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SYMMETRY OF ROOT AND ROOT CANAL MORPHOLOGY OF MAXILLARY AND MANDIBULAR MOLARS IN INDIAN POPULATION: A CONE-BEAM COMPUTED TOMOGRAPHY STUDY

Dental Science

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ABSTRACT

Aim: The aim of this study was to use cone-beam computed tomography (CBCT) to analyze root canal anatomy and symmetry of maxillary and mandibular first and second molar teeth in Indian population.

Methodology: A sum of 166 patients were enrolled in the present study for whom CBCT examinations were done as a part of their dental diagnosis and treatment.481 healthy, untreated, fully developed maxillary and mandibular molar teeth were examined by CBCT to establish the symmetry in root and canal anatomy between right and left sides of the same patient and to evaluate the number of roots, root canals and their configurations.

Results: The normal anatomy of maxillary first and second molars was the exhibition of three separate roots with three separate canals. Two separate roots and three canals was the anatomy exhibited by most mandibular first and second molars. From the present study, it was evident that both maxillary and mandibular second molars exhibited greater symmetry than the first molars. Maxillary first molars were found to be symmetrical in 75.38% of patients and maxillary second molars in 82.35% of patients. 76.31% and 82.9% of mandibular first and second molars respectively showed symmetry.

Conclusion: The results of the present study reported 75-82% of symmetry. These variations in symmetry should be considered greatly while performing treatments on 2 opposite molars in the same patients.

KEYWORDS

symmetry,root canal morphology,root canal anatomy,diagnosis

INTRODUCTION:

The complexity of the root canal system and internal morphology is directly correlated with endodontic treatment planning, therapy and outcome.[16] Successful endodontic therapy stems from thorough canal debridement and effective filling of the root canal system, for which a thorough knowledge of morphology of the root canals is a critical prerequisite.[7] To examine the morphology of root canals, several efforts have made use of macroscopic sections, polyester resin impressions, and transparent samples in vitro.[15,10,2] However, these techniques have the disadvantage of producing irreversible changes to the samples.[19] Cone-beam computerized tomography (CBCT) is a medical image acquisition technique based on a cone-shaped X-ray beam centred on a two-dimensional (2D) detector. The source-detector system performs one rotation around the object producing a series of 2D images. The images are reconstructed in a three-dimensional (3D) data set using a modification of the original cone-beam algorithm developed by Feldkamp. [6] Dedicated cone-beam computerized tomography scanners for the oral and maxillofacial (OMF) region were pioneered in the late 1990s independently by Arai.[1] Cone-beam computed tomography (CBCT) images have been found to be precisely useful in providing accurate anatomic details in 3 dimensions(3D) than the conventional 2D periapical radiographs for diagnosis and treatment planning during the course of endodontic therapy.[4,5]

MATERIALS AND METHODS:

A total of 166 patients who required CBCT as part of their dental diagnosis and treatment were enrolled in the study. The images were collected from various dental colleges and scan centre across India. The images which were taken as a part diagnosis and treatment planning of patients who require large field of view CBCT images for reasons including facial trauma or maxillary sinusitis, preoperative assessment of multiple implants and other orthodontic treatment and not for endodontic treatment (i.e.,only healthy molars were selected). A total of 481 teeth(133 maxillary 1st molar ,112 maxillary 2nd molar, 121 mandibular 1st molar ,115 mandibular 2nd molar) were analyzed . The images were recorded according to axial ,saggital and coronal planed. CBCT images were viewed on reconstructions according to the axial plane, scrolling the cursor in the coronal-apical direction before, and then in the apical-coronal, to get a detailed view of the root canal system of examined teeth. This action was repeated 3 times, and when the images in the axial plane were not clear, the teeth were also inspected in three-dimensional. During examination of the teeth, the number of roots and their morphology, the number of root canals in each root, and the configuration of the root canal system were determined and recorded according to the Vertucci classification [21]. Furthermore, the symmetry between right and left sides in the same patient was analyzed and registered for the tooth type analyzed.

RESULTS:

Root Morphology and Number of Root Canals:

In the 133 maxillary first molars examined, 126 (94.8%) had 3 separate roots; all the distobuccal (DB) and palatal (P) roots had 1 canal, whereas 61% of the mesiobuccal (MB) roots (n = 78) had an MB2 , remaining 39% (n=48) had single MB canal. 6 teeth (4.5%) had 2 separate roots (B and P); 4 teeth (66.66%) had 2 canals (1 for each root), 2 tooth (33.33%) had 3 canals (2 in the Buccal and 1 in the Palatal root), and the other 1 tooth (0.7%) had 4 roots and 4 canals (2 in B and 2 in P root). In the 112 maxillary second molars examined, the number of roots was more variable; 99 (88.39%) had 3 roots, 8 (7.14%) had 2 roots (1 B and 1 P), 3 (2.6%) had 1 root, and 2 (1.78%) had 4 roots (2 B and 2 P). When 3 separate roots were present, all the DB and P roots had a single canal; 83.83% (n = 83) of the MB roots had a single canal, whereas 16.16% (n = 16) had an MB2 canal. When 2 separate roots were present, 6 teeth (75%) had 1 canal in each root, whereas 2 (25%) had 2 canals in the B and 1 in the P root. All 3 teeth with 1 root had 2 canals (B and P), and the 2 teeth with 4 roots had 1 canal in each root. Out of 121 mandibular first molars examined 98.3% (n=119) had 2 separate roots, 1 mesial (M) and 1 distal (D). 83 (69.74%) had 3 canals (2 in the M and 1 in the D root), 25 (21.%) had 4 canals (24 had 2 canals in the M and 2 canals in the D root, whereas 1 tooth had 3 canals in them and 1 in the D root), and 11 (9.24%) had 2 canals (1 for each root), remaining 2 had 3 roots(1.7%).In the 115 mandibular second molars, 102 (88.69%) had 2 separate roots (1 M and 1 D), 11 (9.56%) had 1 root, and 2 (1.73%) had 3 separate roots (MB, mesiolingual, and D). When 2 separate roots were present, all of the distal roots had a single canal. 94 mesial roots (92.15%) had 2 canals, whereas the other 8 (7.84%) had 1 canal. In the 14 teeth that had a single root, 2 (14.2%) had 1 canal, 1 (7.1%) had 2 canals (M and D), and 1 (7.1%) had 3 canals (2 M and 1 D), whereas 10 (71.6%) had a C-shaped canal. Five of these teeth (50%) had 1 canal, 3 (30%) separated into 2 canals, and 2 (20%) separated into 3 canals.(Table 1)

Table 1. No. Of Roots In Maxillary And Mandibular Molars (in Percentage)

Type of tooth	1 root	2 roots	3 roots	4 roots
Maxillary 1st molar	-	4.5%	94.8%	0.7%
Maxillary 2nd molar	2.69%	7.14%	88.39%	1.78%
Mandibilar 1st molar	-	98.3%	1.7%	-
Mandibular 2nd molar	9.56%	88.69%	1.73%	-

Root Canal Morphology:

In the maxillary first molars, when the MB2 canal was present, the root canal configuration was 67.94% type II, 12.3% type III, 11.7% type IV. When 2 roots and 3 canals were present, the root canal configuration of the buccal root was type II, whereas when there were 2 roots and 4 canals, the root canal configuration of both the buccal root and the palatal root was type II. In the maxillary second molars, when MB2 was present, the root canal was 76.2% type II, 14.3% type III, and 9.5% type IV. When 2 roots and 3 canals were present, the root canal configuration of the buccal root was 75% type II and 25% type IV; when a single root and 2 canals were present, the root canal configuration was 66.6% type II and 33.4% type V. In the mandibular first molars with 2 roots and 3 canals, the root canal configuration of the mesial root was 28.4% type II and 71.6% type IV. When 2 roots and 4 canals were present, the root canal configuration of the mesial root was 36% type II, 60% type IV, and 4% type VIII, whereas the distal root was 4% type I, 44% type II, 32% type III, and 20% type IV. In the mandibular second molars with 2 roots and 3 canals, the root canal configuration of the mesial root was 27% type II, 2.4% type III, and 70.6% type IV. When 1 root and 2 canals were present, the root canal configuration of the single root was type II, whereas those teeth that had an initial C-shaped configuration were type IV. When there were 1 root and 3 canals, the root canal configuration of the single root was type VIII; when 3 roots and 5 canals were present, the root canal configuration of the MB and distal root was type I and type III, respectively, whereas in the mesiolingual root, the configuration was 50% type II and 50% type III.

Anatomic Symmetry:

Of the 65 patients who had both maxillary first molars, 75.38% (n = 49) showed perfect symmetry in root and canal morphology of these teeth. With regard to the maxillary second molars, the symmetry was observed in 82.35% (n = 42) of 51 patients analyzed. Of the 38 patients who had both right and left mandibular first molars, 76.31% (n = 29) showed perfect symmetry in root and canal morphology of these teeth. With regard to the mandibular second molars, the symmetry was observed in 82.9% (n = 39) of the 47 patients analyzed. (figure 1)

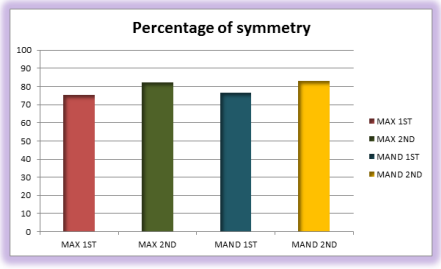

Figure 1: Percentage Of Symmetry In Different Molars

DISCUSSION:

The study of root canal anatomy is important for clinical dental practice and has immense anthropological significance. Clinically, CBCT provides an excellent, nondestructive, non-invasive imaging option with the potential to detect most anatomic variations, while creating an accurate representation of the external and internal dental anatomy.[13]

In this study, in maxillary 1st and 2nd molars 94.7% and 88.39% of the tooth had three roots MB2 was present in 61% of maxillary 1st molar whereas in case of maxillary 2nd molars only 16.16% of mesiobuccal root had MB2 canal. Maximum variations are present in MB roots of both first and second molars which are in agreement with Singh.[17] However, CBCT is said to have lower MB2 identification rate compared with operating microscope.[20,11]

In mandibular first molars examined 98.3% has 2 separate roots which is similar to study done by Chourasia[3]. In this study 1.7% of first molar had three roots , which is different from the study done by Kumar[9].In case of mandibular second molars 88.69% had 2 separate roots which is similar to the study done by Neelakandan [12].

In the present study, the maxillary first molars were found to be symmetrical in 75.38% of patients, and maxillary second molars were symmetrical in 82.35%. The rest of the maxillary first and second molars showed asymmetry. 8% of patients had maxillary first molar teeth with 3 roots and 3 canals on one side and 3 roots and 4 canals on the other. These data are very important from a clinical point of view because to not detect, debride and fill an MB2 canal can lead to a poor long-term prognosis as a result of residual intracanal infection [22,23;]25.It was demonstrated that root canal treatment of maxillary molar teeth has the highest clinical failure rates[18,8], probably because these teeth have the most complex root and canal anatomy[20],with substantial variations in the mesiobuccal roots. These percentage should be kept in mind while treating the opposite tooth of the same patient.

To date, no articles have reported the anatomic symmetry of maxillary and mandibular first and second molar teeth between right and left sides of the same patient, in an Indian population but in white population.[14]

CONCLUSION

The results of the present study reported 75-82% of symmetry. These variations in symmetry should be considered greatly while performing treatments on 2 opposite molars in the same patients. Further studies should be done to evaluate the anatomic symmetry in other tooth ,races and populations with more sample.

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