EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 10
Issue: 2
480-483
Year: 2023

EVALUATION OF ROOT CANAL MORPHOLOGY OF PERMANENT MANDIBULAR PREMOLARS USING CONE BEAM COMPUTED TOMOGRAPHY IN A NEPALESE SUB-POPULATION

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Article Received on 21/12/2022 **Article Revised on 11/01/2023** **Article Accepted on 31/01/2023**

ABSTRACT

Introduction: A thorough understanding of dental anatomy and root canal morphology is necessary for successful dental root canal procedures. Due to a variety of anatomical variances in root canal systems and challenging access to the second root canal, endodontic treatment for mandibular premolars frequently fails because the full root canal length cannot be effectively treated. This study was designed with an objective to assess the root canal shape of apical third of permanent mandibular premolar employing Planmeca CBCT and Romexis 3.0.1.R software. **Material and Methods:** Total of 90 teeth were scanned using CBCT and were categorized at based on the shape: 1. round; 2. oval; 3. long oval; 4. flat/ribbon-like. Root canal shapes were assessed within the apical third at 1 mm, 2 mm, and 3 mm. The root canal morphology was classified based on de-Pablos' classification. Categorical data were analyzed as frequencies using SPSS software version 11.5. **Results:** The most frequent shape was oval (86%) at in apical third. The most common root canal morphology was Type I which is a single canal with a single apex (82.2%). **Conclusion:** At the apical portion of the root, non-round canal shapes are not unusual. The presented information may assist clinicians in comprehending the anatomy in the apical third of the lower premolar and in selecting the most effective course of action.

KEYWORDS: CBCT, Mandibular premolar, Root canal

INTRODUCTION

Endodontic therapy has developed into a crucial and efficient technique for preserving and sustaining oral health in the modern era because to advancements in modern dentistry. The second-most significant factor contributing to treatment failures, behind improper diagnosis and treatment planning, is a lack of understanding of the interior architecture of teeth and dental pulp.[1] Thus, for better debridement and obturation of canals and, consequently, for a better prognosis of the treatment, knowledge of the internal anatomy of teeth is crucial.[2] The quality of root canal treatment might be impacted by complex root canal anatomy.[3] Therefore, it is crucial to understand common root canal anatomy and be aware of any potential variances.[4]

The failure rate in the mandibular first premolar was 11.45%, according to a Washington study that evaluated the outcomes of endodontic therapy for mandibular premolars.[5] Due to a variety of anatomical variances in root canal systems and challenging access to the second root canal, endodontic treatment for mandibular premolars frequently fails because the full root canal length cannot be effectively treated.[6]

Numerous studies have evaluated the root canal morphology of mandibular premolars.[7,8] The anatomy of the root canal system can be recognized using a variety of instruments.[1,5] Through theoretical knowledge from textbooks, radiographic evidence, and examination of the canals during access cavity preparation, pulpal anatomy can be identified.[2] Intraoral and panoramic radiographs are only able to produce a two-dimensional image, omitting the crucial third dimension that could result in the buccolingual curves of root canals and missing canals. Cone beam computed tomography (CBCT) has offered three-dimensional, high-resolution images with

the option of eliminating overlaid structures. This has the potential to aid in a more accurate, non-invasive diagnosis of root canal anatomy and morphology.[9-11]

The purpose of this study is to use CBCT scanning to investigate the root and canal morphology of mandibular premolars in a Nepalese sub-population in vitro and classify them based on de Pablo's classification.

MATERIAL AND METHODS

A descriptive cross sectional study carried out from August 2022 to September 2022. It was assessed and approved by the institutional ethics committee of the B. P. Koirala Institute of Health Sciences (IRC/2367/022). A total of 90 extracted mandibular first premolars had been taken for the study using purposive sampling method. Written consents were taken from all the patients to use their extracted teeth for the research purpose.

Extracted teeth was washed under tap water and stored in distilled water with thymol iodide crystals until the collection was completed. Later, the samples were properly washed under tap water, followed by immersion in 4% sodium hypochlorite solution for 20 minutes to remove adherent soft tissue. Thereafter, if calculus and stains were present, it was removed with ultrasonic scaler and stored as mentioned till further use.

The teeth was scanned by a CBCT scanner (Pro Max 3D, PlanmecaOy, Asentajankatu 6, Helsinki, Finland), in small batches of teeth at a time with identification number on each tooth mounted on a wax block at constant thicknesses of 150 um/slice. The teeth was viewed both in cross and longitudinal section. Volume rendering and multiplanar volume reconstruction was performed by using the PlanmecaRomexis Viewer 3.0.1.R (PlanmecaOy, release date: 10/19/12)

The following features were analyzed by 2 examiners as per the set guideline (one endodontist and one maxillofacial radiologist): Number of root canals per root, root canal configuration [de Pablo's OV classification (Fig. 1 and 2)]

Inter-rater agreement was measured between the endodontist evaluator and radiologist. Intra-rater agreement was measured by having the endodontist and radiologist evaluate one half of the CBCT images at each of 2 separate sessions.

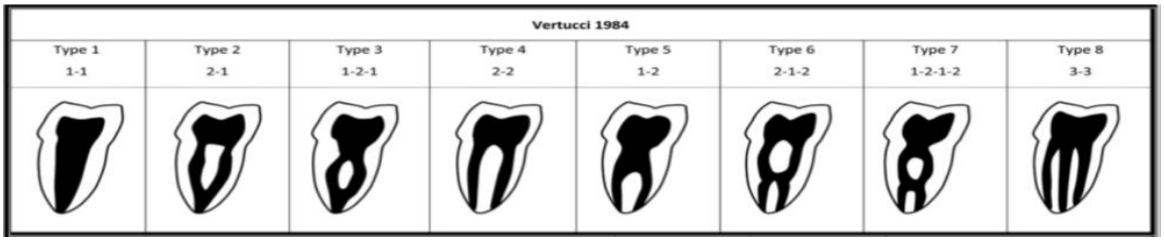

Fig. 1: de Pablo's classification depicting Vertucci's configuration (de Pablo OV, 2010)

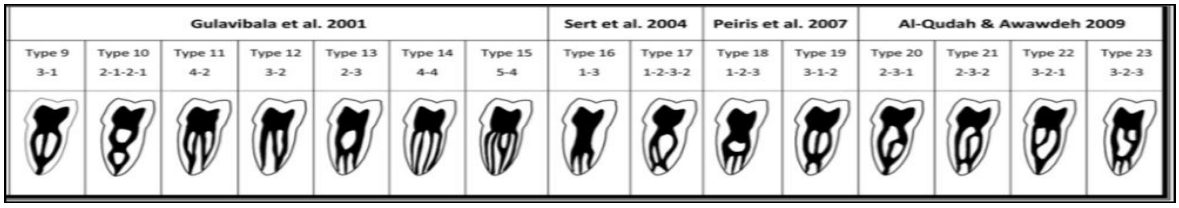

Fig. 2: de Pablo's additional canal anatomy configuration (de Pablo OV, 2010)

Depending on the data obtained on apical anatomy the canals were be interpreted and grouped as (Table 1):

Group	Description
Round:	if the MD and BL diameter are equal
Oval:	if one of the measurement is more than other
Long oval:	if one of the measurement is at least two times the other
Flat or ribbon shaped:	if one of the measurement is at least 4 times the other

The recorded data were analyzed for descriptive statistics using SPSS program version 16 (SPSS Inc., Chicago, USA)

RESULTS

In the present study, variable root canal configurations were found in mandibular first premolar. Vertucci's classification Type I configuration was most prevalent 74(82.2%) followed by type II 8(8.9%) type III 4(4.4%), and type IV 4(4.4%) (Table2).

Root Canal Morphology. (Table 2)

Canal Notation (Vertucci's & Additional Classification	Frequency	Valid Percentage
11: Type I	74	82.2
21: Type II	8	8.9
21: Type III	4	4.4
22: Type IV	4	4.4
Total	90	100

Out of 90 cases most common canal shape at 2 mm on axial section is oval 78 (86.7%).(Table 3)

Table 3: (Axial Section Morphology).

Axial Section Morphology (AS)	3mm (Canal shape at 3mm)	2mm (Canal shape at 2mm)	1mm (Canal shape at 1mm)
Round:1	3/3.3%	10/11.1%	40/44.4%
Oval:2	69/76.7%	78/86.7%	48/53.3%
Long Oval: 3	12/13.3%	0	0
Flat/Ribbon: 4	6/6.7%	2/2.2%	2/2.2%
Total	90/100%	90/100%	90/100%

DISCUSSION

This study provides a detailed report on the root canal morphology of mandibular premolars in a Nepalese sub-population by using CBCT. CBCT is currently widely used in implantology, maxillofacial reconstruction, and in endodontic diagnosis before surgical endodontics as well as for assessment of canal preparation, obturation, and removal of root fillings. The main advantages of CBCT are that it is non-destructive, significantly lower effective radiation dose, short exposure time (2–5 seconds), less expensive than conventional CBCT, and highly accurate that allows 3D reconstruction and visualization of the external and internal anatomy of the teeth.[12]

As Vertucci's canal categorization is frequently used by authors in literature and text books, de Pablos' was chosen for this study that is an elaborated classification, as the baseline for comparing root canal anatomy. Present study revealed that the Vertucci Type I canal structure was present in 82% of the teeth which is slight higher than the other research done in Iran (70%) and India (72%).[13,14] In the present study, type II canal was seen in 8.9%, type III in 4.4%, type IV in 4.4% of the sample. In the Turkish population, where the value of type II canal was 18.5%, while type III canal configuration was 10.5% which is in contrast to present study.[15] The highest percentage of type IV canal layout was reported to be 25% by Parekh et al. in their research of an Indian population which is in contrast to present study where it 4.4%.[16]

Because each canal in these arrangements is different between its orifice and apex, type I and type IV canal systems have very straightforward root canal treatments. However, because of their intricacy, type II and type III configurations are challenging to treat. In order to get the best outcome with a favourable prognosis during the course of treatment, the clinician should be aware of this intricacy.

Most common canal shape at 2 mm on axial section is oval 78 (86.7%) which is in contrast to the study done by Kacharaju et al where only 22% apical canal shape is oval. In present study 11.1% canal shape at 2mm apically is round while 2.2% is ribbon shaped which is in contrast to the study done in Malaysian population.[17]

At the apical regions, the root canal cross-sections of human mandibular premolars showed the various forms. It is crucial for a dentist to be aware of the true root canal shape before preparing because this could affect the choice of treatment. The geometry of a root canal may determine whether endodontic instruments may successfully access all dentinal walls.[12,18]

The difficulties in treating non-round canals, such as oval/long oval, flat/ribbon-like, and C-shaped canals, as well as low file efficiency and a lack of connection with the anatomical apical breadth, are caused by discrepancies between apical diameters and file size.[17,19-21] Preflaring the cervical and middle thirds of the root canal increased the measurement of the anatomical breadth, according to a previous study.[21]

To complete the endodontic treatment step, namely mechanical treatment, it is crucial to comprehend the variety of the root canal shape (preparation of the root canal). The effectiveness and accuracy of this stage, as well as the likelihood that the treatment will be successful, will depend on the equipment and technique used to prepare the canal.

LIMITATIONS

Considering our small sample size, our results may not be generalizable to the entire population.

CONCLUSIONS

The existence of non-round canal shape is not uncommon at apical third of the root. The reported data may help clinician understand the anatomy at apical third of the lower premolar and treat appropriately to ensure success.

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