Cone-beam Computed Tomography Study of Root Canals in a Hamadani Population in Iran

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ABSTRACT

Statement of the problem: Using CBCT to determine root morphology minimizes rate of treatment failure and adverse effects, such as gouging and perforations.

Purpose: The aim of this study was to assess morphology of root canals using CBCT scans.

Materials and Methods: In this cross-sectional study, conducted in the Radiology Department of Hamadan Dental School in 2011–2012, 66 CBCT scans were studied. The following data were analyzed: number of roots, canals, canal types and root canal curvature of mandibular central and lateral incisors, canines, first and second premolars and molars and maxillary first and second premolars and molars. Data was analyzed with SPSS 16.0 and descriptive statistical tests.

Results: In this study, all the mandibular central and lateral incisors, canines, second premolars and most of the mandibular first premolars (98.5%) and all of the second premolars and maxillary first and second premolars (63.6% and 65.1%) had one root. All the mandibular first molars and most of the second molars (95.4%) had two roots. All the maxillary first and second molars had three roots. Most of the mandibular central and lateral incisors, canines and first premolars and maxillary second premolars had one canal. 65.1% of mandibular second premolars and 87.9% of maxillary first premolars had two canals. Most of the mandibular first and second molars and maxillary first molars had three and maxillary second molars had four canals. The majority of mandibular central and lateral incisors, canines, first and second premolars were type I. The majority of teeth, based on Dobo-Nagy classification, were type I (straight). Mandibular second molars had the majority of C-shaped (entirely curved) curvature.

Conclusion: CBCT scans are efficacious tools for the diagnosis of root canal morphology and curvatures to increase the success of root canal treatment.

Keywords: Anatomy and Histology, Dental Pulp Cavity, CBCT Scan.

INTRODUCTION

Two-dimensional imaging techniques have been used since the first dental intraoral radiographs were taken in 1896. Panoramic and tomographic imaging techniques were developed to reduce radiation and faster processing time. CBCT imaging is a new technique of three-dimensional images with lower cost and lower dose compared with conventional CT.[1–3]

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CBCT scanners were presented for use in jaw-facial examinations simultaneously in Japan and Italy in 1990. Advantages of CBCT over conventional radiography and tomography include sub-millimeter resolution, three-dimensional image reconstruction, removal of superimposed structures and showing normal anatomy and morphology of the root canal system without additional exposure. CBCT provides images of root morphology with higher resolution than those obtained by conventional periapical radiography.[4,5]

Kim et al reported that CBCT scans can enhance the understanding of root canal anatomy, with the potential of improving the outcome of endodontic treatment.[6] In addition, Wang et al showed that mandibular first permanent molars commonly have four canals and a higher prevalence for a separated distolingual canal in a western Chinese population.[1] Huang et al showed a high overall incidence (32.6%) of three-rooted mandibular first molars in Taiwanese individuals. CBCT might be a valuable tool for identifying an extra distolingual root in mandibular first molars.[7] Zhang et al showed that mesiobucccal roots of maxillary molar teeth had more variations in their canal system than the distobuccal or palatal roots. The root canal configuration of maxillary second molars was more variable than that of first molars. CBCT can enhance detection and mapping of the mesiobuccal root canal system with the

potential to improve the quality of root canal treatment.[8]

The aim of the present study was to use cone-beam computed tomography to evaluate root canals in a Hamadani population in Iran.

MATERIALS AND METHODS

CBCTs of 66 patients who referred to the Radiology Department of Hamadan Dental School (Hamadan, west of Iran), between March 2011 and July 2012, were studied.

All the teeth except mandibular and maxillary third molars and maxillary central and lateral incisors and canines (maxillary anterior teeth had complex anatomy and were non-uniform) were studied in axial, coronal and sagittal planes.

Teeth with pathological lesions, developmental disorders and endodontically treated teeth were excluded.

In this study, the number of roots and canals, canal types and root canal morphology (curvature) were evaluated. Number of roots and canals, canal types and root canal morphology (curvature) were analyzed in axial, coronal and sagittal planes.

In this study, canal morphology was determined based on Vertucci's classification:[9] Type I (1), Type II (2-1), Type III (1-2-1), Type IV (2), Type V (1-2), Type VI (2-1-2), Type VII (1-2-1-2) and Type VIII (3). In addition, the root canal morphology (curvature) was determined based on Dobo-Nagy classification:[10] I (straight), J (apical curve), C (entirely

curved) and S (multi-curved). Statistical analysis was carried out using SPSS 16.0 and descriptive statistical tests.

RESULTS

In this study, all the mandibular central and lateral incisors, canines, second premolars and most of mandibular first premolars (98.5%) and maxillary first and second premolars (63.6% and 65.1%) had one root. All the first molars and most of the second molars (95.4%) had two roots. All the maxillary first and second molars had three roots (Table 1).

In the present study, most of the mandibular central (75.6%) and laterals (74.2%) incisors, canines (87.9%) and first premolars (72.8%) and maxillary second premolars (62.1%) had one canal; 65.1% of mandibular second premolars and 87.9% of maxillary first premolars had two canals. Most of the mandibular first and second molars (63.6% and 65.1%) and maxillary first molars (74.2%) had three canals and most of the maxillary second molars had four canals (Table 2).

In this study, based on Vertucci classification, the majority of mandibular central (84.8%) and lateral (78.8%) incisors, canines (95.4%), first and second premolars (75.7% and 92.3%) were type I; 54.6% of maxillary second premolars were type II. The majority of mandibular first and second molars (65.2% and 54.6%) were type III and maxillary first premolars (62.1%) and first and second molars (54.6% and 57.6%) were type IV (Table 3).

In the present study, based on Dobo-Nagy classification, the majority of mandibular central (62.1%) and lateral (78.8%) incisors, canines (90.8%), first and second premolars (78.8% and 72.8%), first and second molars (66.7% and 54.5%) and maxillary first and second premolars (72.7% and 69.7%) and first and second molars (72.7% and 78.8%) were type I (straight). Mandibular second molars had the highest number of C-shaped (entirely curved) canals (Table 4).

Table 1: The number of teeth roots in CBCT of patients

Number of roots (%) / Teeth		1	2	3
Mandible	central incisor	66 (100)	-	-
	lateral incisor	66 (100)	-	-
	canine	66 (100)	-	-
	first premolar	65 (98.5)	1 (1.5)	-
	second premolar	66 (100)	-	-
	first molar	-	66 (100)	-
	second molar	-	63 (95.4)	3 (4.6)
Maxilla	first premolar	42 (63.6)	24 (36.4)	-
	second premolar	43 (65.1)	23 (34.9)	-
	first molar	-	-	66 (100)
	second molar	-	-	66 (100)

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Table 2: The number of root canals in CBCT of patients

Teeth	Number of canals (%)	1	2	3	4
Mandible	central incisor	50 (75.6)	26 (24.4)	-	-
	lateral incisor	49 (74.2)	27 (25.8)	-	-
	canine	58 (87.9)	8 (12.1)	-	-
	first premolar	48 (72.7)	18 (27.2)	-	-
	second premolar	20 (30.3)	43 (65.1)	3 (4.6)	-
	first molar	-	-	42 (63.6)	24 (36.4)
	second molar	-	-	43 (65.1)	34.8
Maxilla	first premolar	1 (1.5)	58 (87.9)	7 (10.6)	-
	second premolar	41 (62.1)	25 (37.9)	-	-
	first molar	-	-	49 (74.2)	25.8
	second molar	-	-	38 (57.6)	28 (42.4)

Table 3: The canal types based on Vertucci classification in CBCT of patients

Teeth	Canal types (%)	Type I	Type II	Type III	Type IV	Type V
Mandible	central incisor	56 (84.8)	7 (10.6)	1 (1.5)	2 (3.1)	-
	lateral incisor	52 (78.8)	8 (12.1)	1 (1.5)	5 (7.6)	-
	canine	63 (95.4)	2 (3.1)	-	1 (1.5)	-
	first premolar	50 (75.7)	3(4.6)	-	4 (6.1)	9 (13.6)
	second premolar	61 (92.3)	2 (3.1)	-	2 (3.1)	1 (1.5)
	first molar	-	3 (4.6)	43 (65.1)	20 (30.3)	-
	second molar	-	20 (30.3)	36 (54.6)	10 (15.1)	-
Maxilla	first premolar	7 (10.6)	17 (25.8)	-	41 (62.1)	1 (1.5)
	second premolar	11 (16.5)	36 (54.6)	-	17 (25.8)	2 (3.1)
	first molar	-	-	25 (37.8)	36 (54.6)	5 (7.6)
	second molar	-	-	24 (36.3)	38 (57.6)	4 (6.1)

Table 4: The canal shaping (curvature) based on Dobo-Nagy classification in CBCT of patients

Teeth	Canal shaping (curvature) (%)	I (straight)	J (apical curve)	C (entirely curved)	S (multi curved)
Mandible	central incisor	41 (62.1)	11 (16.7)	7 (10.6)	7 (10.6)
	lateral incisor	52 (78.8)	5 (7.6)	8 (12.1)	1 (1.5)
	canine	50 (90.8)	2 (3.1)	3 (4.6)	1 (1.5)
	first premolar	52 (78.8)	5 (7.6)	3 (4.6)	6 (9)
	second premolar	48 (72.8)	6 (9)	2 (3.1)	10 (15.1)
	first molar	44 (66.7)	7 (10.6)	10 (15.1)	5 (7.6)
	second molar	36 (54.5)	7 (10.6)	20 (30.3)	3 (4.5)
Maxilla	first premolar	48 (72.7)	8 (12.1)	4 (6.1)	6 (9)
	second premolar	46 (69.7)	10 (15.1)	3 (4.6)	7 (10.6)
	first molar	48 (72.7)	8 (12.1)	2 (3.1)	8 (12.1)
	second molar	52 (78.8)	9 (13.5)	3 (4.6)	2 (3.1)

DISCUSSION

The main goal of endodontic treatment is to save the tooth through a root canal procedure, chemical and mechanical cleaning and filling it with a filling material. However, failure is observed in root canal therapy; one of the main reasons for failure is low knowledge about root

canal anatomy and morphology, variations in the number of canals etc. Proper knowledge about root canal morphology can decrease these errors.[11–13]

In this study, morphology (number of roots and canals, canal types based on Vertucci classification and canal morphology [curvature] based on Dobo-Nagy classification) of mandibular central and lateral incisors, canines and mandibular and maxillary first and second premolars and molars were studied. No such study with CBCT has been carried out in Iran.

In this study, all the mandibular central and lateral incisors, canines, second premolars and most of the first premolars and maxillary first and second premolars had one root. All the first molars and most of the second molars had two roots. All the maxillary first and second molars had three roots. Our findings about the number of roots were consistent with previous reports.[2,7,11]

In the present study, most of the mandibular central and lateral incisors, canines and first premolars and maxillary second premolars had one canal; 65.2% of mandibular second premolars and 87.9% of maxillary first premolars had two canals. Most of the mandibular first and second molars and maxillary first molars had three canals and the majority of maxillary second molars had four canals, consistent with those reported by Wang,[1] Tian,[3] Yu[4] and Weng.[5]

In this study, based on Vertucci classification, the majority of mandibular central and lateral incisors, canines and first and second premolars were type I; 54.5% of maxillary second premolars were type II. The majority of mandibular first and second molars were type III and maxillary first premolars and first and second molars were type IV, consistent with the results reported by Mauger,[12] Huang,[7] Parekh,[11] Wang,[1] Sert[13] and Neelakantan.[14]

In this study, based on Dobo-Nagy classification, the majority of mandibular central and lateral incisors, canines, first and second premolars and first and second molars and maxillary first and second premolars and molars were type I (straight). Mandibular second molars had the majority of C-shaped (entirely curved) curvatures. Our findings about canal morphology (curvature) was consistent with reports of Nielsen,[15] Victorino,[16] Sandhya,[17] Rwenyonyi.[18]

CONCLUSION

CBCT scans proved an effective tool for the diagnosis of root canal morphology of mandibular centrals, laterals, canine, first and second premolars and molars and maxillary first and second premolars and molars. This diagnostic tool can be used to increase the success rate of root canal treatment.

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