology of the root and root canal systems of teeth and diagnostic imaging techniques are required for successful root canal treatment, especially inmandibular premolar teeth"[1]. "Most dental textbooks on the anatomy and morphology of teeth describe the human dentition well, but sometimes fail to provide details on the range of variation in

external root anatomy and internal root canal systems. Anomalous root and root canal morphology can be found associated with any tooth with varying degrees and incidence. Both the mandibular first and second premolars most often have a single root and a single canal, however, anomalies of the root and root canal systems as well as multiple canals have been reported in the literature"[2].

"A number of studies using different methodologies have been done to understand the anatomical complexities of the root canal system of human permanent mandibular premolars"[3,4,5]. "The investigators have assessed the same in different population groups globally. A number of differences in the anatomy of the permanent premolars have been reported as specific to races and populations"[6,7,8].

The mandibular first premolars are usually single rooted. Incidence of single canal is 77.3% and two canals is 22.7%. Incidence of single canal is 91.3% and of two canal is 8.7% in second mandibular premolar. Mandibular premolars have one of the most complex anatomies[9].

"A variety of techniques have been proposed to permit visualization of the root canal system such as clearing technique, modified canal staining and scanning electron microscope. Improved examination of the morphology of the canal wall is possible with use of the scanning electron microscope which permits magnification. The major disadvantage of all of these techniques is that the tooth is irreversibly altered as a result of sectioning, dissolution, or the injection of a solid core material"[4,5].

Plotino G et al (2014)[10] in "a study of tomographic techniques noted that it is a non-invasive technique for the three-dimensional assessment of the root canal system before, during and after endodontic instrumentation". "The combination of sagittal, coronal, and axial views eliminates the superimposition of anatomic structures and provides clear view of internal root morphology, the number of root canals present within them and their ramifications in three dimensions"[11].

Thus, this study aims to analyse the root canal configuration of mandibular premolars using database of previously done Cone Beam Computed Tomography, so as to study the range of variations and study the diversity in internal and external anatomy in the North Indian population.

2. MATERIAL AND METHODS

Determination of Optimum Sample Size-

The study consists of one Group – 240 mandibular premolars and two sub-groups (first & second premolars). Within each main group, there was a mixture of Qualitative/ Categorical Parameters. For qualitative variables, Chi-square test was applied for the association of attributes. Family history of patients were taken and confirmed about being North Indian Population.

ASSESSMENT OF CANAL CONFIGURATION-

The canal configuration was assessed using the classification given by **Vertucci FJ. in 1984.** The lingual and the buccal root was assessed separately and thevarious canal configurations identified were tabulated of all the samples.

VERTUCCI CLASSIFICATION-

Type I: A single canal extends from the pulp chamber to the apex (1-1).
Type II: Two canals leave the pulp chamber join short of the apex to exit as one (2-1).
Type III: One canal leaves the pulp chamber and divides into two in the root; the two then merge to exit as one canal (1-2-1).
Type IV: Two separate, distinct canals extend from the pulp chamber to apex (2-2).
Type V: One canal leaves the pulp chamber and divides short of the apex into two separate, distinct canals with separate apical foramina (1-2).
Type VI: Two canals leave the pulp floor, merge and redivide short of apex to exit as two distinct separate canals (2-1-2).
Type VII: One canal leaves the pulp chamber, divides and then re-joins in body of the root, and finally redivides into two distinct canals short of the apex. (1-2-1-2).
Type VIII: Three separate, distinct canals extend from the pulp chamber to the apex (3-3).

3. RESULTS AND DISCUSSION

Vertucci type I was found in 86.66% in mandibular first premolars followed by Type V (8.33%) and Type IV (5%). Vertucci type I was found in 96.6% in mandibular second premolars followed by Type V (1.66%), Type III (0.8%) Type VIII (0.8%). (Table – 1 and figure – 1 and 2).

Table 1: Distribution of premolars according to Vertucci classification in sub-group of Group (Mandibular premolars)

Vertucci classification	First premolars		Second premolars		Total	
	Frequency	%	Frequency	%	Frequency	%
1	104	86.66	116	96.6	220	91.66
2	0	0.00	0	0.00	0	0.00
3	0	0.00	1	0.8	1	0.4
4	6	5.00	0	0.00	6	2.5
5	10	8.33	2	1.66	12	5.0
6	0	0.00	0	0.00	0	0.00
8	0	0.00	1	0.8	1	0.4
Grand Total	120	100.00	120	100.00	240	100.00

p -value < 0.001, the association of first and second premolars within Group-B according to vertucci classification is significant.

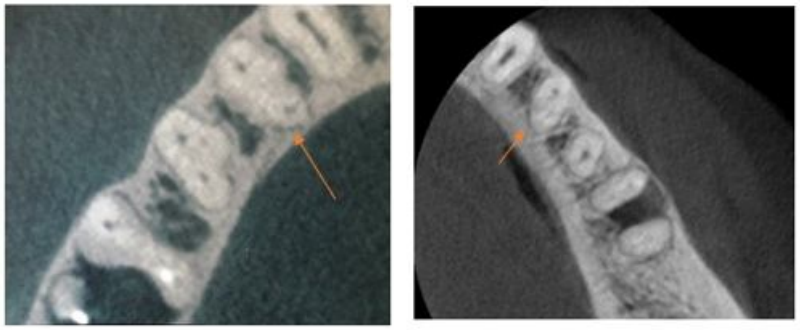

Figure 1(a) Type IV, (b) Type V Vertucci Canal Configuration in Mandibular first premolar

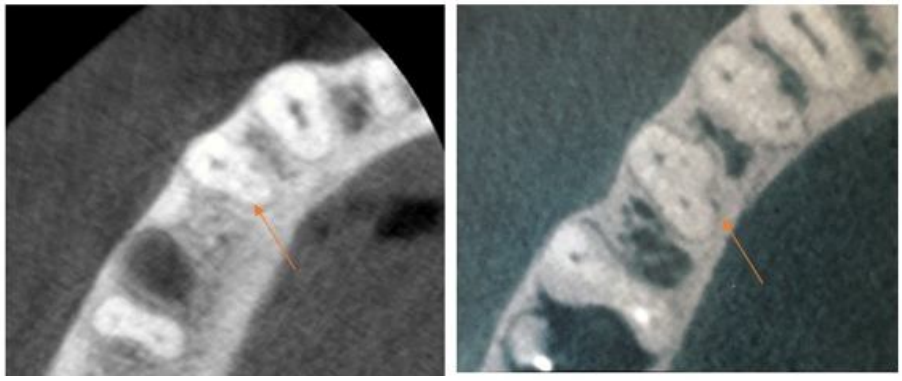

Figure 2(a) Type V, (b) Type VIIIVertucci Canal Configuration in Mandibular second premolar

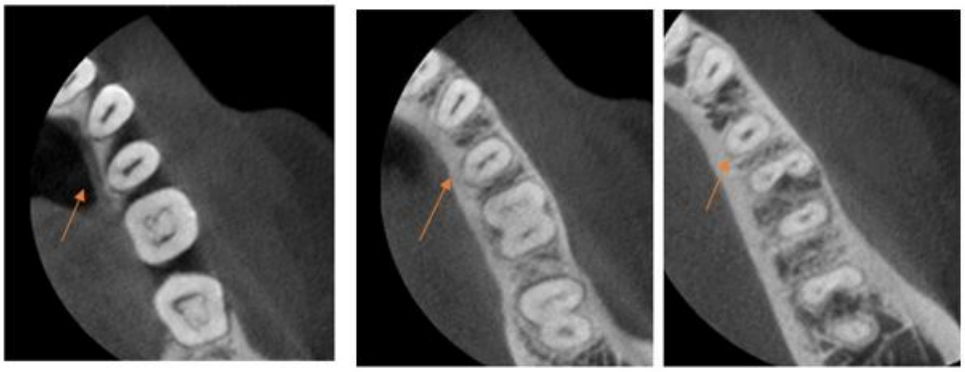

Figure 2(c) Type III Vertucci Canal Configuration in Mandibular second premolar

I. Mandibular first premolars

The findings of the present study in North Indian population are consistent with those reported for other populations, suggesting that the most frequent root canal type is type I (89.15%). In the present study, the type II classification was not found, in contrast with the reports by Velmurugan[13] and Iyer[14], who found low frequencies in Indian population (6% and 2%, respectively) and similar with the study by Alfonso-Rodríguez[15]. Based on a study conducted in a sample of 100 mandibular first premolars in India, Velmurugan[13] reported that "the most frequent type of canal according to Vertucci's classification was type I (72% of the whole population)". In contrast, Khedmat and Assadian[16] found that "88.47% of mandibular first premolars were type I in Iranian individuals".

In this study, type III was not found in mandibular first premolars which is in contrast to that reported by Velmurugan[13] (3%). Sert[17] found "a comparatively higher frequency of this type, corresponding to 10.5% in Turkish individuals". However, Iyer[14] "did not find any mandibular first premolars that were type III".

In the present study type IV was found in 5% of cases which was higher than a study by Vertucci who found that 1.5% of 400 mandibular first premolars as type IV[14]; meanwhile, Sert,[17] Velmurugan[13], and Iyer[14] found that 7%, 10%, and 20.8% of the mandibular first premolars were type IV, respectively.

In North Indian population, type VI was not found which is similar to the studies conducted by Vertucci[9], Velmurugan[13], and Iyer[14]. The type VII classification of Vertucci is unusual, as evidenced by its low frequency in mandibular first premolar studies conducted in different

populations. In North Indian population the types with variation were types I, V, and IV vertucci classification.

II. Mandibular second premolars-

"All of the mandibular second premolars in the present study were single rooted and a large number of them had one canal (96.6%) that is similar to Ingle's results"[10]. "However, 4.4% of these teeth had two canals which was similar to Vertucci's study (2.5%)"[100]. Such differences may result from racial differences and methods of studying. Mandibular second premolars had one canal and one apical foramen in 97.6% and had two canals and two foramens in 2.4% of cases. This finding is different from Ingel's results (one canal and one apical foramen=85.5% and two canals with two apical foramen foramens= 11.5%). Other interesting finding of this study was the 0.8% prevalence of three canals in the mandibular second premolars.

4. CONCLUSION

Certain population and geographic groups have little or no data regarding premolars morphology, like in North Indian populations. The mandibular first premolar was more prone to bifurcation of canals (23–30%) terminating in multiple apical foramina (15–20%), as compared to second premolars. The existence of this type of RCS is critical to successful root canal treatment because it is hard to detect variations on periapical radiograph images.

Ethical Approval:

The present study was conducted in the Department of Conservative Dentistry and Endodontics, to evaluate root canal configuration mandibular premolars. The study plan was approved by the ethical committee.

Consent

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

All authors read and approved the final manuscript.

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