ORIGINAL ARTICLE

Evaluation of Root Canal Morphology of Maxillary First Premolars by Cone Beam Computed Tomography

IRSAM HAIDER[1], SAQIB NAEEM SIDDIQUE[2], SOBIA MASOOD TIRMAZI[3], MUHAMMAD MOAZZAM[4], USMAN SANA[5], MUBASHIR RASHEED[6], IMZA BATOOL[7]
[1]Assistant Professor Pedodontics, University College of Dentistry, University of Lahore, Lahore.
[2]Assistant Professor Operative Dentistry, University College of Dentistry, University of Lahore, Lahore.
[3]Associate Professor Operative Dentistry, Institute of Dentistry, CMH Lahore Medical College, Lahore.
[4]Assistant Professor Operative Dentistry, Sharif Medical and Dental College, Lahore.
[5]Associate Professor Operative Dentistry, Azra Naheed Dental College, Superior University, Lahore
[6]Assistant Professor Operative Dentistry, Sharif Medical and Dental College, Lahore
[7]Dental surgeon, Private practice
Correspondence to: Irsam Haider, Email: dr.irsam1@gmail.com

ABSTRACT

Aim. The study aimed to evaluate the root and canal system in maxillary 1st premolar teeth in our patients using cone-beam computed tomography in subpopulation of Pakistan in Lahore.

Material & methods. This retrospective study in vivo assessed Cone Beam Computed Tomography (CBCT) imaginings of maxillary 1st premolars from February 2017 to January 2019. This study determined the number of roots, canals and root canal conformation as described by Vertucci's classification.

Results. 150 subjects aged 17-75 years were enrolled with 90 females and 60 males. From 200 1st maxillary premolars, 75% of the teeth had two roots. 21% had one root. 4% had three roots. 94% teeth had two canals. Three canals were detected in 4% teeth. One canal in 2% teeth. Regarding canal configuration, type I canal in 72% cases and type V canal in 13% of cases.

Conclusion. The Cone-beam computed tomography system is par excellence diagnostic modality than radiographic diagnosis providing improved and exact knowledge of root and canal variations plus configuration.

Keywords: CBCT, Maxillary premolars, Endodontic treatment, Vertucci's classification, root canal.

INTRODUCTION

The internal and external anatomy of the dentition is variant. The achievement of endodontic management is depending upon comprehensive information of root and root canal anatomy, which remained a serious task because of the difficulty of the root canal system (RCS) and its variation.[1] Effective endodontic treatment depends on comprehensive cleaning and shaping of the root-canal, three- dimensional obturation and well-sealed coronal restoration without any seepage. It is the fact that RCS is almost always complex with residing bacteria.[2] So, a thorough knowledge of teeth morphology is required in order to correctly identify and manage the canals preventing treatment failure.[3] Premolar teeth, especially maxillary premolars, pose great challenges in endodontic treatment because of the number of roots and canals and the variations in the configuration of the pulp cavity.[4] The most difficult teeth to be treated endodontically are the maxillary first premolars. Many factors make its treatment difficult such as the variation in the number of roots, canals, canal's configuration and presence of root depressions, moreover the problems in predicting the apical limit by radiographs. This has been mentioned in different population. Hence understanding of root canal anatomy and its various forms is an important factor in achieving the desired endodontic treatment results. Many researchers have defined the root canal system of permanent dentition and classify these teeth such as Weine, Vertucci, Gulabivala and recently Ahmad tried to provide alternate system but Verticci's classification is still the most famous one.[5]

Numerous techniques have been utilized to study root canal anatomy, such as canal staining and tooth clearing, visual and standard radiography, standard radiograph, alternative radiographic technique, and modified root canal staining technique.[6] The standard or regular used X-rays technique is two-dimensional intraoral periapical X-ray, incapable to take an image of three-dimensional object i.e. tooth.[7] Recently the cone beam computed tomography has revolutionized the imaging technique and thus superb facilitation in endodontic treatment too. CBCT is non-invasive, provides the anatomy in axial, sagittal and coronal section without structure overlapping, therefore it's a preferred method for correct assessment of the root canal system.[8]

The population of Pakistan is over 200 million, a few studies had been contributed in this regard. In this vivo study to evaluate RCS morphological variations in maxillary first premolars during Endodontic treatment using CBCT in Lahore a subpopulation of Pakistan and to share our experience and to compare with other published literature.

MATERIAL AND METHODS

This retrospective study consists of 150 patients age ranged 17-75 years presented with routine checkup at the Sharif Medical and Dental College Raiwind, Lahore and different private dental clinics of Lahore. All of the patients actively took part in the study after which an informed consent was obtained in written form. The ethical committee of the college approved this study.

The images were acquired using CBCT scanner (Planmeca, Finland) and were based on following parameters. " 90KV, 8mA, exposure time of 12 seconds and voxel size of 200 μm. Coronal, axial & sagittal 3D planes were used to evaluate maxillary pre-molars.

Roots/canals number and additional variations and configurations were recorded.

The exclusion criteria for this study consisted of teeth having ambiguous canal shape and form due to any physiological or pathological findings, immature apices especially premolars, teeth restored with either post and crown or root canal fillings. Cases that showed presence of apical periodontitis were also excluded.

Data was processed using the software (SPSS v 22 for win, IBM, Chicago, IL). The descriptive data were processed to analyze the percentage roots and root canal.

RESULTS

Mostly maxillary first premolars studied had two roots (60%), the next came with one root (40%). No tooth had been seen with three roots. The majority of cases were seen in the age group between 21-50 years. No association was identified between the number of roots and their position in the mouth. Out of 150 cases, 90 were females with 36 having one root and 54 females presented with two roots whereas the same ratio observed in males i.e., 24 males with one root and 36 were having two roots. There had been no three roots in either sex. Two canals were found with 94% and 5% three canals and only 1% existing with one canal. The most common canal configuration found in our study was Type I (72%) next common was Type V (13%) followed by Type IV (5%), while Type II (4%), Type III (3%), Type VI (2%) and Type VII (1%) were less frequently found. Type VIII canal has not been identified. The types of root canal were demonstrated according to the standards explained by Vertucci (Figure 1).

Figure 1: CBCT showing pulp morphology of maxillary teeth

DISCUSSION

Comprehensive deep understanding of roots, their anatomy and the canal shape and form mandatory in achieving effective and desirable root canal treatment. Clinicians face difficulties due to variation of the RCS morphology which lead to unfavorable results in endodontic treatment outcome causing embarrassment.

Successful endodontic treatment and periapical surgery required understanding of tooth anatomy and morphology of canals in order to remove the microorganisms, the pulp tissue and make access and management of root end much easier.[9] Ahmad has reviewed the literature regarding the root canal system in detail and after analysing it, suggested that various authors in different populations have reported diversity in the morphology of canals, in spite of all the efforts to classify the root canal morphology.[10] Based on several reports from the history and present researches using latest technologies such as Micro-CT, it has been found that around 37 different types of canals geography exist including those commonly observed in single rooted teeth.[11]

Methods involving both in vivo and in vitro have been used in the study. In this regard the introduction of CBCT has immensely eased the technique of studying, in vivo, the root canal system. As compared to two dimensional images of peri-apical radiographs CBCT provides three-dimensional images i.e. coronal, axial and sagittal view giving precise anatomy of the teeth. Though mirco-CT has also been used in an in-vitro study. The benefits of CBCT imaging have great accuracy, minimum distortion with 3D imagining. Furthermore, a non-destructive method and can requires detailed data. Though researchers had showed their apprehension about the use of CBCT routinely very rightly, but still CBCT has been considered a perfect and precise modality for evaluating tooth morphology before endodontic management.[12]

In this study, CBCT has been used to evaluate maxillary first premolars in-vivo prior to endodontic treatment with precise demography where the peri-apical radiography is unable to visualize the variation. The distribution of roots in maxillary premolars had been reported in many studies using CBCT modality. In our study the most common case found was teeth with two roots (60%), secondly teeth with one root (40%). However, no tooth with three roots was found. Comparing with a study of sub-population of Karachi which shows two roots little higher (68.5%) and single root (31.5%) which is less than our study.[13] The roots of maxillary 1st premolars described in Saudi population is comparable in three studies, single root 36% and two rooted 61% , whereas other two studies of Saudi population revealed with large sample single rooted 23.7% and 17.9% where as two rooted much higher 75.1% and 80.9%.[14] These can be compared with other ethnic groups; Moscow one root 8.7% and two roots 91.3%, South African population showed single root 44% and two- rooted 54.1%, Yemeni study showed one rooted 54.8%, North India 53.6%, Chinese 66%, Australian 42.2%.[15]

In our study three roots have not been found and the same with other study of Karachi, subpopulation of Pakistan but other studies of different global areas showed their presence in different range from 0.4- 3%. Ahmad IA in a literature review mentioned that the most frequent anatomic variation in maxillary first premolar is the existence of three roots with three root canals. Recently MS Bafaqech and A Alqedairi reported four cases of 1st maxillary premolars with three roots.[16]

Classification of the root canal morphology was found to be different in various studies owing to lack of comprehensive and approved guidelines. There were difficulties in differentiating between separate roots and joined roots. Also, in cases of bifurcation, there was confusion among dentists as whether to consider them as a single root or a double root. Even Maxillary first molar with six canals have been reported.[17] That's why the different results of many studies are expected.

The number of canals in the maxillary first premolars have been evaluated and described by different studies with wide range: one canal (2.1-17.7%), two canals (85-96%) and three canals (1.2-9.25%). In our study, the single canal had been seen in 1st maxillary premolars only 2%, the two canals were the majority of cases 94% and three canals 4%. The finding is almost falling in the same range.

CONCLUSION

The CBCT is an excellent modality of investigation which provides a much better and comprehensive view morphology of root , design of canals and its variation, facilitating the diagnosis and endodontic treatment. The success rate of results is increased and avoids failure. CBCT superseded Periapical radiography providing comprehensive information three dimensionally. The sample of this study is small which concluded a significant presence of teeth having two roots especially first premolars in maxilla and Vertucci's type 1 classification. However, further studies are required to be conducted to enhance the data with larger sample, facilitating the endodontics in their performance.

Conflict of interests: There is no conflict of interest of any author.

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