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Assessment of root canal morphology of maxillary II Premolar in Rajasthan Population using clearing tooth technique: An *in vitro* study

Abstract

Objective: The aim of the study is to determine the root canal morphology of the maxillary second premolar teeth in Rajasthan population using clearing tooth technique. **Materials and Methods:** Eighty maxillary second premolars were decalcified, cleared and observed for root canal morphology. The root canal morphology was classified based on Vertucci's classification. **Results:** Type II (35 %) canal pattern is most prevalent followed by type IV (28.7%) and type I (27.5%). But no tooth was observed with type VIII canal pattern. **Conclusion:** The root canal morphology of Maxillary second premolars is highly variable and requires careful evaluation prior to endodontic therapy.

Key Words

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INTRODUCTION

Success in the root canal therapy depends upon the thorough knowledge of root canal anatomy and its variants.[1] However, the complexity of the root canal anatomy presents clinical challenges and difficulties that often jeopardize the primary goal of such therapy.[2,3] Knowledge of both normal and abnormal anatomy dictates the parameters of root canal therapy and can directly affect the probability of success.[4] Careful evaluation of two or more intraoral periapical radiographs, exposed at different horizontal angulations of the x-ray cone is mandatory. These radiographs provide important information about root canal morphology.[5] The evaluation of the root canal system is most accurate when the dentist uses the information from multiple radiographic views together with a thorough clinical exploration of the interior and exterior of the tooth.[6] Many different methods have been used to investigate tooth morphology these methods include radiography,[7] clearing technique,[8] direct observation with microscope,[9] 3D reconstruction[10] and macroscopic section.[11,12] The technique of clearing teeth has considerable value in studying the anatomy of the root canal system because unlike radiographic images, it provides a three-dimensional view of the pulp cavity in relation to the exterior of the teeth and allows a comprehensive examination of the pulp chamber and root canal system.[13] However, except the radiographic technique, all these are *in vitro* techniques and cannot be used clinically. Furthermore, they do not provide the ability to study the external and internal anatomy of teeth three-dimensionally.[10] Maxillary second premolars are one of the most difficult teeth to treat endodontically which could be due to number of roots or canals, direction and longitudinal depressions of roots, various pulp cavity configurations, and difficulties in visualizing the

apical end by radiographs.[14] Since no data is available on the incidence of Root canal configurations of maxillary second premolar in rajasthan population. Therefore, it was decided to study the variations in the root canal configurations of maxillary second premolar using clearing technique.

MATERIAL & METHOD

Eighty extracted maxillary second premolars in rajasthan population were collected from the various dental clinics. Teeth with deep caries, metallic restorations, fractures, teeth with incompletely formed roots, and those which were endodontically treated were not included in study. Teeth were washed and stored in 10% formalin (Western India Chemical, Udupi District, Karnataka, India) until the collection was completed. They were then placed in 6% sodium hypochlorite solution for thirty minutes for the removal of organic debris .They were then cleaned with an ultrasonic cleaner to remove calculus and stains. Access cavities were prepared using No. 2 round bur and the pulp tissue was dissolved by immersing the teeth in 6% sodium hypochlorite (Prime Dental Products Pvt. Ltd., Mumbai, India) for 12 hours. The teeth were then rinsed under running tap water for 30 minute dried overnight. The teeth were then decalcified by placing them in 10% of nitric acid (George Chem, Vellore, Tamil Nadu, India) for 2-3 days and to learn then reliability of the demineralization procedure, teeth were tested for softness by inserting a needle in the coronal region. The teeth were washed under running water to remove traces of nitric acid, dried and dehydrated using increasing concentrations of ethanol (70%, 95%, 100%) (Leonid Chemicals Pvt. Ltd., Bangalore, Karnataka, India) for 24 hours. The teeth were rendered transparent by immersing in methyl salicylate (Jain General Traders, Chennai, Tamil Nadu, India) .The coronal part of the transparent teeth were filled drop by drop with India Ink (Emichem Pvt. Ltd., Kolkata, India) using a syringe with a 27 gauge needle. The access was then sealed with wax and the teeth were placed in vertical position .The excess amount of India Ink around the teeth were cleaned by using cotton dipped in methyl salicylate. Vertucci's classification was used to determine the pattern of the root canal and to compare our findings with the related published reports of different populations.

Type I: A single canal extends from the pulp chamber to the apex (1-1).

Type II: Two separate canals leave the pulp chamber and join, short of the apex, to form one canal (2-1).

Type III: One canal leaves the pulp chamber and divides into 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 the 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 separate canals leave the pulp chamber, merge in the body of the root, and redivide short of the apex to exit as two distinct canals (2-1-2).

Type VII: One canal leaves the pulp chamber, divides and then rejoins in the 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).

RESULT

The results of the observations were as follows:

Pattern and percentage of each canal type

Type II canal pattern (fig.1B) is most prevalent and found to be 35 % (table1). The Type IV (Fig. 1D) canal pattern was observed in 28.7% of the teeth. The Type I (Fig. 1A), V (Fig. 1E), VI (Fig. 1F), III, VII (Fig. 1G) canal pattern was observed in 27.5%, 3.7%, 2.5%, 1.3%, 1.25% of the Teeth respectively. Type VIII canal pattern were not observed in the study. The data for maxillary second premolar canal configuration of this study compared with other studies are shown in Table 1.

DISCUSSION

The pulp space of maxillary premolar is complex; root canals may divide and rejoin, and possess forms that are considerably more involved than commonly implied. Many roots have additional canals and a variety of canal configurations. In the simplest form, each root has a single canal and a single apical foramen (Type I). Commonly, however, other canal complexities are present and exit the root as one, two, or more apical canals (Types II‑VIII).[15] Studies on the internal and external anatomy of teeth have shown that anatomic variations can occur in all groups of teeth and can be extremely complex.[16] Numerous factors contribute to the variations found in the root canal studies including ethnicity[17,18] age,[19] gender[20] and study design (in vitro versus in vivo).[21] Over the years, numerous root canal patterns have been identified. In 1969, Weine *et al.*,[22] provided the

Table 1

Type of canal	Canal Pattern n=80	% of Occurence
Type I^{+}	1-1	27.5
Type II^{+}	2-1	35
Type III^{+}	1-2-1	1.3
Type IV^{+}	2-2	28.7
Type V^{+}	1-2	3.7
Type VI^{+}	2-1-2	2.5
Type VII^{+}	1-2-1-2	1.2
Type VIII^{+}	3-3	0

Fig. 1A: Type I (1-1)

Fig. 1B: Type II (2-1)

Fig. 1C: Type III (1-2-1)

Fig. 1D: Type IV (2-2)

Fig. 1A: Type I (1-1)

Fig. 1B: Type II (2-1)

Fig. 1C: Type III (1-2-1)

first clinical classification of more than one canal system in a single root using the mesiobuccal root of maxillary first molar as the specimen type. Pineda and Kuttler[7] and Vertucci[13] further developed a system for canal anatomy classification for teeth and classified them as Type I through Type VIII. Gulabivala *et al*.,[17] studied the root canal morphology of mandibular molars and identified seven additional canal types according to the number of orifices, canals, and apical foramina . Many studies have investigated the root canal morphology of maxillary second premolar teeth and reported significant variations. However, these studies were mainly performed on teeth of North American,[15] Turkish,[20] and Chinese populations.[23] It has been reported that the most detailed information about three dimensional root canal morphology can be obtained by demineralization and staining. Intervention in the specimens with instrument is not required, so thereby maintaining the original form and relationship of the canals.[24]

CONCLUSION

This study conclude that the root canal morphology of the maxillary second premolar in Rajasthan population shows a higher incidence of type II configuration (35%) with no evidence of type VIII configuration. Maxillary second premolar exhibit highly variable canal morphology. So the traditional belief such that maxillary second premolar are either single rooted containing one or two root canal or double rooted with one canal in each root, but rather lots of accessory and lateral canal are present. So for successful endodontic therapy, instrumentation along with thorough irrigation is required to access these accessory and lateral

canals. So the accurate knowledge of the variations in morphology of the pulp cavity will greatly assist the clinician in performing successful endodontic therapy.

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