Research Article

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Pulpal Morphology of Maxillary First Molar in Gond Population of Central India: A CBCT Study

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ABSTRACT

Aim: The aim of this study was to determine the root and pulpal morphology of the maxillary first molar teeth in Gond tribal population of central India.

Material and Methods: One hundred twenty permanent maxillary first molars extracted from patients of Gond tribal population of Central India were collected and studied using CBCT. Observations of number, length and angulation of the roots, number and configuration of root canals, diameter of the root canals at cemento- enamel junction were made.

Results: Three roots were found in all the teeth, out of which 31.66% had three canals and 68.33% four. The most prevalent root canal configuration in the mesiobuccal root was found to be Type II followed by Type I and IV. Whereas in MB2 predominant configuration was Type I, in distobucal Type IV and Type I in palatal..The mean root length observed was 12.34 mm of MB root, 11.93mm of DB root and 13.22 mm of Palatal. Average canal diameter of MB1 canal was found to be 1mm, MB2 canal 0.58mm, DB canal 0.97mm and palatal canal 1.69mm. The mean angulation of MB root was found to be 11.29 °, DB root 13.43° and palatal root 8.30°.

Conclusion: The permanent Maxillary molars of Gond population are three rooted with four canals. The root canal morphology of these teeth can be complex and requires careful evaluation prior to endodontic therapy.

Keywords: Maxillary First molar, Pulpal Morphology, Root Canal Configuration, Root Canal Orifice.

INTRODUCTION

Awareness of pulpal morphology for successful endodontic treatment is indispensible. It is important to locate all existing canals for proper cleaning, shaping and three-dimensional obturation.The maxillary first molar are among the most difficult teeth to be treated endodontically. This could be due to many factors namely the number of roots, the number of canals, the various pulp cavity configurations, the direction and longitudinal depressions of the roots, variability of mesiobuccal canals and the difficulties in visualizing the apical limit by radiographs. Maxillary molars are known to have an additional canal (MB2) in the mesio buccal root quite frequently. Wolcott et al have shown that failure to find and treat existing MB2 canal will decrease the long-term prognosis.[1] Weine stated that frequent failure of endodontic treatment in maxillary first permanent molar teeth was likely due to the failure to locate and fill the second mesiobuccal canal[2]. The pulpal morphology

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of maxillary first molars tend to change in different ethnic populations[3]. A number of studies have been published [4,5,6] regarding maxillary first molar root canal morphology are using staining solutions,[7] radiographic techniques[8,9] and more recently introduced cone beam computed tomography [10-14]. In the ethnic Gond population of central Indian region, a large percentage of maxillary first molars treated endodontically have reported failure. To assess the pulpal morphology of maxillary first molars in the local ethnic Gond population, this study was carried out, so that awareness of more detailed pulpal morphology results in higher endodontic success.

MATERIALS AND METHODS

Permanent maxillary first molars of the ethnic Gond people, belonging to the central Indian region, with full root length without any evidence of root fracture were collected from the primary health centre, Raisen District, Madhya Pradesh. Teeth were cleaned of calculus and soft tissues by ultrasonic scaler. Assiduous protocol of sterilization was followed. Teeth were placed into 10% formalin solution until evaluation. Out of the collected teeth, 120 teeth were selected on the basis of the following criteria.

INCLUSION CRITERIA

Fully developed intact permanent maxillary first molar extracted due to periodontal conditions, orthodontic or other conditions.

EXCLUSION CRITERIA

- Undeveloped apex
- Root with restoration
- Fractured or crazed root
- Developmental anomalies
- External or Internal resorption
- Any tooth with calcified canals
- Previously endodontically treated teeth
- Severe erosion or abrasion on the root surface

8 arches were made by modelling wax, each containing 15 permanent maxillary molars. The teeth were mounted on modeling wax after determining the various aspects of the tooth, i.e., buccal, lingual, mesial and distal, so as to maintain uniformity in the samples.. Each arch was placed on CBCT scanner (Kodak 9000 extra oral imaging system) at voltage 66 K, tube current 8mA, voxel size 200 µm, for 30 seconds, one after the other. The following observations were made (1) number of roots and root canals (2) Root canal configuration [as per Vertucci's Classification] (3) Diameter of the root canals at Cemento- Enamel Junction (4) Length of the each roots (5) Angulation of the roots.

Using an Imaging software (CS 3D; Care stream Health, Inc., 2011), CBCT data was analyzed on a 21 inches flat screen computer monitor (resolution of 1440 x 900 pixels, Samsung Seoul, Korea). The contrast function was regulated and the magnifying device was activated when required. For the horizontal and vertical orientation of CBCT images of teeth X and Y cursors were used. The Z cursor was moved slowly (1 mm interval) in cervico-apex direction in order to survey the number of roots, number of root canals and configuration of canals of maxillary molars from the axial plane.

CEJ was evaluated by X and Y axis plane and minimum 3 readings were taken for the each canal width of all respected canals. Root length measurements were made along the axis of the root for determination of root curvature.

RESULTS

Number of root and canals : All the 120 teeth included in this study were found to possess 3 roots. 28 teeth had three canals whereas 82 teeth were found to possess four canals. (Table 1)

Root canal configurations As per Vertucci's classification, mesiobuccal root displayed complex root canal types with Type I (30%), Type II (31.6%), Type IV (30%), Type V (6%), and Type VI (1.6%). MB2 canals were found in 68.3% teeth (82 teeth) and had mainly Type I(95.12%) and Type II (4.87%).Distobuccal root had Type I (92.5%), Type II (1.7) and Type V (5.8%), configurations. Palatal root displayed Type I (98.3%) and type II (1.6%) configuration (Table 2).

Diameter of the root canals at Cemento- Enamel Junction: The mean canal diameter at CEJ of MB1 canal was found to be 1mm, MB2 canal 0.58mm, distobuccal canal 0.97mm and palatal canal 1.69mm. (Table 3)

Fig 1: Preperation Of Samples

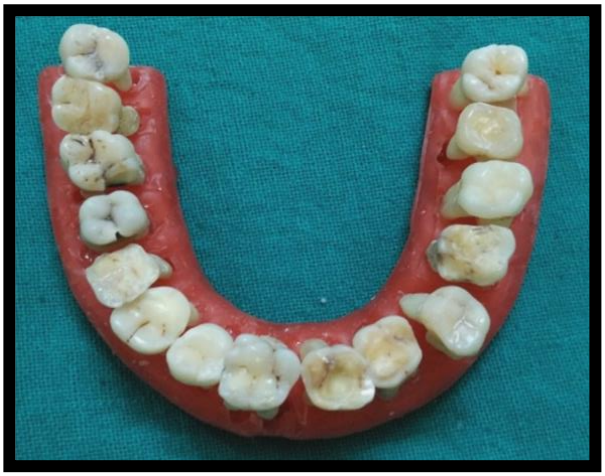


FIG 2: CBCT image for calculating Numbers of root and root canals

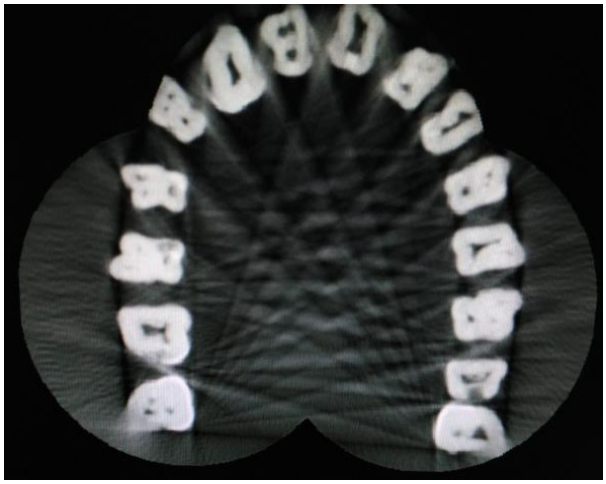


Fig 3: Root canal configurations

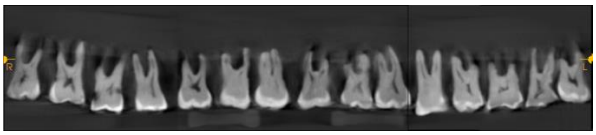
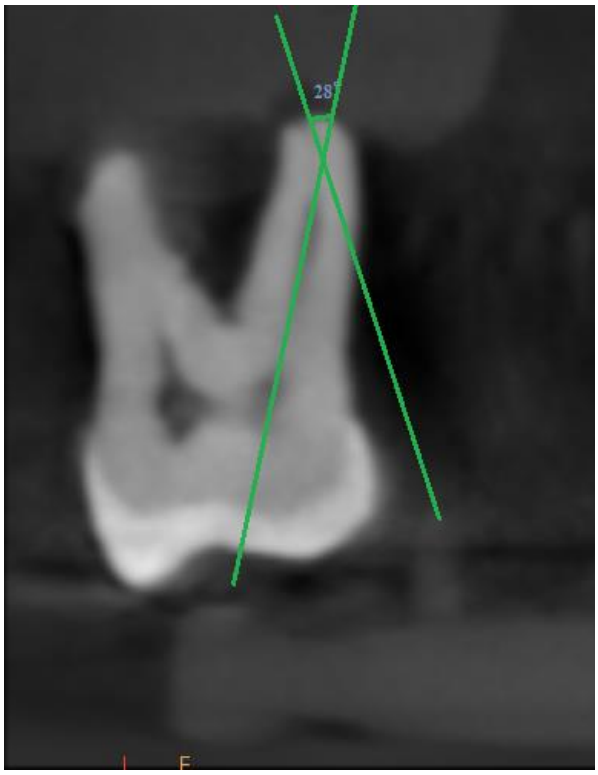


Fig 4: Diameter of the root canals at Cemento-Enamel Junction

Fig 5: Length of the root

Fig 6: Angulation of the roots



Length of the root: The mean root length of mesiobuccal root was found to be 12.34 mm, distobuccal root 11.93mm and palatal root 13.22 mm. (Table 4)

Angulation of the roots: The mean angulation of mesiobuccal root was found to be 11.29 ° , distobuccal 13.43° and palatal root 8.30 °. (Table 5)

DISCUSSION

Success in endodontic treatment requires an understanding of canal anatomy and morphology. To achieve endodontic success, entire pu6pal space including canals must be debrided, disinfected, shaped and obturated completely [15,15]. The root canal consists of tissues with high-density contrasts. Tachibana and Matsumoto[17] were the first to suggest using tomography to study the root canal system. CBCT is the latest system which has been introduced in dentistry since 1991 for imaging hard tissues of the maxillofacial region.

CBCT is an office-based imaging technique that can be conveniently performed when required. It acquires volumetric data in a single rotation with a short scan time of 20 secs, producing quality images with higher spatial resolution than multi-slice CT slice range from 80-200µ. CBCT poses fewer hazards to patients[18] because of the reduced radiation dose required. Moreover it is less expensive as compared to spiral CT.[19]

Besides identification of root canal system anomalies and root curvature, CBCT also helps in diagnosis of periapical pathosis, extent of the lesion, intra or postoperative assessment of endodontic treatment complications, dentoalveolar trauma, especially root fractures, luxation, differentiate between external, internal root resorption, invasive cervical resorption.

It is largely recognized that the most frequent pattern of the permanent maxillary 1st molar comprises of three separated roots. Thomas et al [20] examined maxillary molars radiographically using radiopaque gels as canal filler and reported three roots in 94.40% molars while Al-Shalabi et al [21] reported a higher percentage (97.60%). Pulpal morphology of maxillary first molar tends to vary with difference in race and population.[22] In this study we found all teeth possessing three roots. Root morphological anomalies though rare, however exists in most population like four roots (2 palatal) or five roots.

Number of canals inside each root is one of the primary concerns for endodontists. This study found all palatal and 92.5% distobuccal roots containg one canal. The main focus of morphological studies is on the mesiobuccal root as the incidence of more than one canal is significantly high and a wide range of variations have been reported. The type of canals observed in the mesiobuccal root are varied. Type I (30%), Type II (31.6%), Type IV (30%), Type V (6%), and Type VI (1.6%). The findings of our study cannot be generalised even within an Indian population. Neelakantan *et al.*[23] reported the canal morphology of 220 maxillary first molars of an indigenous Indian population. Three-rooted first molars in the mesio-buccal root showed high incidence of Type I configuration (51.8%). Type II were 5.5%, Type-IV (38.6%), and additional canal types (2-3) were 1%. A study on tooth morphology on Khasi polpulation of Meghalaya shows mesiobuccal canal have Type I and II at 28.3% each, with type IV being the most prevalent (30%), other configurations being Type V (5.0%) and Type VI (6.7%).[22]

Table 1: Number of roots and canals.

NN Permanent		NO. Of canals 3 Canals		4 Canals		Total	
2 Rooted	2 Rooted	0 0	0	0	0	0 00	0
3 Rooted	3 Rooted	19	38	41	82	60	120
Total	Total	19 3	38	41	82	60	120

Table 2: Root canal configurations.

Type of canal	MB1 MB1		MB2 MB2		DB Distal		P Palatal	
I	36	36	0	78	111 111111		120	118
II IIII II	38	38	38	4	2	2	2	2
III III	0	0	0	0	0	0	0	0
IV IV	36	36	36	0	0	0	0	0
V V	8	8	0 0	0	7	7	0	0
VI VI	2	2	8	0	0	0	0	0
A Additional	120	120	82	82	120	120	120	120

Table 3: Diameter of the root canals at Cemento- Enamel Junction.

Diameter of root canal at CEJ (mm)		Number Number	Minimum	aximum Maximum	Mean Mean	Standar Standard Deviation
Mesiobuccal	MB1 MB1	60 12 0	0.6 0 0.6	1.6 1.6	1.0 1 .0	0.31 0. 0.31
	MB2 MB2	41 82	0.4 0.4	0.7 0.7	0.58 0 .58	0.10 0.10
Dis Distobuccal		60 12 0	0.5 0.5	1.6 1.6	0.97 0 .97	0.26 0.26 0.26
Palatal Palatal		60 12 0	0.9 0.9	2.0 0.2	1.69 1 .69	0.26 o.26 0.26

Table 4: Length of the root.

Root Le Root Length (mm)	Number Number	Minimum Minimum	Maximu Maximum	Mean	Standard Deviation
Mesiobu Mesiobuccal	60 120	9.9 9.9	12.9 12.9	12.34 12.34	0.72 0.72
Distobuc Distobuccal	60 120	9.4 9.4	12.7 12.7	11.93 11.93	0.72 0.72
Palatal Palatal	60 120	10.7 10.7	15.0 15	13.22 13.22	0.70 0.70

Table 5: Angulation of the roots.

Canal angulation	Number Number	Minimum Minimum	Maximum Maximum	Mean Mean	Standard Standard Deviation
M Mesiobuccal	60 120	142° 3	177° 30	154.95° 11. 29	9.92 8.11
Distobucc Distal	60 120	152° 7	172° 24	167.7° 13. 44	7.12 6.23
Palatal Palatal	60 120	151° 0	180° 22	171.0° 8.3 0	9.03 6.49

In the distobuccal root, the most prevalent configuration was Type I (92.5%), Type II (1.7) and Type V (5.8%) and palatal root is of Type I (98.3%) and type II (1.6%) configuration. Cleghorn *et al.*[24] mentioned that 98.3% of distobuccal roots displayed one canal; two canals were found in (1.7%). In the palatal root, Type I (99%) with two or more canals in 1% teeth. In the present study, the types of canal in the palatal root are similar to those reported by Atul Chandra et al.[22] Canal diameter is also a very important aspect for access to canal. The mean canal diameter at CEJ of MB1 canal was found to be 1mm, MB2 canal 0.58mm, distobuccal canal 0.97mm and palatal canal 1.69mm. While calculating length of the roots from Cemento-enamel junction it was found similar to what was illustrated by Constance R.Sharuga[25] where mean length of mesiobuccal, distal and palatal root was 13mm, 12mm, 14 mm respectively. In this study the mean root length of mesiobuccal root was found to be 12.34 mm, distobuccal root 11.93mm and palatal root 13.22 mm. At apical third of root, the mean angulation of mesiobuccal canal was found to vary from 3° to 30° with mean of 11.29 °, distobuccal from 7° to 24° with mean of 13.43° and palatal canal from 0°to 22°and mean of 8.30°.

CONCLUSION

CBCT is a excellent clinical modality for endodontic diagnosis and treatment. Maxillary first molars in Gond population tend to possess three roots, with a 68.3% incidence of MB2 canal. The most common canal configuration of the mesiobuccal is Type II. All the roots of these teeth tend to have an angulations with mean of mesiobuccal root be 11. 29 °, distobuccal 13.43° and palatal canal was 8.30 °.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Wolcott J, Ishley D, Kennedy W, Johnson S, Minnich S Clinical investigation of second mesiobuccal canals in endodontically treated and retreated maxillary molars. J Endod. 2002 Jun;28(6):477-9.

2. Weine FS. Initiating endodontic treatment. In: Weine FS, editor. Endodontic Therapy. 6th ed. St. Louis, MO, USA: Mosby; 2004. pp. 106–10.

3. Kim S, Kim BS, Woo J, Kim Y. Morphology of mandibular first molars analyzed by cone-beam computed tomography in a korean population: Variations in the number of roots and canals. J Endod. 2013;39:(12)1516-1521. doi:10.1016/j. joen.2013.08.015.

4. Zheng Q, Wang Y, Zhou X, Wang Q, Zheng G, Huang D. A cone-beam computed tomography study of maxillary first permanent molar root and canal morphology in a Chinese population. J Endod. 2010;36:(9)1480-1484. doi:10.1016/j. joen.2010.06.018.

5. Cleghorn BM, Christie WH, Dong CCS. Root and root canal morphology of the human permanent maxillary first molar: A literature review. J Endod. 2006;32:(9)813-821. doi:10.1016/j.joen.2006.04.014..

6. Rizvi A, Zafar MS, Farid WM, Gazal G. Assessment of antimicrobial efficacy of MTAD, sodium hypochlorite, EDTA and chlorhexidine for endodontic applications: An in vitro study. Middle-East J Sci Res. 2014;21:(2)353-357.

7. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol. 1984;58:(5)589-599.

8. Weine F, Hayami S, Hata G, Toda T. Canal configuration of the mesiobuccal root of the maxillary first molar of a Japanese sub-population. Int Endod J. 1999;32:(2)79-87.

9. Zafar MS, Javed E. Extraoral radiography: An alternative to intraoral radiography for endodontic (root canal system) length determination. Euro Sci J. 2013;9:(15)51.

10.Yang H, Tian C, Li G, Yang L, Han X, Wang Y. A cone-beam computed tomography study of the root canal morphology of mandibular first premolars and the location of root canal orifices and apical foramina in a Chinese subpopulation. J Endod. 2013;39:(4)435-438. doi:10.1016/j.joen.2012.11.003.

11, Yu X, Guo B, Li KZ, Zhang R, Tian YY, Wang H et al. Cone-beam computed tomography study of root and canal morphology of mandibular premolars in a western Chinese population. BMC Med Imaging 2012; 12: 18.

12. Nur BG, Ok E, Altunsoy M, Aglarci OS, Colak M, Gungor E. Evaluation of the root and canal morphology of mandibular permanent molars in a south-eastern Turkish population using cone-beam computed tomography. Eur J Dent 2014; 8:154–159.

13. Scarfe WC, Levin MD, Gane D, Farman AG. Use of cone beam computed tomography in endodontics. Int J Dent 2009; 2009: 634567.

14. Altunsoy M, Ok E, Nur BG, Aglarci OS, Gungor E, Colak M. A cone-beam computed tomography study of the root canal morphology of anterior teeth in a Turkish population. Eur J Dent 2014; 8: 302–306.

15. Nallapati S. Three canal mandibular first and second premolars: a treatment approach. J Endod 2005; 31: 474–476.

16. Berkan Celikten, Kaan Orhan, Umut Aksoy, Pelin Tufenkci, Atakan Kalender, Fatma Basmaci and Pervin Dabaj. Cone-beam CT evaluation of root canal morphology of maxillary and mandibular premolars in a Turkish Cypriot population. BDJOpen (2016) 15006

17. Tachibana H, Matsumoto K. Applicability of X-ray computerized tomography in endodontics. Endod Dent Traumatol 1990;6:16–20

18. Tsiklakis K, Donta C, Gavala S, Karayianni K, Kamenopoulou V, Hourdakis CJ. Dose reduction in maxillofacial imaging using low dose cone beam CT. Eur J Radiol. 2005;56: 413–417.

19. Zhang R, Yang H, Yu X, Wang H, Hu T, Dummer PM. Use of CBCT to identify the morphology of maxillary permanent molar teeth in a Chinese subpopulation. Int Endod J 2011;44:162-9.

20. Thomas RP, Moule AJ, Bryant R. Root canal morphology of maxillary permanent first molar teeth at various ages. Int Endod J 1993;26:257-67.

21. O.E.Omer,R.M.AlShalabi,M.Jennings,J.Glennon&N.M. Claffey.Acomparisonbetweenclearing and radiographic techniques in the study of the root-canal anatomy. Internationall Endodontic Journal, 37 , 291^296, 2004.

22. Bhuyan, Rubi Kataki, Pynshngain Phyllei, Gurdeep Singh Gill. Root canal configuration of permanent maxillary first molar in Khasi population of Meghalaya: An in vitro study. Journal of Conservative Dentistry | Jul-Aug 2014 | Vol 17 | Issue 4

23. Neelakantan P, Subbarao C, Ahuja R, Chandragiri VS, Gutmann JL. Cone-beam computed tomography study of root and canal morphology of maxillary first and second molars in an Indian population. J Endod 2010;36:1622-7.

24. Cleghorn BM, Christie WH, Dong CS. Root and root canal morphology of the Human permanent maxillary first molar; a literature review. J Endod 2006;32:813-21.

25. Sharuga CR. *Dimensions of Dental Hygiene*. May 2010; 8(5): 36, 38-39.