

## CASE REPORT

# Morphological Variation of Mandibular Canine with Type II and IV Root Canal System

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## ABSTRACT

Successful endodontic treatment depends on the clinician's knowledge and ability to manage aberrant anatomy. The mandibular canine normally comprises one canal and one root, but 15% may have two canals with one or two foramina and even less frequent may have two roots. The anatomy of root canal system dictates the condition under which root canal therapy is carried out and directly can affect its prognosis. Extra canals if not detected are a major reason for the failure of endodontic therapy.

**Keywords:** Mandibular canine, Morphological variation, Root canal system.

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## INTRODUCTION

Proper access cavity preparation, cleaning and shaping, and obturation form the triad for successful root canal therapy. Nearly 60% of the failures are apparently caused by incomplete obturation of the radicular space. Root canal variations predispose to inadequate root canal preparation and should be recognized before or during treatment. There are innumerable instances of variations in root canal anatomy like extra canals which

are missed by a novice operator which ultimately leads to root canal failure.<sup>[1,2]</sup>

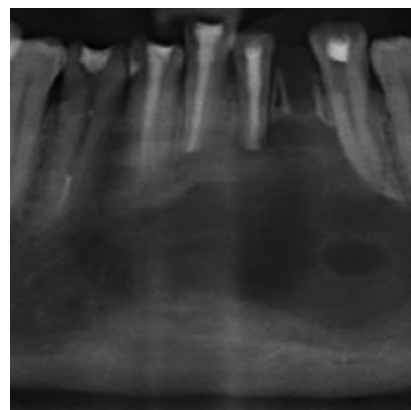
It is generally accepted that an inability to recognize the presence of and to adequately treat all of the canals of the endodontic system may be a major cause of the failure of root canal therapy. The frequency and risk of missed anatomy are strictly linked with the complexity of the root canal system; good knowledge of the potential aberrant canal morphology in maxillary and mandibular teeth will help clinicians to successfully recognize and treat these difficult cases.<sup>[3]</sup> The anatomy of root canal system dictates the condition under which root canal therapy is carried out and directly can affect its prognosis. Extra canals if not detected are a major reason for the failure of endodontic therapy. In mandibular anterior teeth, the prevalence of two/three canals has been reported as low as 1% and as high as 43%. Mandibular canines are recognized as having one root and one root canal in the majority of cases. Investigators have reported that mandibular canine with two canals with one or two foramina is 15%.<sup>[4]</sup> Heling *et al.* have reported a case of root canal retreatment case with two roots and three canals. Orguneser and Kartal reported about a mandibular canine with three canals and two foramina. All these cases are suggested to be the result of the abnormal development of the tooth and the root.<sup>[5]</sup>

## CASE REPORTS

### Case 1

A patient of age 32 reported from oral and maxillofacial surgery department for the assessment of mandibular canines.

Access cavity was done before she reported the department, and endodontic procedure was incomplete.



Pre-operative radiograph

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Then, endodontic treatment was planned for the right and left mandibular canines. When access cavity was opened, we were able to locate two canals labial and lingual and were confirmed by placing the files in the canals.

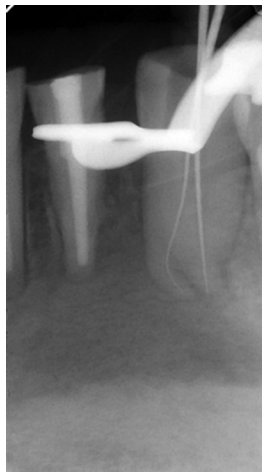
Clinical radiographs taken to confirm the presence of two canals:

Mandibular right canine with type II canals.



Files placed in canals to confirm two canals of type II

Same patient of the left mandibular canine was planned for endodontic treatment and found the occurrence of two roots.



Lower left canine with two roots

## Case 2

Endodontic management of mandibular canine with type II root canal system is reported here.

A 39-year-old male patient was referred to the Department of Conservative Dentistry and Endodontics, for the endodontic treatment (intentional) in relation to tooth number 33 [Figure 1] from the Department of Prosthodontics, Krishnadevaraya College of Dental Sciences, Bengaluru. Patient's medical history was not significant. The tooth was asymptomatic, and palpation and percussion were negative. Radiographic analysis

showed normal periodontal condition, no pulp exposure and pulp testing showed normal response to test.

Local anesthesia was administered and tooth was isolated using rubber dam. Access opening was done using Endo Access Bur, two bleeding spots were noted in the pulpal floor suggestive of two orifices, access cavity was made in oval shape (labiolingually) for the accessibility for both the labial and lingual canals [Figure 2]. Working length was taken using K and H files using radiovisiography. The same lingual, opposite buccal technique was used to confirm the orientation of two canals that are separate and confirmed by cone-beam computerized tomography. Working length was confirmed using root ZX apex locator [Figure 3], buccal canal joined the lingual canal only at the apical third with a single foramen.

The canals were cleaned and shaped with Protaper rotary instruments. A 1 ml of sodium hypochlorite (NaOCl) (AVUECHLOR) was used for irrigation in between the instrument change followed by chlorhexidine (RC-CHLOR) as the last irrigant. About 17% ethylenediaminetetraacetic acid (RC-PREP) paste was used



Figure 1: Pre-operative



Figure 2: Access cavity preparation

along with the rotary instrument as a lubricant during instrumentation. After the use of last irrigant, the canal was dried using paper points and the position of master cone was confirmed radiographically [Figure 4]. Then, the obturation of the canals was done using Protaper gutta-percha and zinc oxide eugenol sealer [Figure 5]. Canal anatomy was confirmed by cone-beam computed tomography [Figure 6]. Post-endodontic restoration was done and the patient was referred back to the department of prosthodontics for fixed prosthesis.

## DISCUSSION

The objective of the root canal treatment is to debride the root canals of the pulpal tissue remnants, microorganism, and bacterial products followed by a proper obturation. Failure to find and fill a canal has been demonstrated to be a causative factor in failure of endodontic therapy.<sup>[5]</sup> It is of utmost importance that all canals be located and treated during the course of non-surgical endodontic therapy.<sup>[4]</sup>

During the past year, there have been many studies on pulp morphology. The anatomical studies of

Vertucci, Peinada, and Kuttler all state that mandibular canine has a single root most of the time.<sup>[6]</sup>

Diagnostic measures such as multiple pre-operative radiographs with different angulations, examination of the floor of pulp chamber with a sharp explorer, troughing of grooves with ultrasonic tips, staining the chamber floor with 1% methylene blue dye, performing the sodium hypochlorite "champagne bubble" test, and visualizing canal bleeding points are important aids in locating root canal orifices and the latest cone-beam computed tomography (CT).<sup>[7]</sup>

Intraoral radiographs are a two-dimensional imaging modality of a three-dimensional structure. Hence, anatomy in the third dimension cannot be assessed on radiographs. Because root canals tend to lie one behind the other in buccolingual plane, they get superimposed onto each other on periapical panoramic radiographs and easily go undetected (1) Dental CT is reformatting software used along with spiral/helical CT and allows assessment in all three dimensions. It provides axial, panoramic, paraxial, and 3<sup>rd</sup> volume rendering which helps in diagnosis purpose.<sup>[1]</sup>



Figure 3: Working length determination



Figure 5: Obturation

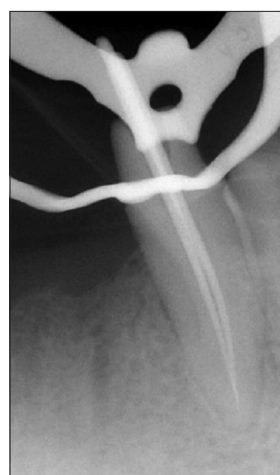


Figure 4: Master cone selection

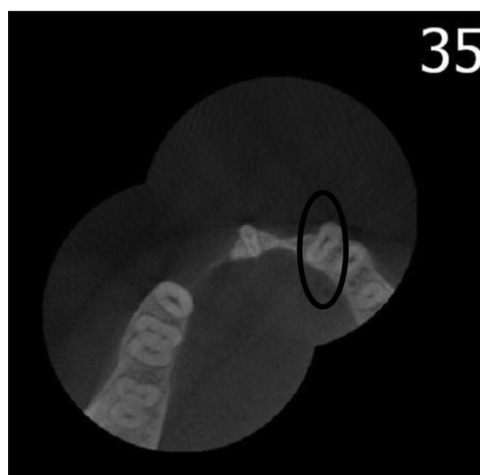


Figure 6: Cone-beam computed tomography image

Undetected canals are the major cause for failure of this treatment. Incomplete removal of all the irritants from the pulp space may increase the possibility of treatment failure. The main cause for failure in endodontic treatment of mandibular incisors can be due to inability to detect the presence of a second root canal and its subsequent treatment.<sup>[8]</sup>

A common reason for not locating a second canal in mandibular anterior is an inadequate access opening into the tooth which leaves a lingual shelf of dentine over the record usually lingual canal.<sup>[9]</sup>

Careful interpretation of the radiographic features is essential to ensure that additional root canals are not overlooked. This may necessitate imaging the tooth from different angles so that the root canals may be distinguished in the resulting films. In addition, if an obvious canal ends abruptly, the clinician should be suspicious that there are in fact two canals or canal bifurcation.<sup>[3]</sup> A minimum of two diagnostic periapical radiographs should be taken for a careful evaluation of the root canal morphology using the parallel and mesial or distal horizontal angle techniques.<sup>[10]</sup> Lozano *et al.* examined the effect of X-ray tube inclination on accurately determining the root canal system present in premolar teeth. They found that by varying the horizontal angle, the number of root canals observed in maxillary premolars coincided with the actual number of canals present.<sup>[11]</sup>

In the present case, the mandibular canine has two canals where they join each other at the apical area which is of Vertucci's type II classification [Figure 7].<sup>[6,12,13]</sup>

According to the Vertucci's study, he says that the incidence of canine with two canals is around 14%.<sup>[6,9]</sup>

Pecora *et al.* studied the internal anatomy, direction, and number of roots of 830 extracted mandibular canines. Using a clearing method, the authors found that 98.3% of these teeth had a single root, 92.2% presented with one canal and one foramen, 4.9% had two canals and one foramen, and 1.2% had two canals and

two foramina. The incidence of two rooted canines was low, 1.7%, always with two canals. The total frequency of mandibular canines with two separate canals was 2.9% in this study.<sup>[10]</sup>

Whenever a root contains two canals which join, the palatal/lingual canal is generally the one with straight line access to the apex. This anatomy is best treated by preparing and obturating the palatal/lingual canal to the apex and the buccal canal to the point of juncture. If both canals are enlarged to the apex, an "hourglass" preparation results. The point at which the two canals join would be more constricted than the preparation at the apex. Filling such a situation leaves voids in the apical third and invites failure particularly if bacteria remain in the canal. Rotary nickel-titanium file must also be used with caution when this type of anatomy is present because instrument separation can occur as the file transverses the sharp curvature into the common part of the canal.<sup>[6,12]</sup>

Table 14<sup>[6]</sup> and 7<sup>[12]</sup> taken from the Vertucci's study shows the incidence rate of mandibular teeth and case reports of apical canal configuration for mandibular teeth.<sup>[6,12]</sup>

## CONCLUSION

Pulp space anatomy of mandibular canine shows very low incidence of complexity which includes variations in canal configuration, number of canals, and presence of isthmus. Thorough knowledge of root canal anatomy and morphology, additional radiographs taken at different angles and correct interpretation of radiographs is important. Modification of the access opening is required, which will assist the clinician for a more thorough assessment and successful treatment.

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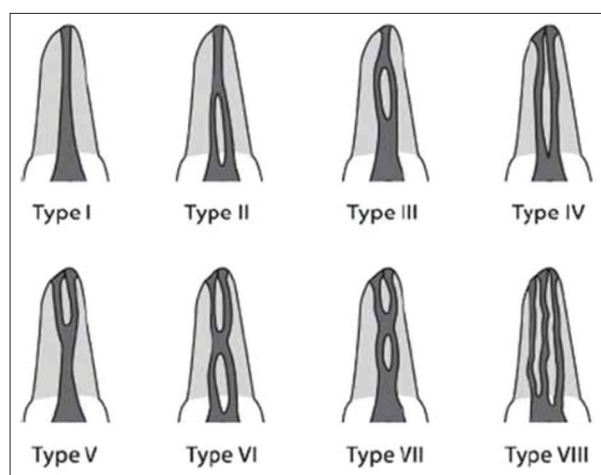


Figure 7: Vertucci's types

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