Original Article

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Prevalence of Root Canal Morphology in Maxillary Premolars of Northern Part of Karnataka State, India: *An In-Vitro Study*

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Abstract

Aim: To study the root canal morphology in maxillary first and second premolars and classify the canal configuration according to Weine. **Materials and Methods:** 100 maxillary teeth (50 first premolar and 50 second premolar) were selected for the study. The teeth were cleared using clearing technique. The canal morphology was studied and classified according to Weine. **Results**: Maxillary first premolars showed 26% type I, 0% type II, 56% type III, 18% type IV configuration and maxillary second premolars showed 34% typeI,12% type II, 42% type III, 12% type IV configuration. **Conclusion:** The canal configuration studied and classified showed that type III predominated in both maxillary first and second premolars. **Clinical significance:** This study helps the undergraduate and postgraduate students to know the prevalence of type of canal configuration in maxillary premolars of northern part of Karnataka state, India. Also, helps in knowing the anatomy of teeth so that a successful endodontic therapy can be rendered to the patient.

Key words: Clearing technique; Canal configuration; Weine's classification.

Introduction

Dental pulp is a soft gelatinous, living, cellular tissue of ectomesenchymal origin having various functions. It is enclosed within bilayered mineralized structures namely enamel and dentin. The hard tissue encompassing the dental pulp can take a variety of configurations and shapes. The root canal anatomy in human teeth has not changed for hundreds of years. However, earlier studies proved to be inaccurate for some inexplicable reason.[1] The canal anatomy and its complexity has been attempted to be classified by many researchers. Hess and Zurcher and the most recent studies demonstrate the anatomic complexities of the root canal system. It has been established that a root with a tapering canal and a single foramen is the exception rather than the rule. Investigators also have shown the presence of multiple foramen, additional canals, deltas, loops, c-shaped canals, furcation and lateral canals.[2]

Hence, for a successful treatment in Endodontics, a thorough knowledge of tooth morphology, careful interpretation of angled radiographs, adequate access to canal orifice, explanation of the tooth's interior is required. Various methods are used to study the morphology and canal anatomy of human teeth.

Conventional radiography which is commonly used during endodontic treatment is one of the methods to study the root canal anatomy. However, radiograph gives a two dimensional representation of a three dimensional object and is open for a wide range of interpretation .The limitation in defining certain aspects of root canal anatomy are noteworthy. Root canals take a varied course from orifice to apical foramen. Different canal configurations exist depending on race, ethinicity etc.

Weine gave a simple but a basic classification of root canal morphology.[3] Also the classification is based on endodontic therapy,

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specifically as recorded on radiographs taken during and after endodontic treatment .It is simple to use and is clinically oriented classification. Vertucci found more complex pulp space system and classified into 8 types.[4] But these types are merely variants of that listed by Weine.

Hence, it is absolutely essential for an operator to form a mental picture of pulp in cross-section and longitudinal sections. Thus, the aim of this study was to study and classify the canal configurations according to Weine by using tooth clearing technique.

Methodology

Freshly extracted 100 maxillary premolars with closed root apex were selected for the study from northern part of Karnataka state, India visiting the institution. Teeth with root resorption, cracks and fractures were not selected for the study. Out of 100 selected teeth, 50 were maxillary first premolars and 50 second premolars. The teeth were stored in saline until use. The teeth were then decoronated with the help of a carborundum disc. The teeth were then placed in 5.25% sodium hypochlorite to dissolve the organic tissue for few days. Methylene blue dye was injected under pressure through the orifice of the teeth with the help of a syringe and was kept in methylene blue for one day.

The teeth were placed in 5% nitric acid for decalcification for three days. The acid was changed daily till the end point of decalcification occurred which was checked by periodic radiographs.

Thereafter the teeth were washed in running water for approximately 4 hours. Then the decalcified teeth were dehydrated in 60%, 80%, 100% isopropyl alcohol sequentially for 8 hours, 4 hours and 2 hours respectively.

The teeth were then placed in xylene for 2 hours to clear. Then the cleared teeth were preserved in methyl salicylate. The teeth were visualized for the root canal configuration under magnifying glass. The number of teeth pertaining to the different canal configurations were noted and classified according to Weine.

Results

The number of roots with different canal configuration was detected by clearing technique. The number of teeth with different canal configuration in maxillary first and second premolars was noted (Fig 1-Fig 4).

Maxillary first premolars

Type I -13 teeth (26%)

Type II – 0 teeth (0%)

Type III- 28 teeth (56%)

Type IV- 9 teeth (18%)

Fig 1: Type 1

Fig 2: Type 2

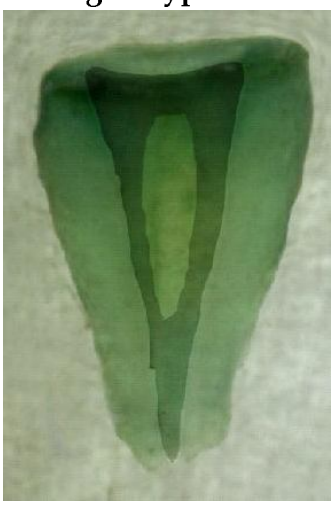

Fig 3: Type 3

Fig 4: Type 4

Maxillary second premolars

Type I -17 teeth (33%)

Type II – 6 teeth (12%)

Type III- 21 teeth (42%)

Type IV- 6 teeth (12%)

Discussion

The prerequisite for accurate diagnosis, treatment planning, and success of endodontic treatment, knowledge of common root canal morphology and its frequent variations is a basic requirement. Though there is a combination of canals present in the roots of permanent teeth and canal takes a different course between canal orifices to apex, it is possible to categorize the canal system in a very simple and basic manner as suggested by Weine.[3]

Type 1: Single canal from the pulp chamber to the apex.

Type 2: Two separate canals leaving the chamber but merging short of the apex to form only one canal.

Type 3: Two separate canals leaving the chamber and exiting the root in separate apical foramina.

Type 4: One canal leaving the pulp chamber but dividing short of the apex into two separate and distinct canals which separate canals and apical foramina.

The study and examination of the root canal system has become an obsession for endodontists .Since, the early days of dentistry, morphology of internal root anatomy has been explored. Several methods have been used to visualize the internal anatomy namely:

A) Radiographic method[5]

B) Cross-Section and Longitudinal Section[6]

C) Clearing Technique[4,7,8]

Recently, Computed Tomography Studies[9] and Observation under dental Operating Microscopes[10]

The internal anatomy of root canals often does not represent the simplicity of the external anatomy of the tooth. Due to its complexities as shown in previous studies, this study uses a technique which clears the tooth and helps in visualizing the tooth three dimensionally. Clearing a tooth now remains as a teaching and research tool only.

Tooth Clearing Technique

Hermann Prinz in 1930 was the first one who cleared a tooth successfully using a protocol which was proposed by Spaltholz in 1906.This technique provides an advantage of

- Maintaining the original form of the root
- Observation of minute details of root canal morphology

- Conservation of samples for long time[7]
- Inexpensive[7]
- easy to perform

This process involves many physical and chemical changes .The inorganic contents are first dissolved, dehydrated and then cleared.[11]

Demineralization

Samples are demineralized by either using

5% Nitric acid[12]

20% Formic Acid[13]

5% Hydrochloric Acid[14]

In this study 5% nitric acid is used because of its aggressive action and to reduce the time of demineralization. It is simple to perform and gives good results in few days as compared to other methods. The acid was changed daily till the end point of decalcification occurred which was checked by periodic radiographs.

Dehydration

This consisted of a series of alcohol (isopropyl alcohol) rinses starting with 60% per cent for 8 hours followed by 80% for 4 hours and 100% for 2 hours. This sequential order from 60 to 100% was performed to prevent high degree of shrinkage due to rapid removal of water. Dehydration also involves removal of air, water and lipid components.[15]

Clearing

The dehydrated teeth were then placed in xylene for 2 hours. Then the teeth were stored in methylsalicylate. Xylene returns dentin hardness but values are slightly lower to that of normal dentin.[16] Methylsalicylate tolerates more water and also increases the refractive index of the tooth.[15,17]

The roots studied for the canal configuration were classified according to Weine. Various studies have been conducted to study the canal configuration. The comparisons of canal configuration as recorded by various authors are noted in tables 1 and 2.[18-25]

There was a variation in the percentage of canal configuration between the studies conducted by various authors. This could be due to numerous factors like the ethnicity,[7,8] age,[26] gender,[23] and study design.[27] The prevalence of type III canal configuration predominated in both maxillary first and second premolars.

A limitation of the study was lack of data on intraexaminer reproducibility, although experienced endodontists are relatively consistent in radiographic interpretation.

Other applications of clearing technique are to study the

- Canal instrumentation technique[14]

Table 1: Comparison of prevalence of canal configuration inmaxillary first premolar

	Type I	Type II	Type III	Type IV
Deepak Sharma, Meetu Mathur[18]	5%	25%	45%	11.67%
Vertucci[19]	8%	18%	62%	7%
LipskiM et al[20]	2.1%	82.4%	6.3%	9.2%
Present study	**26%**	**0%**	**56%**	**18%**

Table 2: Comparison of prevalence of canal configuration in maxillary second premolar

	Type I	Type II	Type III	Type IV
Vertucci[4]	48	22	11	6
Caliskan *et al*[21]	44	22	12	6
Kartal *et al*[22]	48.6	6.3	37.99	4
Sert and Bayirili[23]	32	20	25.5	6
Weng *et al*[24]	27.7	36.9	33.8	-
Udayakumar Jayasimha Raj Sumitha Mylswamy[25]	29.2	33.6	31.1	2.1
Present study	**34%**	**12%**	**42%**	**12%**

- Effect of post design and its influence on root fracture.[28]
- Penetration of human saliva on dentinal tubules.[29]
- Sealer placement technique in curved canals.[30]
- Micro leakage of root canal sealers.[31]

Conclusion

The clearing technique to analyse the root canal configuration is an excellent teaching tool. However, it is not useful for clinical purposes as it is impractical. It is helpful for novice dentist to create a mental picture of canal anatomy. This helps in rendering a successful restoration to the patient.

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Clinical/practice/practical implications

It is a very useful method to study the canal configuration which leads to a better root canal treatment. This study gives an idea about the canal configuration of maxillary premolars of north Karnataka population.