ORIGINAL ARTICLE

Root and Canal Morphology of Human Primary Molars in a Local Population of Southern Punjab: an in vitro Study

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ABSTRACT

Background: The root canal is a procedure in which whole of the diseased pulp is removed and the canal is filled with an inert material. Therefore the success of root canal is mainly dependant on making the entire root canal system free of micro-organisms.

Aim: To evaluate and asses the number of root canals and root curvatures present in primary maxillary and mandibular first molars that got extraction at Nishtar Institute of Dentistry, Multan.

Methods: This prospective study was carried at Nishtar Institute of Dentistry Multan from June 2014 to August 2014. A total 60 primary molars were taken randamly out of that 30 were maxillary first molars and 30 were mandibular first molars. After extraction, the teeth were cleaned under running tap water to make them free of blood clots and debris. Ultrasonic scaler was used to remove the hard tissue attached to the teeth. The teeth were then put in glass container filled with the distilled water and the number, length and angulation of all the roots were measured. Access cavities were prepared using a fissure diamond bur (SF 12 Mani Japan) used in air turbine (NSK Japan) for penetration into the pulp chamber and Endo Z bur (E0152, 21mm Mani Japan) having non-cutting end for de-roofing.

Results: Most of the teeth in the mandibular first molar had two roots. The two canals (90%) in the mesial root and one canal in the distal root (86.66%). The mean length of the mesial root was 8.99mm and mean angulation was 10.80^{o}. The mean length of the distal root of mandibular molar was 7.10mm and the root angulation that of 8.10^{o}. All the maxillary molars had three roots. Although a few had distobuccal and palatal roots fused yet the canals were completely separated. The mesiobuccal root of maxillary molar showed the maximum mean angulation of 18.74^{0} followed by distobuccal and palatal having the mean angulation of 15.41^{0} and 12.49^{0} respectively.

Conclusion: All the root canals of maxillary first molars are separated and the palatal canal being the longest one and straight. The mandibular first molars have two roots and three canals. The distal root being longer than mesial one. No specific aberrations were found.

Keywords: Root canal, Root angulation, Zipping, Ledge, Perforation, Primary molars

INTRODUCTION

Dental caries is a very chronic bacterial disease leading to the disintegration of the organic and inorganic components of teeth. The destruction of the tooth tissue is due to the acid production. The deciduous teeth are the primary teeth present in the oral cavity during childhood. Primary teeth are considered essential in the development of the oral cavity. The permanent teeth replacements develop from the same tooth germs as the primary teeth, which provide guides for permanent teeth eruptions. Also the muscles of the jaw and the formation of the jaw bones depend on the primary teeth in order to maintain proper spacing for permanent teeth in oral cavity. The roots of primary teeth provide a salient feature, an opening for the senescence permanent teeth to erupt. The primary teeth are also mandatory for proper development of a child's speech and chewing of food. The tradition of throwing a baby tooth up into the sky to the sun or to Allah and asking for a better tooth to replace it is common in Middle Eastern countries (including Iraq, Jordan, Egypt and Sudan). It may have been originated in a pre-Islamic offering and certainly dates back to at least the 13th century, when Izz bin Hibat Allah Al Hadid mentions it.[1] In old Britain, lost teeth were commonly burnt to destroy them. This was partly for religious reasons connected with the Last Judgement and partly for fear of what might happen if an animal got them. A rhyme might be said as a blessing.[2] The treatment of primary and young permanent teeth is quite safe and predictable, that has been approached by a lot of research detailing the best clinical techniques helping the clinical practices. With sound clinical techniques and some rather extraordinary compounds, splendid can be done to save baby teeth. As always, treatment is based on assessment and diagnosis, though the diagnosis being much important,

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especially in the case of primary teeth, may be decided by the state of the tooth at the time of examination and treatment. What's necessary is a thorough knowledge and state-of-the art treatment techniques for the various stages of pulpal involvement for milk teeth with trauma and caries. The main object of the erudite clinician is to appease the patient regarding the specific treatment protocol whatsoever has been chosen. In the same way any failure in the desired treatment may be of much fractious both for the patient and clinician. The health of the permanent successors is somewhat dependant on the deciduous teeth. As we may say that deciduous teeth with caries control and well oral hygiene are a good indicator for the next coming sound and healthy permanent successors otherwise in the absence of any systemic disorder that affects bones and teeth. The main etiologic factor for dental diseases is the caries or the trauma leading to pulp exposure. In case of major pulp exposure, endodontics is indicated as sole treatment option in conjunction with the evaluation of the affected tooth prior to going for treatment. The patency of canals and root morphology is of prime importance while going for the endodontics. The main aim of this study is to evaluate and assess the root and canal morphology of extracted human primary mandibular and maxillary first molars.

PATIENTS AND METHODS

This prospective in vitro study was carried at Nishtar Institute of Dentistry Multan from June 2014 to August 2014. A total number of 60 extracted deciduous molar teeth were collected without having any sign of gross root resorption or fracture from the Department of Pedodontics, Nishtar Institute of Dentistry Multan. These teeth were meant for this study to investigate the root canals and morphology and were collected randomly after being extracted. The collected teeth were divided into two categories; c*ategory I - m*andibular first molars (*n*=30) and c*ategory II - m*axillary first molars (*n*=30). All the extracted teeth were cleaned to make them free of debris and blood clots by washing in running tap water. Ultrasonic scaler (Piezon, Japan) was used to remove any hard tissue like bony remnants or the calculus. All the surfaces were made clean free of debris. The collected teeth were then placed and stored at room temperature in a glass containers filled with distilled water. The number, length and angulation of the roots were then determined. The length of the roots was measured after pointing of the cervical and apical reference point on tracing paper to the nearest 1 mm using a 6 inch long scale. The measurement was rounded off to the nearest 1mm. The most constricted area was considered a cervical point [3] and the apex of the root was assumed as an apical reference point. Coronal root angulation was evaluated and assessed using a protractor. The angle was measured between a line perpendicular to the cervical line[3] and then a fabricating a tangent to the outer surface of the coronal part of each root on tracing paper. This method had been employed according to a study that was meant for root canal morphology of human primary molars[3]. As no clearing technique has been documented for deciduous teeth, so we modified the technique that was meant for permanent teeth.[4,5] Access cavities were prepared using a fissure diamond bur (SF 12 Mani Japan) used in air turbine (NSK Japan) for penetration into the pulp chamber. Then Endo Z bur (E0152, 21mm Mani Japan) having non-cutting end was used for de-roofing of all the extracted teeth. Two things are necessary for the proper finding to be assed. Firstly, the clean tooth surface and secondly, the disinfection. For both of these purposes, the teeth were placed and immersed for 24 hours in 5.25% sodium hypochlorite solution (Sultan Englewood, NJ USA). For making teeth decalcified, the teeth were again immersed in 6% hydrochloric acid (Merck, Darmstadt, Germany) for 24 hours first, and then washed under running tap water for one hour to flush out any debris remnants. After that it was followed by passage through different concentrations of ethyl alcohol for dehydration of the teeth. The sequence of ethyl alcohol concentrations used was 70%, 80%, 90%, and absolute ethanol. The teeth were immersed in each concentration for 5 hours. Clearing of the teeth was done by immersing them in a mixed solution of methyl salicylate and absolute ethanol for 5 hours, followed by immersion in methyl salicylate (Merck, Darmstadt, Germany) until the next step of procedure. India ink was injected into the root canals of the transparent teeth. In case of incomplete passing of dye into the canals, the suction was applied at the apical portion of teeth for a thorough distribution and flow of dye. After injecting the dye, the roots of the teeth were first examined under a magnifying glass (Lumagny, No. 7540, Hong Kong) at ×5 magnification and then under a stereomicroscope (Olympus, Tokyo, Japan) at X10 magnification for a better vision and thorough inspection. The canal type according to Vertucci's classification, the root canal curvature (straight, curved or S-shaped) and root canal angulation were determined.[6] Statistical analysis was then applied to determine the frequency, mean, standard deviation and range for all two categories using the SPSS-20 version of software.

RESULTS

All the mandibular molars had two roots i.e., one mesial and one distal. All the variants pertaining to the number of root canals, curvature of the canals and type according to the Vertucci's has been mentioned in the table 1a and 1b. The mean length of the mesial root was found to be 8.99mm and mean angulation was 10.80^{o}. The mean length of the distal root was 7.10mm and the root angulation that of $8.10^{o.}$ All the maxillary deciduous molars had three roots, i.e. mesiobuccal, distobuccal and palatal. Mostly the teeth had three separate roots. Only a small fraction i.e., 4(13.33%) had fused palatal and distobuccal roots. The mesiobuccal root was found to be the longest root with mean of 8.00 followed by palatal with mean of 7.54 and distobuccal having mean of 6.80. There was a small difference in lengths between the palatal and the distobuccal roots. The mesiobuccal root showed the maximum mean angulation of 18.74^{0} followed by distobuccal and palatal having the mean angulation of 15.41^{0} and 12.49^{0} respectively (Tables 1-4).

Table 1: Deciduous mandibular first molar data

Variants	No.	%
Root Canal Number		
Mesial root		
1	3	10.0
2	27	90.0
Distal root		
1	26	86.7
2	4	13.3
Canal curvatures (mesial root)		
MB canal		
Straight	9	33.3
Curved	18	66.7
MI canal		
Straight	21	77.8
Curved	6	22.2
Mesial canal		
Straight	2	66.7
Curved	1	33.3
Canal curvatures (distal root)		
DB canal		
Straight	3	75.0
Curved	1	25.0
DL canal		
Straight	2	50.0
Curved	2	50.0
Distal canal		
Straight	16	61.6
Curved	10	38.4
Vertucci's type of canal		
Mesial root		
Class IV	27	90.0
Class I	3	10.0
Distal root		
Class IV	4	13.4
Class I	26	86.6

Table 2: Mean±SD of mandibular first molar

Variants	Range	Mean±SD
Root length		
Mesial root	7-10 mm	8.99±1.05
Distal root	8-10 mm	7.10±0.99
Root angulation		
Mesial root	3-17°	10.80±3.20
Distal root	3-17°	8.10±3.27

Table 3: Deciduous maxillary first molar data

Variants	No.	%
Root Canal Number		
MB root		
1	24	80.0
2	6	20.0
DB root		
1	25	83.4
2	5	16.6
Palatal root		
1	30	100.0
Canal curvatures		
MB canal		
Straight	4	13.3
Curved	26	
DB canal		
Straight	6	20.0
Curved	22	73.4
S shaped	2	6.6
Palatal canal		
Straight	26	86.3
Curved	4	13.7
Vertucci's type of canal		
MB root		
Class IV	6	20.0
Class I	24	80.0
DB root		
Class IV	5	16.6
Class I	25	83.4
Palatal root		
Class I	30	100.0

Table 4: Mean±SD of maxillary first molar

Variants	Range	Mean±SD
Root length		
MB root	8-10 mm	8.00±0.80
DB root	5-10 mm	6.80±1.02
Palatal root	5-11 mm	7.45±1.01
Root angulation		
MB root	5-29°	18.74±4.98
DB root	5-27°	15.41±5.06
Palatal root	4-29°	12.49±5.39

DISCUSSION

Different studies have been done to get an accurate root and canal morphology of deciduous teeth. These studies have used techniques like including radiography[7] computed tomography[4] and clearing[7] Zoremchhingi et al[4] have explored the root and canal morphology of primary molars in an Indian population using a CT scan technique. They found that it had

wide variations having certain complexities also. CBCT (cone beam computerized tomography) is a relatively new and effective technology, which provides a good image to add conventional radiography for assessing the variation in root canal morphology of primary teeth.[14]

The prevalence of fused palatal and distobuccal roots in primary maxillary molars was common in Indians.[4] Gupta and Grewal[8] and investigated the root canal configuration of deciduous mandibular first molars in another Indian community using radiographic and clearing methods. Their investigation showed certain variations in the root canal morphology of these primary teeth. Their finding was a maximum of five root canals in a single specimen, and most of the specimens had four root canals on average.[8]

Pulpotomy is the "partial pulp removal," a technique, which has high successful rate of nearly 90%. It is used to treat the accidental, iatrogenic or carious pulp exposures. When the inflammation or infection is confined to the coronal area of the pulp, this technique is much beneficial to the patient. The procedure includes removal of the coronal portion of the pulp while at the same time preserving the vitality of the remaining root areas of the pulp. Pulpectomy is the procedure that involves complete removal of all the pulp tissue because of disease or trauma. If a child has tooth pain along with swelling of the gums or cheek, this requires the immediate clinician's attention. A small hole is made to gain entry in pulp chamber with the help of high speed air turbine on the occlusal surface of the tooth. Its purpose is to drain the abscess or removal of necrotic pulpal tissue in order to give an immediate soothing effect to the patient without having any danger of further flare ups. This will remove all of infected tissue from the root canal/s completely. Root canal anatomy is the study of the pulp chamber and root canals through the sectioning of teeth. Both the pulp chamber and the roots contain the dental pulp. The smaller branches which are present laterally are termed as accessory canals. These are most frequently found near the root end (apex), but may be encountered anywhere along the root length. The total number of root canals per tooth depends on the number of the tooth roots present ranging from one to four, five or sometimes more in some cases. However sometimes there may be more than one root canal per root. Some teeth have a more variable internal anatomy than others. An unusual root canal shape, complex branching (especially the existence of horizontal branches), and multiple root canals are thought to be the main causes of root canal treatment failures. Tissue debris or biofilm remnants along such un-instrumented canal ways may lead to failure due to both inadequate disinfection, preparation of the canal and the inability to properly obturate the root-canal space.[4] Alternatively, the biofilm should always be removed with a proper disinfectant during root canal treatment. Therefore the main goal of the root canal is to make canals free of the microorganisms and the infected tissue[9,10]. The retention of the healthy primary dentition is a good indicator for proper phonetics, spacing, mastication and esthetics[3,9,11].

There are so many methods that may have been employed for the improvement of our knowledge regarding to the deciduous root morphology, canal configuration and investigation of various anomalies in the canals and roots. Unfortunately no method is currently devoid of some sort of demerits and limitations. These methods including the conventional radiography, computed tomography and filling the canals with certain materials to investigate the canals are being employed exclusively. The conventional periapical radiography is a two dimensional imaging of the tooth. That's why the buccolingual root dimension still needs to be marked on the sample while in oral cavity the cone shift technique may be used to differentiate the buccal and lingual roots. The computed tomography is an excellent option for the different segments evaluation of the tooth in different planes but is an expensive one and requires special operatory training. In our study we have used the clearing technique which is inexpensive and reliable. Also there is minimal loss of the enamel.

Most of the teeth in the mandibular first molar had two roots and two canals (90%) in the mesial root and one canal in the distal root (86.66%). This is in accordance to the studies conducted by Gupta and Grewal[8] regarding the canal curvatures, 66.66% of the canals of the mesiobuccal side were curved while the ratio being lower in the mesiolingual canal being 22.22%. Although the roots of mesial portion were fused yet the canals were completely separated. All the canals in the mandibular molars followed the straight or the curved pattern. most of the canals in the distal roots were straight (61.53%). There was a broader distal canal which was much prominent in the pulp chamber. The distal root was longer as compared to the mesial roots. Since the curvatures in the canals may lead to perforations, zipping, elbow formation and ledge formation, a good knowledge of canal morphology and the root structure may provide us convenience to avoid these problems.[12] The maxillary molars had three canals with slight discrepancy of 20% and 16.66% with having two canals in the mesiobuccal and distobuccal canals respectively. Another finding was the canal curvature of S shaped in the distobuccal canal. 86.66% canals of the palatal roots were straight. The palatal roots found to be the longest roots having 5-11mm of length. both the palatal roots and distal root length of

the mandibular were more and in accordance with the Zoremchhingi et al.[3] The study so far done is also a good source for the morphology of second deciduous molars because the study of certain researchers say that external and internal anatomy of primary first molars are in close resemblance to that of primary second molars.[13]

CONCLUSION

There has been a little evidence of variation in the root lengths of mandibular molars between mesial and distal roots, the distal root being longer than mesial ones. All the orifice openings are rounded or oval in shape without any band like shape. Palatal root canals are found to be longest as compared to mesiobuccal and distobuccal canals. It is common to have separated root canals even in fused canals. Most of the distobuccal and palatal canals were separated. The obtained data in our study may help clinicians improve sagacity to get a confident knowledge of the morphological variations of root canals in primary molars and to overcome problems related to cleaning, shaping and canal preparation during root canal procedures, and thus giving a helping opportunity for the management strategies for root canal treatment to perform in a better way. Further research in this respect may reticulate our clinical experience and broaden our knowledge. A good knowledge regarding the canal morphology, being a quintessential requirement may thus improve the outcomes of root canal preparation and endodontics.

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