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Original Article

Dentistry Section

# Retrospective Study of Root Canal Configurations of Mandibular Third Molars Using CBCT- Part-II

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## ABSTRACT

**Introduction:** Abnormal root canal morphologies of third molars can be diagnostically and technically challenging during root canal treatment.

**Aim:** The aim of this retrospective study was to investigate the root and canal morphology of mandibular third molars in Central India population by using Cone Beam Computed Tomography (CBCT) analysis.

**Materials and Methods:** CBCT images of 171 mandibular third molars were observed and data regarding number of roots, number of canals, Vertucci's classification in each root, prevalence of C shaped canal, gender and topographical relation of morphology in mandibular third molar was statistically evaluated.

**Results:** Majority of mandibular third molars had two roots (84.2%) and three canals (64.3%). Most mesial root had Vertucci Type II (55.6%) and Vertucci Type IV (22.2%), distal root had Type I canals (87.5%). Over all prevalence of C shaped canals in mandibular third molars was 9.4%.

**Conclusion:** There was a high prevalence of two rooted mandibular third molars with three canals.

**Keywords:** Cone beam computed tomography, C shaped canals, Root canal morphology, Vertucci

## INTRODUCTION

For the successful root canal treatment proper access cavity preparation, biomechanical preparation and fluid tight seal obturation of root canal is of prime importance [1]. Any abnormal root canal anatomy should be identified before initiation of the root canal treatment thereby making it necessary to understand the root canal anatomy of the tooth [2]. Any failure in detection of untreated canal may cause failure of root canal treatment. There are various methods available to understand the root canal morphology. These are ranging from conventional radiograph, root canal staining and clearing, plastic resin injections, digital radiographs, contrast medium radiographs, tooth sectioning, in-vitro microscopic examinations, CBCT and micro computed tomography [3]. Conventional radiographs give two dimensional data and fail to determine the root canal complexities. Sectioning and clearing techniques are in vitro methods to study three dimensional morphology of the pulpal anatomy but the morphology of the exterior of tooth is destroyed in the process [4].

CBCT was developed in 1990s by Italian and Japanese groups. This technique helps in visualizing root canal anatomy in three dimensions [5,6].

Retention of every functional component of dental arch is the principal goal of endodontic therapy [7]. Third molars are usually considered for endodontic treatment for restorative, prosthodontic, and orthodontic needs. Non restorable teeth can be replaced by auto transplantation of third molars. In prosthodontics they are saved to be used as abutment teeth in fixed partial denture [8,9].

Few researches have been done to study the morphology of mandibular third molars [10]. Pubmed data base search did not reveal any studies on the root canal morphology of third molars in Indian population using CBCT.

The aim of this study was to investigate the root canal morphology of mandibular third molars and to evaluate the number of roots and canals and classify them according to Vertucci. Present study is an extension of the retrospective study of root canal configurations done on maxillary third molar using CBCT [11].

## MATERIALS AND METHODS

The retrospective study was done in a private clinic (Geeta Imaging Centre) of Bhopal. Patients reported between June 2011 and March 2015 were evaluated. CBCT images of 325 patients who reported for various dental issues were observed for presence and absence of mandibular third molar. Entire study was done at Geeta Imaging Centre, Bhopal, Madhya Pradesh, India. For ethical clearance Ethical Committee of Peoples College of Dental Science was approached.

Patients were informed and consent was obtained. The CBCT scans (KODAK CS. 9000C 3D, 70 kvp, 10 mA, 36 seconds scan time, 10.8 seconds exposure time, 5 cm diameter–5 cm height scan volume, France) were produced by a technician according to the manufacturer's instructions using lowest dose radiation and the field of view of 40• 40 mm or 60 • 60 mm. Only those CBCT images were selected in which mandibular third molar was present. The inbuilt CS3D imaging software Nearest Neighbouring Tool (NNT) was used to analyse the CBCT images in HP workstation (HP Compaq LE 1911) with a 19 inch HP LED screen with a resolution of 1280×1024 pixels on a dual monitor. For better visualization of images, contrast, brightness and grey scale were adjusted using image processing tool in the software. All the images were simultaneously assessed by three endodontists and a trained technician to reach to a conclusion regarding number of roots, number of canals and Vertucci type. A random sample of 45 images were re-examined after one week to test inter examiner agreement. Kappa value for inter-examiner reliability was 0.897 and Cronbach's Alpha value for intra-examiner reliability was 0.947. The NNT toolbar was moved up and down from pulp chamber to root apex at the axial tomographic slices. Slices were taken in the entire three planes coronal, sagittal and axial plane to confirm the findings. Images were further rotated in entire axis to reach to the conclusion. Good quality CBCT images of completely erupted third mandibular 3rd molars with no periapical lesions, without endodontic treatment or open apex, calcification or resorbtion were selected for the study. Exclusion criteria included teeth with root canal fillings, restorations, posts or crowns. Out of total 171 CBCT scans of patients, 66 scan belong to males and 50 to females.

No specific sample size was calculated for the study. As mentioned in materials and methods out of 325 CBCT available from June 2011 to March 2015, 171 were included as per the exclusion criteria. Sampling technique was convenient sampling. After exclusion criteria CBCT scans of 144 mandibular third molars were obtained. Sample size was determined according to inclusion criteria. All CBCT images were observed for presence of third molars and only those images which fulfilled the inclusion criteria were selected for study. All the CBCT images were scanned for following information, number of roots, number of canals per tooth, Vertucci classification in each root, frequency of additional root if present and frequency of C- shaped root canal in mandibular third molar. Vertucci divided the root canal configurations into eight types which is more practical to the four types we generally follow like given in Weine classification. The only problem with Vertucci is it does not consider exit and position of apical foramen which is considered in Weine classification [12]. Frequency and percentage of variables were calculated using SPSS version 21.0 and data was further analysed by Pearson Chi-square test and Fisher's-exact test.

## RESULTS

Evaluation of CBCT scans of 171 mandibular third molars showed that 60.2% of the teeth belong to males and 39.8% were of females, 39.8% were of right side and 60.2% were of left side. Maximum mandibular third molars (n=171) had two roots (84.2%) followed by one root (12.9%) and three roots (2.3%). Analysis of number of canals for mandibular third molars revealed that maximum have three canals (64.3%), 19.9% had two canals, 8.2% have four canals, 5.8% had one canals, and 1.2% of five canals and 0.6% of seven canals respectively [Table/Fig-1].

Single rooted mandibular third molars showed equal predominance of Vertucci Type I, Type II and Type IV (33.3%) canals configuration. In double rooted mandibular third molars mesial root have mostly Vertucci Type II (55.6%), followed by Vertucci Type IV (22.2%) and Vertucci Type I (18.1%). In distal roots of mandibular molars maximum roots had Vertucci Type I (87.5%) followed by Vertucci Type II (9.7%) and Type IV (2.8%). Three rooted mandibular third molars usually had Vertucci Type II and Type IV (50%), distal root Type IV (100%) and radix had Type I Vertucci classification [Table/Fig-2].

**Vertucci classification of canals in mandibular third molars according to gender:**

Gender predilection for double rooted mandibular third molars showed that mesial roots had Vertucci Type II (60.4%) and Type IV (22.9%) predominant in males as compare to females who had Vertucci Type II (45.8%) and Type I (29.2%) predominant and the results were not statistically significant. In distal roots in mandibular third molars in both males (87.5%) and females (87.5%) Vertucci Type I was predominant. In radix entomolaris Vertucci Type I was predominant in both females and males. None of the comparison was statistically significant [Table/Fig-3].

**Vertucci classification of canals in mandibular third molars according to tooth position:** In single rooted mandibular third molars

| Number of Canals | Mandibular Third Molar n (%) |
|---|---|
| 01 | 10 (5.8) |
| 02 | 34 (19.9) |
| 03 | 110 (64.3) |
| 04 | 14 (8.2) |
| 05 | 02 (1.2) |
| 07 | 01 (0.6) |
| Total | 171 (100.0) |

**[Table/Fig-1]:** Distribution of mandibular third molars according to number of canals.

| No. of roots | Root type | Vertucci Classification | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | Type I | Type II | Type III | Type IV | Type V | Type VI | |
| 01 | -- n (%) | 02 (33.3) | 02 (33.3) | 00 (0.0) | 02 (33.3) | 00 (0.0) | 00 (0.0) | 06 (100.0) |
| 02 | Mesial n (%) | 26 (18.1) | 80 (55.6) | 04 (2.8) | 32 (22.2) | 02 (1.4) | 00 (0.0) | 144 (100.0) |
| | Distal n (%) | 126 (87.5) | 14 (9.7) | 00 (0.0) | 04 (2.8) | 00 (0.0) | 00 (0.0) | 144 (100.0) |
| 03 | Mesial n (%) | 00 (0.0) | 02 (50.0) | 00 (0.0) | 02 (50.0) | 00 (0.0) | 00 (0.0) | 04 (100.0) |
| | Distal n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 04 (100.0) | 00 (0.0) | 00 (0.0) | 04 (100.0) |
| | Disto-lingual n (%) | 04 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 04 (100.0) |
| 05 | Buccal n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) |
| | Mesio-buccal n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) |
| | Disto-buccal n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | 00 (0.0) | 01 (100.0) |
| | Mesio-lingual n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) |
| | Disto-lingual n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) |

**[Table/Fig-2]:** Vertucci classification of canals in mandibular third molars.

Vertucci Type I was predominant on right side (100%) whereas on left side Vertucci Type II and Type IV were equally predominant and the comparison was statistically significant (p=0.05) [Table/Fig-4]. While comparing results of double rooted mandibular third molars most of mesial roots on right side show Vertucci Type II (47.6%) and Type IV (23.8%) whereas on left side Type II was predominant (66.7%) but it was not significant. Distal roots on both sides mostly show Vertucci Type I. Topographical comparison of three rooted and five rooted mandibular third molars show no significant result.

**Presence of C-shaped canals in mandibular third molar:** Evaluation of C-shaped canals in mandibular third molar revealed that 12.9% of single rooted teeth over all prevalence of C shaped canals in mandibular third molars was 9.4% [Table/Fig-5].

## DISCUSSION

Mandibular third molars have been associated with greater variation in root patterns and canal morphology [13]. Race and genetics play an important role in determining the variations in the root canal morphology [14]. Therefore, variations in tooth morphology among different racial groups should be investigated. Various studies those are done among different racial groups show a trend in shape and number of canals [15].

The multiplaner CBCT scans obtained from axial sections of 171 mandibular third molars revealed that maximum mandibular third molars had two roots (84.2%) followed by one root (12.9%). This was consistent with the findings of CBCT study done by Wang Y et al., on Chinese population [16]. Sidow SJ et al., studied mandibular third molars (n=150) utilizing dye and concluded that 77% had two roots,17% had one roots 5% had three roots and 1% had four roots [17]. Faramarzi F et al., showed that 92.4% mandibular third molars were two rooted, 4.6% single rooted and 2.89% were three rooted. Two canals (47.5%) and three canals (43.9%) were observed in maximum teeth [13]. Dye study of third molar on Turkish population revealed 24.9% single rooted [18]. Study done by Park JB et al., showed that highest percentage of mandibular third molars (56.5%) had two roots [19].

| No. of roots | Root type | Gender | Vertucci Classification | | | | | | | Chi-square test |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Type I | Type II | Type III | Type IV | Type V | Type VI | Total | |
| 01 | - | Male n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | Not applicable |
| | | Female n (%) | 02 (33.3) | 02 (33.3) | 00 (0.0) | 02 (33.3) | 00 (0.0) | 00 (0.0) | 06 (100.0) | |
| 02 | Mesial | Male n (%) | 12 (12.5) | 58 (60.4) | 02 (2.1) | 22 (22.9) | 02 (2.1) | 00 (0.0) | 96 (100.0) | Yates$\chi^2$ = 5.117 p = 0.402, NS |
| | | Female n (%) | 14 (29.2) | 22 (45.8) | 02 (4.2) | 10 (20.8) | 00 (0.0) | 00 (0.0) | 48 (100.0) | |
| | Distal | Male n (%) | 84 (87.5) | 08 (8.3) | 00 (0.0) | 04 (4.2) | 00 (0.0) | 00 (0.0) | 96 (100.0) | Yates$\chi^2$ = 1.1013 p = 0.962, NS |
| | | Female n (%) | 42 (87.5) | 06 (12.5) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 48 (100.0) | |
| 03 | Mesial | Male n (%) | 00 (0.0) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | Fisher's Exact Test Yates$\chi^2$=1.000 p = 0.963, NS |
| | | Female n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | |
| | Distal | Male n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | Not applicable |
| | | Female n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | |
| | Disto-lingual | Male n (%) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | Not applicable |
| | | Female n (%) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | |
| 05 | Buccal | Male n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Female n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |
| | Mesio-buccal | Male n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Female n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |
| | Disto-buccal | Male n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Female n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |
| | Mesio-lingual | Male n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Female n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |
| | Disto-lingual | Male n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Female n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |

**[Table/Fig-3]:** Vertucci classification of canals in mandibular third molars according to gender, *NS= Not significant

| No. of roots | Root type | Tooth position | Vertucci Classification | | | | | | | Test of Significance |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Type I | Type II | Type III | Type IV | Type V | Type VI | Total | |
| 01 | - | Right n (%) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | Yates$\chi^2$ = 1.6886 p = 0.890, NS |
| | | Left n (%) | 00 (0.0) | 02 (50.0) | 00 (0.0) | 02 (50.0) | 00 (0.0) | 00 (0.0) | 04 (100.0) | |
| 02 | Mesial | Right n (%) | 18 (21.4) | 40 (47.6) | 04 (4.8) | 20 (23.8) | 02 (2.4) | 00 (0.0) | 84 (100.0) | Yates$\chi^2$ = 0.475 p = 0.475, NS |
| | | Left n (%) | 08 (13.3) | 40 (66.7) | 00 (0.0) | 12 (20.0) | 00 (0.0) | 00 (0.0) | 60 (100.0) | |
| | Distal | Right n (%) | 70 (83.3) | 12 (14.3) | 00 (0.0) | 02 (2.4) | 00 (0.0) | 00 (0.0) | 84 (100.0) | Yates$\chi^2$ = 3.588 p = 0.610, NS |
| | | Left n (%) | 56 (93.3) | 02 (3.3) | 00 (0.0) | 02 (3.3) | 00 (0.0) | 00 (0.0) | 60 (100.0) | |
| 03 | Mesial | Right n (%) | 00 (0.0) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | Yates$\chi^2$=1.000 Fisher's-Exact test p = 0.963, NS |
| | | Left n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | |
| | Distal | Right n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | Not applicable |
| | | Left n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | |
| | Disto-lingual | Right n (%) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | Not applicable |
| | | Left n (%) | 02 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 02 (100.0) | |
| 05 | Buccal | Right n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Left n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |
| | Mesio-buccal | Right n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Left n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |
| | Disto-buccal | Right n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Left n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |
| | Mesio-lingual | Right n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Left n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |
| | Disto-lingual | Right n (%) | 01 (100.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 01 (100.0) | Not applicable |
| | | Left n (%) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | 00 (0.0) | |

**[Table/Fig-4]:** Vertucci classification of canals in mandibular third molars according to tooth position., * S= Significant, NS= Not significant

**Number of canals:** In the present study, maximum mandibular third molars showed three canals (64.3%) followed by two canals (19.9%) and one canal (5.8%), 1.2% of teeth had five canals. In two-directional radiography used by Pineda F et al., did two directional radiographic study and concluded that the prevalence of Vertucci Type 1, Type 2, and Type 4 canal types in mesial roots of mandibular third molars were high and the lowest was type 5. Interestingly, a new root canal configuration type (2-5-1) in a mesial root of a mandibular third molar was also reported [20].

Distal root showed Vertucci Type I in more than 90% of the cases. Types II (2-1), IV (2-2) and V (1-2) have also been reported [21].

| No. of roots | C-shaped canals | | Total n (%) |
|---|---|---|---|
| | Present n (%) | Absent n (%) | |
| 01 | 16 (72.7) | 06 (27.3) | 22 (100.0) |
| 02 | 00 (0.0) | 144 (100.0) | 144 (100.0) |
| 03 | 00 (0.0) | 04 (100.0) | 04 (100.0) |
| 05 | 00 (0.0) | 01 (100.0) | 01 (100.0) |
| Total | 16 (10.3) | 155 (89.7) | 171 (100.0) |

**[Table/Fig-5]:** Presence or absence of C-shaped canals in mandibular third molars.

**Vertucci classification:** In double-rooted mandibular third molars, >90% of the root canal configurations in the mesial root showed four Types I (1), II (2-1), IV (2-2) and V (1-2), whereas Type I and II are the most common [17,22]. While the root canal configuration in the distal root is Type I in more than 90% [10,23-25], other root canal configuration Types II (2-1), IV (2-2) and V (1-2) have also been reported.

**Gender predilection:** Study conducted by Bolanos MV et al., showed no significant difference based on gender [23]. No significant difference was observed in the development of third molar between males and females in previous studies [24].

**Topological predilection:** In previous studies, there are no reports of significant side differences in third molar mineralization [25]. Gunst K et al., concluded that bilateral symmetry in the development of roots of mandibular third molar was very high (a correlation coefficient of 0.93 for males and 0.95 for females) [26]. Sert S et al., in his study concluded that 80.5% showed similar predilection bilaterally [18]. Meinl A et al., studied chronology of third molar mineralization and found no significant difference between left and right mandibular third molar [27]. Extraction of mandibular third molars is a common phenomenon in oral and maxillofacial surgery, and many cases related to this issue have been published [28].

There is a high prevalence of occlusal caries in erupted third molar and is usually associated with patients' caries experiences in first and second molars [29]. The knowledge of root canal morphology of third molar is important during surgical removal [30]. The prevalence of caries in third molars is considered to be high as well as associated with patients' caries experiences in first and second molars. Procedures like surgical removal of third molar, auto transplantation for atraumatic procedures, and endodontic treatment require thorough knowledge of root canal anatomy [18]. Non restorable teeth can be replaced by using third molar [31]. Recently, new techniques like phase contrast radiography was used to evaluate the root morphology of mandibular third molars, and it may be more useful than conventional radiography for this purpose [32].

Conventional radiograph does not provide high resolution isotropic images if canal cortication is lost which is possible with the help of CBCT. Conventional radiograph provide two dimensional images and superimposition of anatomic structures which is eliminated in CBCT which offer three-dimensional geometric accuracy and images can be visualized in all the three planes sagittal, coronal and axial planes [24].

## LIMITATION

Limitation to the study is CBCT should only be done when the conventional periapical radiographs are unable to provide required data about the area of interest, as CBCT views may also show some misleading results [25]. Scattered and beam hardening artefacts caused by high density adjacent structures such as enamel or metal post can affect the image quality and diagnostic accuracy of CBCT [33]. Comparison of CBCT with periapical radiography using clinical sectioning as gold standard confirmed that CBCT is reliable method for detection mesiobuccal-2 canal in maxillary molars [34]. Comparison of several methods for identification of root canal morphology concluded that CBCT is as accurate as the clearing technique [35]. Thus, magnification in the form of CBCT is an effective method to understand the root canal intricacy of third molar thus rendering long term success of root canal treatment. Understanding of such complexities will help in saving third molar which is usually send for extraction. Therefore, more retrospective studies in different ethnic groups with more sample size should be done to understand root canal morphology of various teeth. CBCT images can provide a non-invasive method for such future studies.

## DECLARATION

The study is an extension of the retrospective study of root canal configurations of maxillary third molars in Central India population using cone beam computed tomography [11].

## CONCLUSION

According to this study, mandibular third molars show great anatomic variability. There was a high prevalence of two rooted mandibular molars with three canals in Central India population. Vertucci Type II and Type IV classification was most common in mesial root and Type I in distal roots of mandibular third molars. C shaped canal in mandibular third molar was a rare finding. Further studies should be done to confirm the findings in Central India population.

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