Research Article

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Root Canal Morphology of Mandibular First Premolars in Rajasthan Population

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ABSTRACT

Background: This study was conducted to investigate root canal morphology of mandiblar first premolars in Rajasthan population. One hundred fifty mandiblar first premolars were collected, stained, and decalcified. Cleared teeth were examined and canal morphology was studied. Of the 150 mandibular first premolars 76% teeth possessed type I canal systems, 2% had type II, 8%had type III and 14% had type V canal systems according to Vertucci's classification for root canals. The study concludes that mandibular first premolars have mostly one root one canal system (76%)..

Keywords: Mandiblar first premolars, morphology, root canal system, clearing, india ink.

INTRODUCTION

The success of root canal treatment is dependent on a thorough understanding of normal root canal anatomy as well as variations from the norm. Proper cleaning, shaping and obturation of the root canal system in the three dimensions are based on a working knowledge of such information.[1] The internal anatomy of a canal system may demonstrate fins, isthmuses, lateral and accessory canals, or diverse canal shapes. Incomplete cleaning and shaping of these areas may leave tissue, bacteria, or necrotic debris in the canal. The presence of these irritants can result in persistent periapical inflammation and failure of root canal treatment.[2]

Studies of the internal and external anatomy of teeth have shown that anatomical variations can occur in all groups of teeth with variable prevalence. It is important to be familiar with variations in tooth anatomy and characteristic features, since such knowledge can aid in the location & negotiation of canals, as well as their subsequent management. Amongst the human permanent dentition, the mandibular premolar teeth have the most variable canal pattern.

Slowey has suggested that mandibular premolars may present with greatest difficulty of all teeth to be treated endodontically.[3] Mandibular first premolar often called as "Endodontist's enigma" was one such tooth having wide variety of morphological rarities[3] which leads to highest failure rate. The aim of conducting this study is to know the variation in the mandibular first premolar in Rajasthan population.

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AIMS AND OBJECTIVES

1. Root canal configuration in each root using Vertucci's classification with additional modifications
2. Presence and location of lateral canals

MATERIALS AND METHODS

Study was done in the department of conservative dentistry and endodontics in NIMS dental college. One hundred fifty extracted mandibular first premolars with mature apices from Rajasthan population of varying age and sex were collected from NIMS dental college. The extracted teeth were immersed in 5.25% sodium hypochlorite for 30 minutes for the removal of external debris and after scaling the extracted teeth were stored in 1 % thymol for 2 weeks and later on normal saline until further study was carried out. Access cavities were prepared in all teeth with a high-speed handpiece and were placed in 5.25% sodium hypochlorite solution for dissolving the pulp tissue for 12 hours followed by 20 minutes immersion in an ultrasonic bath. Teeth were than washed under running tap water for 2 hours and dried overnight.

The access to apical foramina was established by passing a size 08 K-file into the root canal until it penetrated in to the root apex. Then non water proof India ink was injected in to the pulp chamber with an plastic disposable endodontic irrigating syringe with a 27-G needle. The ink was drawn through the canal system by applying negative pressure to the apical end of the tooth with the use of a suction tip. Excess ink was then removed from the surface of the tooth with gauze soaked in alcohol.

The teeth were dried overnight for 12 hours and decalcified with 5% nitric acid for 4 days at room temperature. The acid solution was changed daily and the end point of decalcification is determined by periodic radiography. After achieving the desired amount of decalcification, teeth were washed under running tap water overnight and air dried. The specimens were then dehydrated in ascending concentrations of ethyl alcohol (70%, 96%, and 99%) for 12 hours each. Finally, transparent specimens were obtained by immersing the dehydrated teeth in methyl salicylate solution into which teeth were stored until they were examined. The transparent specimens were then examined by the naked eye as well as a magnifying lens (3 X). Photographs of the specimens were taken with a Nikon D 52 camera with a Macro lens (Fig – 2).

RESULTS

Of the 150 extracted mandibular first premolar, 114 teeth (76%) belongs to Vertucci's class I, 3 teeth(2%) are of class II, 12 teeth(8%) are of class III and 21 teeth(14%) belongs to class V (Table 1& Fig.1).

Table 1. Vertucci's classification and its involvement

Vertucci's classification.	Number of teeth showing variation	Percentage
Type I	114	76%
Type II	3	2%
Type III	12	8%
Type IV	0	0%
Type V	21	14%
Type VI	0	0%
Type VII	0	0%
Type VIII	0	0%
Total	150	100%

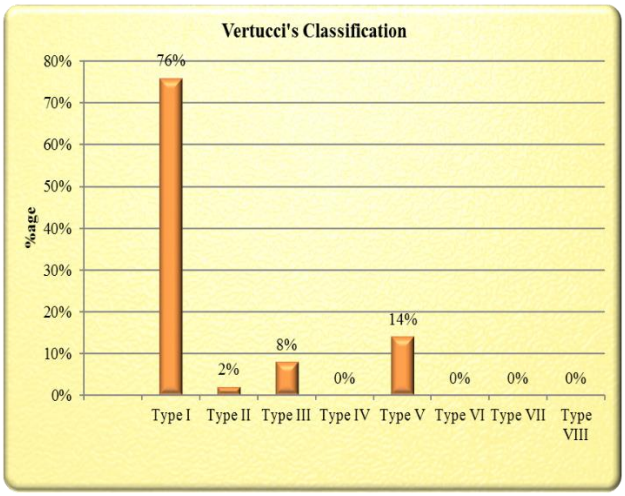

Fig 1: Vertucci's classification and its involvement.

Fig 2: Type 1, Type II, Type III, Type V canal systems found in this study

DISCUSSION

This study examined the root canal morphology of extracted mandibular first premolars collected from dental clinic of NIMS dental college which represents mostly the Rajasthan population. Studies of the internal and external anatomy of teeth have shown that anatomical variations can occur in all groups of teeth with variable prevalence. It is important to be familiar with variations in tooth anatomy and characteristic features, since such knowledge can aid in the location & negotiation of canals, as well as their subsequent management. Amongst the human permanent dentition, the mandibular first premolar teeth have the most variable canal pattern. Slowey has suggested that mandibular first premolars may present with greatest difficulty of all teeth to be treated endodontically.[3]

A university of Washington study assessed the non surgical root canal treatment in all teeth, the failure rate was highest for the mandibular first premolar of 11.45% and this may be attributed to the frequent variations in the root canal morphology.[4] Possible reasons for this conclusion are the numerous variations in root canal morphology and difficult access to additional canal systems when present.[5] The root canal system of the mandibular first premolar is wider buccolingually than mesiodistally. At the cervical line of the root, canals are oval; this shape tends to become round as the canal approaches the middle of the root. If two canals are present; they tend to be round from the pulp chamber to their apical foramen.

In some of teeth, a single, broad root canal may bifurcate into two separate root canals. Direct access to the buccal canal is usually possible, whereas the lingual canal may be very difficult to find. The lingual canal tends to diverge from the main canal at a sharp angle. In addition, the lingual inclination of the crown tends to direct files buccally, making location of a lingual canal orifice more difficult. Sometimes they may have three roots and three canals. One study reported a C-shaped canal anatomy in this tooth. Because of the lingual inclination of the crown, buccal extension of root canal access can nearly approach the tip of the buccal cusp to achieve straight-line access. Lingual extension barely invades the poorly developed lingual cusp incline. The access preparation is mesiodistally centered between the cusp tips and the preparation must often be modified to allow access to the complex root canal anatomy frequently seen in the apical half of the tooth root.[6]

Different methods have been used to study the root canal morphology of mandibular premolars like replica technique, cross sectioning, radiography, and clearing. We have used clearing technique as described by Okumura[7], Robertson et al[8], and Robertson and Leeb[9] to study the root canal anatomy of these teeth. This method of canal staining and root clearing was found to be excellent for three dimensional evaluation of root canal morphology. Even examination of the fine details (intercanal communications, lateral canals) was possible by clearing method without staining.[10] The advantages of the dye injection and clearing technique for studying the morphology and anatomy of root canals was that the original form of the root is retained and the relationship between internal root surfaces and external contour of the tooth is maintained, the form of the canal and even minute structures can be seen clearly, failure in preparation of specimens is rare, the specimen can be preserved for a long time, little equipment and space is required, and the chemicals used are less toxic.

Recently spiral computed tomography (SCT) (Robinson et al. 2002)[11], cone beam computed tomography (CBCT) (Matherne et al.2008)[12] and micro computed tomography (MCT) (Gianluca Plotino et al. 2006[13] have been used to study the root canal morphology as they produce

images of high diagnostic values and have the ability to identify morphology not visible on conventional radiographs. But these techniques are not easily available everywhere and are expensive. Omer et al[14] compared the clearing technique and radiographic technique in the study of root canal anatomy and concluded radiographs alone had a limited use when studying certain aspects of the root canal system. The cross-section method was used by Lu et al[15] but appeared to be complicated. Wu et al[16] indicated the limited value of using direct digital radiography when compared with the clearing technique in studying root canal morphology. A study by Neelakantan et al[17] concluded that cone-beam tomographic and peripheral quantitative computed tomographic imaging was only as accurate as the gold standard canal staining and clearing technique.

The clearing technique followed resulted in very clear specimens, allowing excellent visualization of the canal anatomy, which is evident in the photographs taken. Surprisingly, the incidence of lateral canals was negligible in these samples. The root canal morphology of the cleared teeth was examined under good lighting with a magnifying glass, and observations were made. The root canal morphology was studied using the universally accepted classification as given by Vertucci[18] used by endodontists all over the world,[19]and this can be considered as a baseline point for root canal anatomy comparison.[20]

The most prevalent canal pattern in this study is Type I, occurring in 76% of the mandibular first premolar which resembles with the result of similar study done in Iranian population having prevalence of 70.6 %.[6] The second most prevalent canal pattern in this study is Type V, occurring in 14% of mandibular first premolar. The results are similar to Iranian population study having prevalence of 16.9%.[6] In this present study prevalence of Type III canal pattern is 8% which is almost same in Iranian population study having 6% prevalence. The prevalence of Type II canal pattern in this study is 2% of mandibular first premolar which is similar to study done in Iranian population with a prevalence of 1.9%.[6]

On contrast to this study, 29% of Iranians[6], 0.2% of Koreans[21], and a range of 14%–30.7% of Americans exhibited more than 1 root canal. Although 82% of Indian teeth had a single apical foramen, 65% of Chinese teeth[22] and 74%–90% of American teeth had a single apical foramen. Considering various investigators used different study methods, these racial differences are interesting and need to be researched further.[20] In this study, mandibular premolars were found with complex pulp anatomy. In terms of the success of root canal treatment, knowledge of pulp anatomy cannot be exaggerated. In the list of causes of treatment failures, lack of working knowledge of pulp anatomy ranks second only to errors in diagnosis and treatment planning. These finding deserves more emphasis in the textbooks on the subject of endodontics and on the complexity of the canal anatomy.[5]

CONCLUSION

Mandibular premolars are undoubtedly an endodontic challenges, because of the presence of extra canals which may occur far too often than one can expect. A thorough knowledge of the root canal anatomy, careful interpretation of the radiographs, proper preparation of the conventional access cavity are the essentials for recognition and adequate treatment of these anatomical variations. As maximum variations in the morphology has been studied and observed in mandibular first premolar, in this study type I canal pattern was found to be the most prevalent in mandibular first premolar amongst Rajasthan population.

The following conclusion was drawn from the study.

1. The incidence of one canal in 76% of mandibular first premolars is found.

2. In the premolars with multiple canals, the type V (14% in mandibular first premolar) canal system was the most prevalent canal configurations. Other canal configuration like type III (8% in mandibular first premolar), type II (2% in mandibular first premolar) are less prevalent.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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