ROOT CURVATURE IN THE MAXILLARY FIRST PERMANENT MOLARS IN A KENYAN POPULATION

Nyaga J. M[1], Maina S.W[2], Gathece L.W[2], Okoth J[2]

[1]Department of conservative and Restorative dentistry University of Nairobi

[2]Department Periodontology, Community and Preventive Dentistry, University of Nairobi

Abstract

Objective; To determine the root curvature in the maxillary first permanent molars
Methodology; A total of 187 maxillary molars were collected from male and female patients aged between10 and 40 years. The teeth were orientated in their anatomical positions on a calibrated graph paper and the root curvature determined with reference to the long axis of root from the bifurcation.
Results; Majority of the mesiobuccally roots (63.6%) were curved and of the curved, 95% curved distally. In the distobuccally root, 49.7% of the roots were curved and majority (77.4%) curved mesial. Majority of the palatal roots were straight (65.3%). Of the curved palatal roots, 92.5% curved in a buccal direction. The gender variations in root curvature in maxillary first permanent molars was not statistically significant.

Conclusion; Palatal root in maxillary first permanent molars had the lowest frequency of curved roots.

Key words; roots, curvature, maxillary, molars

Introduction

The knowledge of the complexity in the root canals and the direction of curvature help in the understanding of the principles and problems of shaping, cleaning and post placement in the canal system. In addition, it facilitates performance of microsurgical procedures successfully.[1]

Thus evaluation of the root curvature is a crucial step during chemo mechanical preparation and the ost space preparation. Curved roots have curved canals and based on the severity of curvature, may have negative impact on instrumentation during shaping and post space preparation. The root curvature is reported to influence the outcome following canal prepation.[2, 3]

Nearly all roots are reported to be curved, particularly in a mesiodistal or buccolingual direction.[4, 5, 6, 7, 8, 9] These curvatures may pose a problem during the shaping and cleaning procedures because they are not evident on a standard facial radiograph. The number of cycles necessary to induce cyclic fatigue fracture in rotary instruments is lower in curved canals compared to straight ones.[10] Angled views are necessary to determine their presence, direction, and severity. A curvature may be a gradual curve of the entire canal or a sharp curvature near the apex. Double S- shaped canal curvatures have also been reported.[4, 11] A separated instrument is one of the most troublesome incidents in endodontic therapy.[10] Through recall radiographic evaluation, the frequency of remnant separated instruments is reported to range between 2% and 6%.[10] Most of the instrument separation is reported to occur in the molars and the most canals involved are the mesial canals of mandibular molars followed by the buccal canals of maxillary molars.[32] Investigators have reported a wide variations in first permanent molar root curvatures. Researchers have frequently applied the radiographic technique to determine the root curvatures. However conventional radiographs may only demonstrate the main features and are unlikely to show the complexities of root anatomy.[12, 13] In addition, radiographs are two dimensional and are open to a wide range of interpretation according to Omear et al.2004.[14]

Materials and Methods

This was an in vitro-cross sectional descriptive study which was conducted at the University of Nairobi, School of Dental Sciences. One hundred and eighty seven maxillary first permanent molars extracted from Kenyans of African descent aged between 10 and 40 years were collected in four oral health care facilities within Nairobi. The teeth were grouped into two at the collection point based on gender. The extracted teeth were washed in tap water immediately after extraction. Then immersed in 3.85%m/v sodium hypochlorite solution (Reckitt Benckiser E.A. Nairobi, Kenya) for a minimum of thirty minutes to remove adherent soft tissue and for disinfection. Subsequent storage was done in 10% formalin solution till the day of analysis. During the analysis, the teeth were orientated in their anatomical positions on a calibrated graph paper (Kartasi Graph Book, Nairobi Kenya) and the root curvature determined with reference to the long axis of root from the bifurcation. By visual examination of the root against the grid, it was determined whether the root is straight, curved towards mesial,

buccal, lingual, palatal or curved in multiple directions (see Figure 7).

The direction of the root curvature was determined by the position of the root apex from the long axis of the root.

Results

Table 1 shows the frequency of curved and straight roots in maxillary first molars. Generally, the maxillary first molar roots were frequently curved 283 (50.5%). The mesiobuccal root was the most frequently curved 65.8% while the palatal root was the least curved 67 (35.8%). Similarly, the palatal root had highest frequency of straight roots 120 (64.2%) compared to distobuccal 94 (50.3%) and mesiobuccal roots 64 (34.2%). The observed variation among the straight versus curved roots in the maxillary first molar was statistically significant (χ^2 =34.39, d.f. 2, P<0.05). Table 2 shows the direction of root curvature in maxillary first molars. Majority of mesiobuccal roots 118 (95%) were curved distally, 2 (2%) were mesially curved, 2 (2%) were S shaped and 1 (1%) curved palatally. Of the distobuccal roots, 72 (77.4%) were curved mesially, 16(17.2%) curved distally, 1 (1%) curved lingually, 1 (1%) curved buccally, and 3 (3.2%) were S shaped. Of the curved palatal roots, 62 (92.5%), 4 (6%) and 1(1.5%) curved buccally, palatally and S shaped respectively. Palatal root curvature in a distal or mesial direction was not observed. Females had lower frequency of straight roots 29(29.6%) compared to males 49(58.3%) in the mesiobuccal root. Of the curved mesiobuccal roots, 49(92.5%) in males and 69(98.6%) in females curved distally. Mesiobuccal root curvature in mesial and palatal direction was observed among males.

However, the observed gender variation in the straight versus the distally curved roots was not statistically significant [χ^2 =2.89, d.f 1 and P=0.09(>0.05)]. In the distobuccal root, straight roots were more frequent in males 48 (55.8%) than in females 46 (47.9%). Of the curved distobuccal roots, 31(77.5%) and 41 (77.4%) were curved mesially while 7(17.5%) and 9(7%) were curved distally among males and females respectively. The gender variations in the straight, mesially curved and distally curved roots was not statistically significant [χ^2 =1.14, d.f. 2 and P=0.57(>0.05)].

In the palatal root, males had a higher frequency of straight roots 61(69.3%) compared to females 59(59.6%). Of the curved roots, root curvature in the buccal direction was higher in males 25 (92.6%) compared to females 37 (92.5%). The observed differences between the genders in straight versus buccally curved roots was not statistically significant [χ^2 =1.81, d.f. 1 and P=0.18 (>0.05)].

Figure 7: Diagramatic representation of determination of root curvature

Discussion

Majority of the roots in maxillary first permanent molars were curved. The palatal, mesiobuccal and distobuccal roots frequently curved buccally, distally and mesially respectively. Previous studies by Dienya et al. 2008[8] and Pecora et al. 1991[7] reported frequencies of 90.0% and 54.6% for buc-

Table 1: The frequency of straight and curved roots in the maxillary first molars

Root	Root curvature				Test done
	Straight		Curved		
	No	%	No	%	
Mesiobuccal root	64	34.2	123	65.8	
					χ^2 =34.39, d.f
Distobuccal root	94	50.3	93	49.7	2, p<0.05
Palatal root	120	50.3	93	49.7	

Table 2: Directions of root curvature in maxillary first molars

Root	Direction of root curvature (frequency in percentage)				
	mesial	distal	palatal	buccal	others
MB (n=123)	2	95	1	0	2
DB (n=93)	77.4	17.2	1	1	3.4
P (n=67)	0	0	6	92.5	1.5
Total (n=283)	26.1	47.4	2.1	22.3	2.1

cally curved palatal root, 95.2% and 86.5% for distally curved mesiobuccal roots, 73.8% and 32.6% for mesially curved distobuccal root respectively. Bone et al. 1986[9] in a sample of 100 first molars reported that 90% of palatal roots were curved and of the curved roots, 85% curved buccally among the Australians. The variations in frequencies between this and previous studies may be attributed to the variations in study samples and methodology used. Dienya et al. 2008[8] used CBCT to determine root curvature which differs from this study's graphic method in precision. Bone et al. 1986[9] used a radiographic method which differs from graphic method in this study which did not classify the degree of root curvature. In addition, there was racial variation in the samples used. Pecora et al.1991[7] sample was from Caucasian population compared to African population in this study.

Endodontic treatment in curved roots has been associated with disastrous consequences such as loss of working length, apical transportation, and creation of ledges, perforations and instruments separation.

Conclusions and Recommendations

Palatal root in maxillary first molars had the lowest frequency of curved roots. In the curved palatal roots, 92.5% curved buccal. Thus the palatal root of maxillary first permanent molars are the most suitable for post placement. Further research is needed to determine and classify the severity of root curvatures in first permanent molars

Acknowledgements

To the dentists in the various dental clinics in Nairobi, who facilitated the collection of the extracted teeth for this study. They are also grateful to the departments of Conservative and Prosthetic Dentistry and the Oral and Maxillofacial Surgery, School of Dental Sciences, University of Nairobi where the study was conducted. The study was approved by the Ethics and research Committee of the Kenyatta National Hospital and University of Nairobi (P219.8.2008).

References

1. Vertucci FJ. Root canal morphology and its relationship to enodontic procedures. Endodontic Topics 2005; 10: 3-29.
2. Peters OA, Laib A, Gouring TN, Barbakow F. Changes in root canal geometry after preparation assessed by high resolution Computed tomography. Journal of Endodontic 2001; 27: 1-6.
3. Peter OA, Peters CI, Schonenberger k, Barbakaw F. ProTaper rotary root canal preparation: assessment of torque forces in relation to canal anatomy, International Endodontic Journal 2003: 36; 93-99.
4. Frank J, Vertucci, James E, Haddix, Leandro R, Britto. Tooth Morphology and Access Cavity Preparation in Pathways of the Pulp, Ninth Edition Elsevier Mosby 2006; 148 -232.
5. Enrique P, Richard Z, Peter Y. Root curvature localization as indicators of post length in various tooth groups. Dental Traumatology 2006; 2 (2): 58 -61.
6. Sharma R, Pecora JD, Lumley PJ, Walmsley AD. The external and internal anatomy of human mandibular canine teeth with two roots. Endodontic Dental Traumatology 1998; 14: 88-92.
7. Pecora JD, Woelfel JB, Sousa N. Morphologic study of the maxillary molars part 1: External Anatomy. Brazillian Dental Journal 1991; 2(1):45-50.
8. Dienya JM, Yeti R, Norliza I. Determination of root and canal morphology of 1st permanent molars amongst Kenyan adults. Research report submitted for the partial fulfillment of degree of masters of Dental Science (endodontics) University of Malaya Kuala Lumpur 2008.
9. Bone J, Moule AJ. The nature of curvature of palatal canals in maxillary molar teeth. International Endodontic Journal1986; 19: 178-186.
10. Mian K, Iqbal, Meetu R, Kohli, Jessica S, Kim. A Retrospective Clinical Study of Incidence of Root Canal Instrument Separation in an Endodontics Graduate Program: A PennEndo Database Study. Journal of Endodontics 2006; 32:1048 –1052.
11. Berkovitz BK, Holland GR, Moxham BJ. Oral Anatomy, Histology and Embryology. Mosby, Elsevier Science Limited Third Edition 2000 Page 13-33.
12. Omer OE, Al Shalabi RM, Jennings M, Glennon MJ, Claffey NM. A comparison between clearing and radiographic techniques in the study of the root-canal anatomy of maxillary first and second molars. International Endodontic Journal 2004; 37: 291-296.
13. Insoo k, Ki-suk P, seung-pyo L. Quantitative Evaluation of the Accuracy of Micro-Computed Tomography in Tooth Measurement. Clinical anatomy 2007; 20: 27-34.
14. DE Moor RJ, Deroose CA, Calberson FL. The radix entomolaris in mandibular first molars: an endodontic challenge. International Endodontic Journal 2004; 37: 789–799.

Corresponding Author
James Nyaga
Department of conservative and Restorative dentistry
University of Nairobi
Email:
nyagajames14@gmail.com