

MORPHOLOGICAL VARIATIONS IN MANDIBULAR ANTERIOR: CASE STUDIES

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ABSTRACT

Endodontic treatment mainly aims at chemomechanical debriding and filling the root canal space three-dimensionally. Post-treatment complications may arise due to failure to detect all the root canals. Teeth identified as having a single root canal are considered uncomplicated to treat. Literature reports suggest several variations in internal and external root canal anatomies. The case studies present cases of mandibular anterior with two canals and with different canal morphologies. Radiographs were taken at 30 to 40 degrees angle. Radiographic analysis of the mandibular anterior revealed presence of two canals. After access opening, determination of working length was done using angled radiographs and further confirmed by apex locator. Root canal preparation was done using the step-back technique with side vented needle irrigation using sodium hypochlorite and ethylene-di-amine tetra acetic acid. Cold lateral condensation was used for obturation along with AH Plus sealer. The post-operative endodontic restoration was done with light cure composite resin.

Key words: Angled radiographs, Apical foramina, Endodontic treatment, Mandibular anterior, Two canals.

Introduction

Endodontic treatment aims to completely debride the entire canal space and fill it three-dimensionally [1]. Location of all the canals not done effectively can result in serious post-operative symptoms. Mandibular incisors show the incidence of two canals in almost 12% to 41.1% [2] whereas mandibular canines revealed the incidence of two canals in 4.1% to 24% [3].

North-eastern Indian population shows prevalence of two canals in almost 36.25% of the population that was consistent with earlier studies on the population of different racial origins [4]. Maximum number of cases in mandibular canines present only a single root. The presence of two roots followed by two root canals is a rare occurrence with range of 1% to 5% [5].

For the successful result of root canal treatment, root canal morphology along with its variations is important to master. Mandibular incisors have three pulp horns along with bifurcated and lateral canals. Bifurcation is the point where a single canal divides into two small canals and continues into divergent pathways. However, sometimes again join to continue as a single canal. Canals originating laterally from the main canal run perpendicularly to exit into periodontal ligament space.

Vertucci [6] gave eight types of morphological patterns.

Type one, a single canal from the apex to the pulp chamber.

Type two, two distinct canals from the pulp chamber, but uniting at the site of exit

Type three, one canal leaving the pulp chamber, but dividing into two and merging to the point of exit

Type four, two distinct canals continue to the apex.

Type five, Single canal leaving the pulp chamber but in-between into two distinct canals until the point of exit

Type six, two canals from the pulp chamber, uniting into one and then dividing into two before exiting.

Type-seven, one canal leaving the pulp chamber then dividing and again uniting into in its course and finally dividing into two before exiting.

Type eight, three canals leaving the pulp chamber and exiting separately.

Commonly, one root canal with one apical foramen is present in mandibular incisors (Vertucci's type I) or the presence of two canals with one apical foramen (Vertucci's type II). However, the prevalence of two root canals with the exit of distinct apical foramina, (Vertucci's type IV) within the mandibular incisors is an unprecedented incidence of 3% and 2% within the mandibular central incisors and lateral incisors respectively, and 6% of canines [7]. Funato A has mentioned a case with two root canals exiting into distinct apical foramen within the mandibular central incisor [8].

Case reports

Case report 1

Department of Conservative Dentistry and Endodontics, Inderprastha dental college, Sahibabad, Ghaziabad (India) reported a 36-year-old female patient, a chief complaint of pain in the lower anterior teeth region for 1 week. The pain was continuous. The patient gave no history of trauma and the medical history was non-significant. Intraoral hard tissue examination revealed severe attrition in mandibular anteriors. Mandibular left lateral incisor (32) showed direct pulp exposure suggesting treatment initiation. The restoration was done concerning (31, 41) which depicts dental treatment from the private clinic which was confirmed from the patient's history. On thermal and electric pulp testing 32 showed no response. Radiographic examinations revealed the presence of two canals (32) (**Figure 1a**) and obturated (31, 41). The diagnosis was made as a non-vital tooth (32). The treatment plan included the completion of root canal therapy (32). Local anesthesia was given (2 % lignocaine). Under rubber dam isolation, access modification was done (32), which buccolingual extension was done extending into cingulum gingivally, which detected the existence of a lingual canal with the help of DG 16 explorer and dental operating microscope. No.10 K- file confirmed the unobstructed of the canal. The radiograph functioning measurement was established based on confirmation using an apex locator (Woodpecker V). Angulated Radiographs were taken to confirm the presence of two canals. Cleaning and shaping were done with K- files (Dentsply, Maillefer, Ballaigues Switzerland). Irrigation was done with a 2.5% solution of sodium hypochlorite (Qualikems, India) and normal saline (NS .9% w/v) alternatively used as irrigant after each instrument change. The access cavities were temporarily sealed with Intermediate restorative material. Follow-up after 2 weeks was carried out and the tooth was asymptomatic, lateral condensation technique was done for obturation using AH Plus sealer (Dentsply, Sirona). Post obturation radiograph revealed well obturated 2 canals with type III configuration according to Vertucci's classification (**Figure 1b**). The post-operative endodontic restoration was done with composite (Ivoclar Vivodent, India).



a)



b)

Figure 1. a) Preoperative radiograph reveals presence of two canals. b) Post obturation radiograph shows well obturated two canals with vertucci type III configuration.

Case report 2

A 48-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, Inderprastha dental college, Sahibabad, Ghaziabad (India), with a chief complaint of pain in the lower anterior teeth region for 2 weeks. The pain was continuous and dull. The patient gave no history of trauma and the medical history was non-significant. Intraoral hard tissue examination revealed severe attrition irt42 and tenderness to percussion. The restoration was evident irt43 which reflects dental treatment from some other clinic. While taking dental history, the patient revealed that he had undergone some treatment from a private dental clinic. On thermal and electric pulp testing irt42 showed an exaggerated response. Radiographic examinations revealed severe attrition irt42 and the presence of two canals (**Figure 2a**), tooth number 43 was root canal treated and was asymptomatic. The diagnosis was made as chronic irreversible pulpitis irt42. The treatment plan included root canal therapy irt42. Local anesthesia was administered (2 % lignocaine). Under rubber dam isolation, access opening was done irt42, clinically groove was seen extending lingually, champagne bubble test was done, and bubbles were formed lingually indicating the presence of another canal lingually. Therefore, the access was widened buccolingually and extended into the cingulum gingivally, which detected the presence of a lingual canal i.r.t 42 with the help of DG 16 explorer and dental operating microscope. Utilizing a no.10- K file the patency was checked. The functioning measurement was established based on a radiograph and confirmed using an apex locator (Woodpecker V). Different angulated radiographs were taken to confirm the presence of two canals. K files (Dentsply, Maillefer, Ballaigues Switzerland) were used for cleaning and shaping. Irrigation was done with a 2.5% solution of sodium hypochlorite (Qualikems, India) and normal saline (NS .9% w/v) alternatively used as irrigant after each instrument change. Sealing of access cavities was done temporarily with IRM. After 1 week, a follow-up was done. The tooth was asymptomatic so obturation was

done using lateral condensation technique and AH plus sealer (Dentsply, Sirona). Post obturation radiograph revealed well-obtured 2 canals with type II configuration according to Vertucci classification (**Figure 2b**). The restoration was done with composite (Ivoclar Vivodent, India) post-operatively.

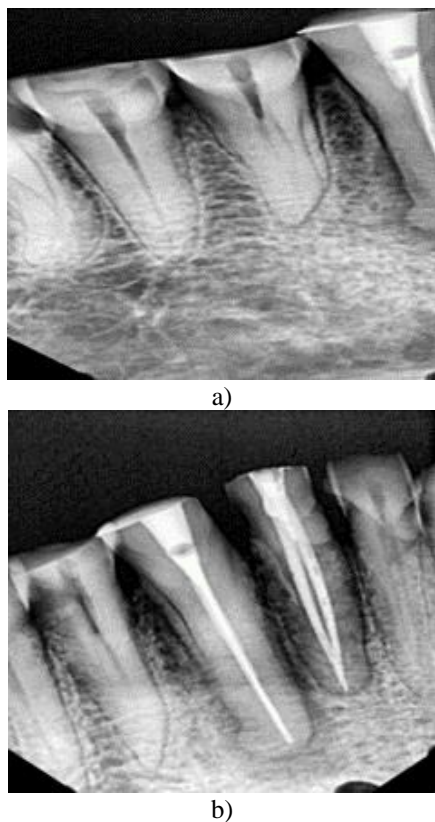


Figure 2. a) Preoperative radiograph reveals presence of two canals. b) Post obturation radiograph shows well obtured two canals with vertucci type II configuration.

Case report 3

18-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, Inderprastha dental college Sahibabad, Ghaziabad (India), with a chief complaint of pain in lower anterior teeth region since 3 days. The pain was continuous and severe. The patient gave a history of trauma 3 days back and the medical history was non-significant. Intraoral hard tissue examination revealed Ellis class III fracture irt42. Pulp exposure was evident from clinical presentation. There were lacerations on the lower lip. No thermal and electric pulp testing was done which could give false results due to fresh trauma. Radiographic examinations confirmed the presence of pulp exposure (**Figure 3a**). The treatment plan included root canal therapy irt42. Local anesthesia was given (2 % lignocaine). Under rubber dam isolation, access opening was done irt42, red line test was done, blood oozing from canals follows the dental map in a lingual direction so the access was widened buccolingually and extended into cingulumgingivally, which detected the presence of a lingual canal i.r.t 42. The patency was checked using a

no.10 K- file. The working length was established based on a radiograph and confirmed using an apex locator (Woodpecker V). Radiographs were taken at different angulations to confirm the presence of two canals. K- Files (Dentsply, Maillefer, Ballaigues Switzerland) were used for cleaning and shaping using the step-back technique. Irrigation was done with a 2.5% solution of sodium hypochlorite (Qualikems India) and normal saline (NS .9% w/v) used alternatively after every change of instruments. The temporary restoration was done with IRM. After 2 weeks follow-up was done. The tooth was asymptomatic so obturation was undertaken using cold lateral condensation technique and AH plus sealer (Dentsply Sirona). Post obturation radiograph revealed well-obtured 2 canals with type V configuration according to Vertucci classification (**Figure 3b**). Access cavity was sealed with composite (Ivoclar Vivodent, India)

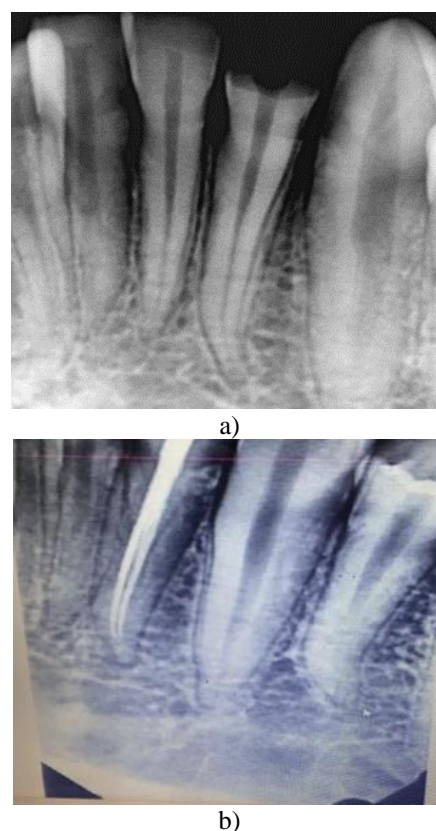


Figure 3. a) Preoperative radiograph with suspected two canals due to abrupt thinning of canal in the middle third. b) Post operation radiograph shows well-obtured radiograph with Vertucci type V configuration

Results and Discussion

Missed canals are the main reason forendodontic treatment failure [9]. Therefore, endodontists should make every effort to diagnose and treat through appropriate available armamentaria. Some investigators recommend angulated periapical radiographs for detecting morphological variations in the teeth [10]. In addition, root sectioning,

staining, and clearing techniques have been used. Cone Beam Computed Tomographic images are very useful in the diagnosis of various morphological variations [11]. Preoperative radiographs play an important role in the identification of suspected root and root canal variations, so radiographic interpretation is important that may give the details of the presentation of bifurcations or trifurcations [12].

As an endodontist, one should always search for a second canal in the mandibular anterior, even in the case of mandibular canines with either single or double roots. Vertucci [13] reported that 18% of mandibular canines might have two canals.

Proper access cavity design is very important to visualize the whole pulp-chamber floor. Access cavity with straight-line access to the apical foramina helps in locating root canal orifices and conservation of tooth structure [14]. Therefore, access cavities were modified under the dental operating microscope in all the cases. Extension was done more lingually to manage the lingual canals. Visualization of the pulp-chamber floors under magnification and illumination increases the chance of locating missed canals.

If there are abrupt changes in the root canal density with narrowing of canal space or disappearance of root canal continuity in preoperative radiographs then angulated radiographs must be taken to diagnose extra root or root canal [15].

Kartal N and Yanikoglu reported that mandibular incisors with a second canal have a frequency of 45% [16]. The percentage of Vertucci type IV configuration with two root canals and different apical foramina exit in the mandibular central and lateral incisors are 3% and 2% respectively and in canines, it is 6%. In the present case report, one of the teeth showed a mandibular lateral incisor with two separate apical foramina (Vertucci's type V) configurations [17]. determined the root canal configuration of mandibular incisors among the Saudi subpopulation of the Qassim region by the use of cone-beam computed tomography (CBCT) and concluded that all the mandibular incisors under examination had a single root. Type I root canal configuration represented 44.4%, Type II - 8%, Type III- 44.9%, Type IV- 0.5%, and Type V- 2.1% [17]. In the Indian population Type, I Vertucci's configuration (66.5%) was the most prevalent root canal configuration, followed by Type-III (15.25%), Type-II (12.12%), Type-V (3.12%), and Type-IV (2.37%) [18].

There are various tests in the literature to locate hidden canals apart from magnification. Some clinicians suggest 1% methylene blue dye for staining the pulp chamber floor. Methylene blue is a water-soluble dye when irrigated inside the canal; it is absorbed into canal orifices and serves to visually localize the hidden canals [19].

The sodium hypochlorite champagne bubble [20] test has been proposed to be an important aid in locating canal orifices. Solution dissociates into Na⁺ and Cl⁻ ions, which liberates free oxygen when placed in the access cavity and form bubbles. These bubbles might indicate some reaction of NaOCl with pulp tissue, releasing oxygen and thus indicating the possible location of the root canal entrance. This step can be performed during the whole treatment, aiming to observe possible extra canals.

Another test is the Redline test, in the case of vital teeth blood ooze out from canal orifices and maps the direction of canals [21].

Conclusion

The morphology of the canals in mandibular incisors often reflects deviations in the number as well as configuration. For the success of endodontic treatment, a clinician needs to have a thorough knowledge of the anatomy of the teeth. Therefore, additional, angulated radiographs should be taken and access modified, which would help in locating additional root canals. However, utilization of operative dental microscope, Cone Beam Computed Tomography, and loupes are additional aids in diagnosis.

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