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ROOT CANAL MORPHOLOGY OF MANDIBULAR FIRST PERMANENT MOLAR, A CBCT STUDY.

Dental Science

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ABSTRACT

Introduction: Knwoledge of root canal anatomy is of utmost importance as success depends on thorough knowledge of tooth morphology with its complex internal anatomy, thorough shaping and cleaning, and complete fluid tight seal of the root canal system.
Objective: To study the root canal morphology of mandibular first molar using CBCT and de Pablos classification.
Methods: Total of 90 teeth were scanned using Pro Max 3D CBCT machine followed by image study using Planmeca Romexis software.
Results: In lower 1st molars with 2 roots, the most common canal configuration was type IV (46.7%), followed by type II (30%).
Conclusion: This study supported the use of CBCT machine as a potential non-destructive means to study root canal anatomy.

KEYWORDS

Mandibular 1st molar canal anatomy, CBCT, Nepalese population

Introduction

Endodontic success depends on thorough knowledge of tooth morphology with its complex internal anatomy, thorough shaping and cleaning, and complete fluid tight seal of the root canal system (Vertucci FJ, 2005). However, giving a thought to anatomical variations and complexities of the canal system, it poses challenges to endodontic treatment. Considering this, mesial roots of mandibular first molar have complex canal anatomy with intercanal communications and isthmuses (de Pablo OV et al., 2010). Yet, mandibular first molars being the first permanent teeth to erupt, they are the most frequently in need of endodontic treatment (Scavo R et al., 2011).

Back in 1969, four canal configurations were reported; since then, eight canal configurations classification (Vertucci, 2005) followed by additional types have be formulated (de Pablo OV et al. 2010, Harris S P et al. 2013). Root canal morphology studies earlier used the clearing technique and were considered as the gold standard (Gulabivala et al. 2002). However, the technique is destructive and can at times distort internal anatomy with inclusion of artifacts.

In recent years, micro-computed tomography (MCT) that provides detailed three-dimensional (3D) visualizations of has evolved as one of the non-destructive methods to study root canal morphology (Kim Y, et al., 2015); it is time-consuming and therefore, not suitable for the dental office.

Nowadays, cone beam computed tomography (CBCT) has become available for dental offices because of the reduced costs and dimension (Patel S, et al., 2009a). It has reduced acquisition time and use lower irradiation doses. Also, their field of view is limited, but the spatial resolution is very good in all planes (Hashimoto K et al. 2003).

Moreover, Nepalese population is mixture of Aryan and Mongoloid with very few studies conducted in this area. With this aim, CBCT has become a potential tool to explore different structures in maxillofacial region along with root canal.

Materials and Methods
Study Design and Participants
This study was a descriptive cross sectional study carried out from March 2016 to August 2016. It was assessed and approved by the institutional ethics committee of the B. P. Koirala Institute of Health Sciences (IRC/677/015).

The patients enrolled were from University Dental College at Dept of Conservative Dentistry and Endodontics after an informed consent was signed.

Inclusion and Exclusion Criteria
The inclusion criteria were extracted mandibular 1st molar of Nepalese patients between 16 years and above with well-defined crown and root morphology.

The exclusion criteria were teeth with calcification that poses difficulty in canal identification and grossly carious tooth destroying root structure.

Determination of the Sample Size
The sample size was calculated based on statistical analysis. Out of 120 teeth, 90 were selected for the study.

Clinical Procedure
The acquired teeth meeting the inclusion criteria was washed under tap water and stored in distilled water with thymol iodide crystals until the collection was complete. Later, the samples was 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 stain 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, Planmeca Oy, 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 Planmeca Romexis Viewer 3.0.1.R (Planmeca Oy, release date: 10/19/12)

Analysis of sample:
The following features were analyzed by 2 examiners as per the set guideline (one endodontist and one maxillofacial radiologist):

1) 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.

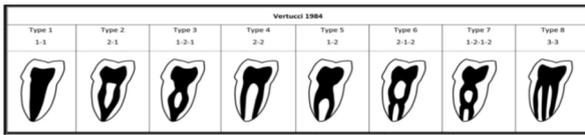**Fig. 1: de Pablo's classification depicting Vertucci's configuration (de Pablo OV, 2010)**
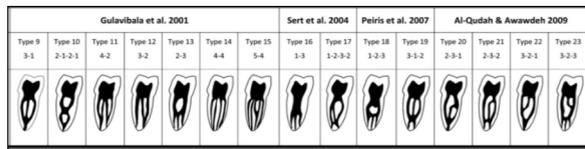

Fig. 2: de Pablo's additional canal anatomy configuration (de Pablo OV, 2010)

Statistical Analysis

The descriptive statistics was carried out in SPSS version 11.5.

Results

A total of 90 teeth were recruited in the study. Table 1 shows the descriptive statistics in relation mesial and distal root canal configuration.

Table 1. Mesial and Distal Root Canal Morphology

Canal Notation (Vertucci's & Additional Classification)	Frequency Mesial Root	Valid Percent for Mesial Root	Frequency Distal Root	Valid Percent for Distal Root
Additional root (11)	2	2.2%	2	2.2%
11: Type I	3	3.3%	53	58.9%
21: Type II	27	30.0%	22	24.4%
121: Type III	6	6.7%	2	2.2%
22: Type IV	42	46.7%	6	6.7%
12: Type V	4	4.4%	2	2.2%
212: Type VI	2	2.2%	1	1.1%
1212: Type VII	0	0%	1	1.1%
2121: Type X	3	3.3%	1	1.1%
42: Type XI	1	1.1%	0	0%
Total	90	100%	90	100%

In molars with 2 roots, the most common in mesial (M) root was type IV (46.7%), followed by type II (30%). Two additional canal types were identified: Type X (3.3%) and Type XI (1.1%) in M root. In distal (D) root, the incidence of Type I (58.9%) was highest followed by type II (24.4%) configuration.   Few different types noticed were Type V (2.2%), VI (1.1%), VII (1.1%), and X (1.1%) in D root. Of total teeth examined, 88 teeth had two roots and 2 had additional single root.

Discussion

This study provides a detailed report on the root canal morphology of molars 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 nondestructive, significantly lower effective radiation dose, short exposure time (2–5 seconds), less expensive than conventional CT, and highly accurate that allows 3D reconstruction and visualization of the external and internal anatomy of the teeth. The slice thickness in CBCT ranges from 80–200 μm. The slice thickness used in our study was 150 μm (O.A. Peters' et al. 2000).

The root canal configurations of mandibular first permanent molars reported in the literature vary on the basis of the different ethnic populations and different methods used (Kim et al. 2013; A. A. Al-Qudah and L. A. Awawdeh, 2009) In mesial roots, the prevalence of type IV canals was nearly 50% in Asian populations (Gulabivala K et al. 2002).

In Jordanian population, the majority had three (48%) or four (46%) canals, whilst 4% had a third disto-lingual root (A. A. Al-Qudah and L.

A. Awawdeh, 2009). This study is in close proximity with our finding.

The number and morphology of roots of Nepalese were different from those of Mongoloids (Kim et al. 2013) in that 97.7% had two roots, 2.2% had three roots and 1.1% had single root. Overall, 25.82% of examined molars had 3 roots, 73.51% had 2 roots, and 0.67% had 1 root in Mongoloid population. The incidence of the fourth canal was 30% compared to Korean population which was 50.36% (Kim et al. 2013).

Conclusion

The root number and canal morphology anatomy of Nepalese mandibular molars showed features that were different from different traits. The prevalence of 2 roots was higher, in contrast to Mongoloid populations. Type IV canal anatomy was the most prevalent in two canal roots. Thus, CBCT is a potential tool and efficient method of studying root canal systems which should include different areas of Nepal as is composed of different ethnic groups.

Acknowledgement

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