

Endodontic Management of Mandibular Incisors with Multiple Canals Using Cone-beam Computed Tomography – A Case Series

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Abstract

Mandibular incisors are considered to be the simplest for endodontic treatment but the internal and external root canal anatomy of mandibular incisors could present with a number of variations including extra canals. This case series describes the successful endodontic treatment of mandibular incisors having two root canals. This case series also emphasizes the use of recently developed diagnostic aids in dentistry like cone-beam computed tomography which helps clinician to know about tooth morphology well before starting the treatment.

Keywords: Canal configuration, Mandibular incisor, Two root canals, Cone-beam computed tomography.

INTRODUCTION

The variability of root canal system poses a constant challenge to endodontic diagnosis and treatment. A thorough knowledge of internal and external anatomy coupled with accurate diagnosis and appropriate cleaning and shaping of the root canal system leads to successful treatment outcome. Many endodontic failures that occur are the result of a poor knowledge of this anatomy mainly missed canals. Failure to locate all root canals may lead to several complications such as post-treatment disease.^[1] With the development in the field of dentistry, diagnostic aids like cone-beam computed tomography (CBCT) help clinician to know about tooth morphology well before starting the treatment.

The morphology of mandibular central and lateral incisors is very similar and is not as simple as it may appear to be on standard periapical radiographs. It may be complicated by the presence of bifurcated and lateral canals; in some cases, these canals may rejoin to form a single canal again. As reported, more than 40% of mandibular incisors have two canals and more than 1% has two separate apical foramina.^[2]

The purpose of this case series is to describe the signs suggesting the presence of second canals in mandibular

incisors and the clinical endodontic management of mandibular incisors, each with two canals of varied configurations.

CASE REPORT 1

The patient reported to the dept. of conservative dentistry and endodontic with the chief complaint of pain in lower front teeth region for the past 6 months. Clinical examination revealed proximal caries with all four mandibular incisors. All four teeth were tender on percussion and showed negative response to electric pulp test (Digitest™ Pulptester). The intraoral periapical (IOPA) radiograph showed radiolucency approaching pulp with all four incisors and complex root canal morphology can be seen suggesting the existence of two canals (Figure 1). For better understanding of complicated canal morphology, CBCT was done, revealing two separate root canals in all four mandibular incisors indicating an endodontic rarity (Figure 2).

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Clinical/radiological findings and vitality tests led to a diagnosis of chronic apical periodontitis with all four mandibular incisors. Non-surgical endodontic root canal treatment was planned for all four mandibular incisors.

The tooth was isolated with rubber dam and access was gained to the pulp chamber with high-speed round diamond bur. Further, compensatory wearing was carried out with a high-speed Endo-Z bur (Maillefer-Dentsply, Switzerland) to improve the exploration of canals. Access cavity was examined with dental loupes revealing two orifices (Figure 3).

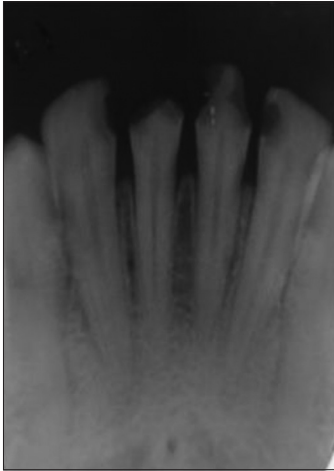


Figure 1: Intraoral periapical radiograph reveals caries involving pulp



Figure 2: Spiral computed tomography image showing the presence of two canals in lower incisors

The pulp was extirpated with barbed broach. The working lengths were estimated using an apex locator and then confirmed with a radiograph (Figure 4).

The instrumentation was done with ProTaper universal files (DENTSPLY Maillefer, Ballaigues, Switzerland) to size F1 using copious irrigation with 5.25% sodium hypochlorite, 17% EDTA, and 2% chlorhexidine. Canals were dried with paper points and calcium hydroxide is placed as an intracanal medicament followed by temporization with IRM. After 1 week, the patient was asymptomatic. All canals were irrigated, dried and master cone radiograph was taken.

The canals were dried with sterile paper points and filled with gutta-percha and AH Plus Sealer in a lateral compaction manner. Finally, post-obturation restoration was done using composite (Figure 5).

CASE REPORT 2

The patient reported with the chief complaint of swelling and pain in the lower front teeth region. The patient has a history of trauma 15 years back and history of intermittent pain and swelling in same region. Clinical examination revealed intraoral vestibular swelling in relation to lower central incisors, grossly attrited incisors – 41, 42, and showed negative response to Electric Pulp Test (Digitest™ Pulp tester).

The IOPA showed radiolucency involving pulp with 41, 42 along with large periapical radiolucency (Figure 6). Variation in the canal configuration was first noted in this pre-operative radiograph.

Clinical/radiological findings and vitality tests led to a diagnosis of acute exacerbation of chronic apical abscess in relation to both the lower right central and lateral incisors (Phoenix Abscess). Non-surgical endodontic root canal treatment was planned for both the incisors.

Treatment started with an emergency access opening in both the incisors through the worn out incisal edges with an oval-shaped outline form. The presence of extra canals was then noted in both the incisors during the exploration of canals, mucopurulent discharge was then drained through the canals. Canals were thoroughly irrigated with 2% chlorhexidine. An

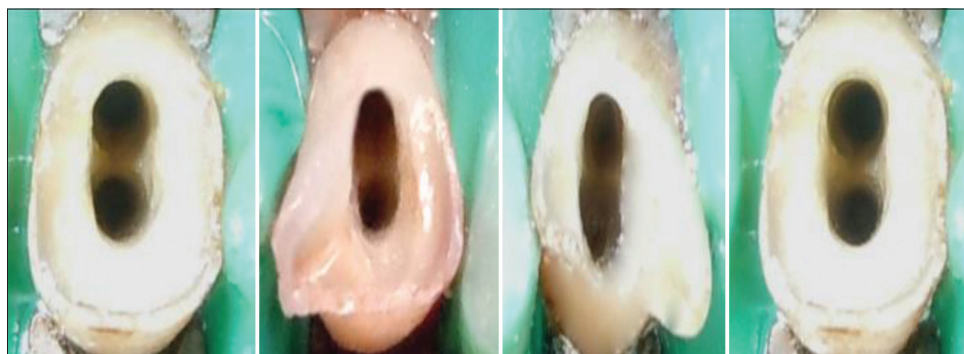


Figure 3: Pictures of access cavity showing two separate canal orifices for all four incisors

open dressing was placed; the patient was prescribed analgesics and antibiotics and recalled after 24 h. For better understanding of complicated canal morphology, CBCT was done (Figure 7), revealing two separate root canals in both incisors. In the next appointment, the tooth was isolated, access cavity was refined (Figure 8), and working lengths were estimated using an apex locator and then confirmed with a radiograph (Figure 9).

The biomechanical preparation was done and calcium hydroxide is placed as an intracanal medicament followed by temporization with IRM. After 3 weeks, the patient was asymptomatic. Obturation was done and post-obturation restoration was done using composite (Figure 10).

CASE REPORT 3

The patient reported with a chief complaint of pain in the lower front teeth region and the clinical examination revealed deep proximal caries and pain on percussion present with 41.

Radiographic examination showed radiolucency involving pulp with 41 (Figure 11). Access opening was done (Figure 12), working length determined which also confirmed the presence of two canals (Figure 13). Initial biomechanical preparation

was done, and in the next appointment, complete biomechanical preparation and obturation were done (Figures 14 and 15)

CASE REPORT 4

Chief complaint: Pain in the lower right front teeth region with a history of trauma 8 years back

Clinical examination: Discolored crown with 42 with Ellis Class IV # with 42.

CT revealed the presence of two canals, (Figure 16), access opening was done, working length was determined using apex locator and radiograph, biomechanical preparation was done, master cone radiograph was acceptable, and the obturation was done (Figure 17).

DISCUSSION

Successful root canal therapy depends on thorough knowledge of the normal and abnormal internal anatomy of the treated tooth. Studies have shown various abbreviations from normal like multiple foramina, loops, fins, and deltas. Consequently, the practitioner must possess knowledge and must treat each tooth assuming that complex anatomy occurs often enough to be considered normal.

Endodontic treatment of mandibular incisor teeth is considered simple as these teeth usually have single root canal, but at times, it also presents with variations. Various investigators have studied root canal system in mandibular incisors and reported following findings.^[3]

In the present case series, we have one case with Type IV canal configuration and two cases with type II canal configuration both of which considered as a rare endodontic occurrence. Occurrence of two separate canals is very rare in mandibular central incisor around 0.3% and lateral incisor 0.8%.^[4] Over 40% of mandibular incisors have two canals, but only just over 1% has two separate foramina.^[5] Occurrence of Vertucci type IV canal configuration in all three mandibular incisors has not been reported in any of the available literature to the

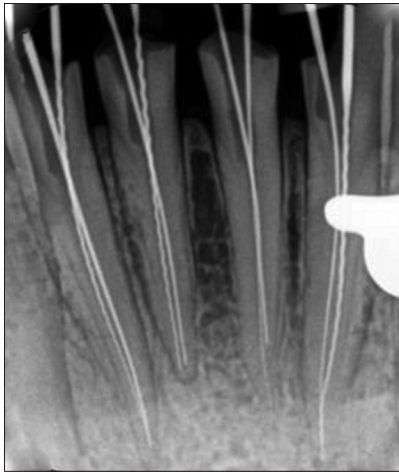


Figure 4: Vertucci type IV canal configuration



Figure 5: Master cone and obturation intraoral periapical

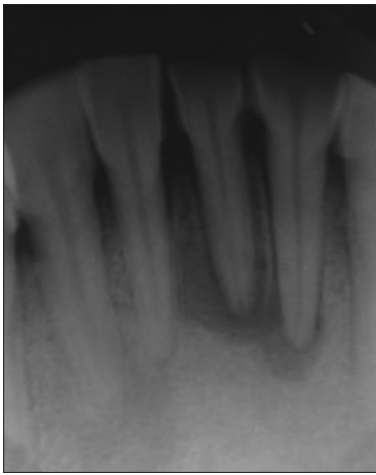


Figure 6: Intraoral periapical radiograph showing periapical lesions

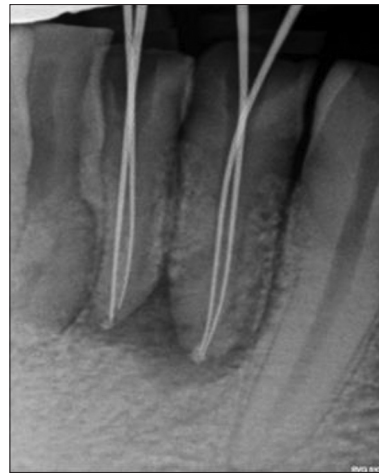


Figure 9: Working length radiograph showing two canals



Figure 7: Spiral computed tomography image showing the presence of two canals in lower incisors

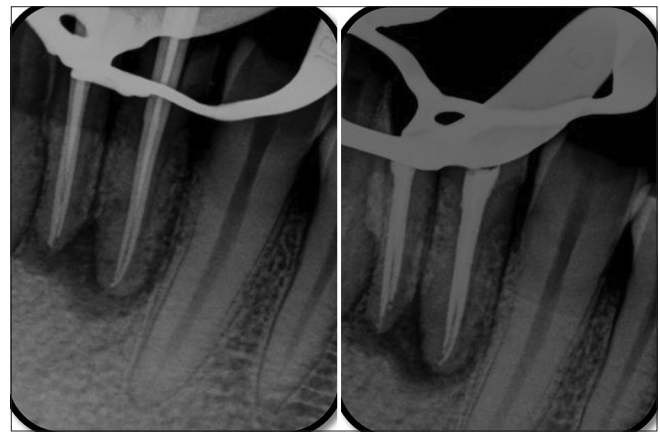


Figure 10: Master cone and obturation intraoral periapical

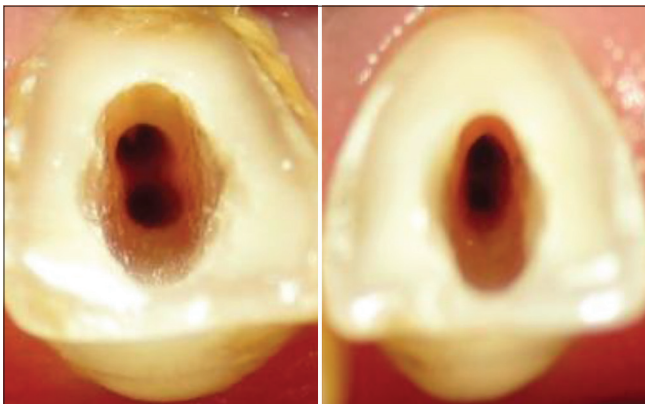


Figure 8: Access opening



Figure 11: Intraoral periapical radiograph

best of our knowledge. This case series illustrates some of the difficulties that may arise during root canal treatment. The main reason for failure in endodontic treatment of mandibular incisors can be due to inability to detect the presence of a second root canal which can then not be prepared and obturated during treatment.^[6] According to the endodontic literature, mandibular incisors with two canals are not unusual.^[7-10] In

most cases in which two canals are present, however, they merge into a single canal short of the apex.

Clinician should always assume for the presence of a second canal and should then thoroughly search for the second canal.^[11] It is essential that clinicians know the clinical and radiographic signs that suggest the presence of extra canals.



Figure 12: Access opening showing two canal orifices



Figure 15: Obturation radiograph

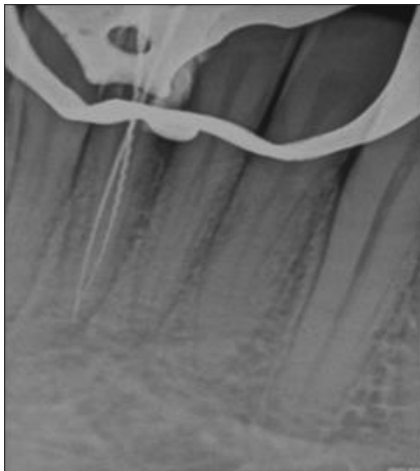


Figure 13: Working length radiograph



Figure 16: Spiral computed tomography showing two canals

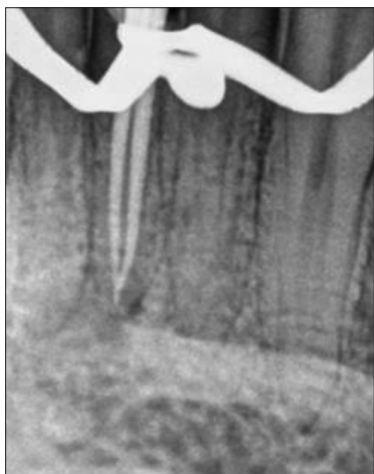


Figure 14: Master cone radiograph

- Clinically, the presence of continuous bleeding in teeth with pulpitis or normal pulp despite complete instrumentation can suggest the presence of such canals.

Table 1: Various percentage of canal configurations

Author	Type I	Type II	Type III	Type IV
Vertucci	75%	5%	18%	02%
Kaliskan <i>et al.</i>	68.63%	13.73%	15.69%	-
Miyashita <i>et al.</i>	87.6%	9.3%	1.4%	1.4%
Al-Qudah and Awawdeh	73.8%	10.9%	6.7%	5.1
Liu <i>et al.</i>	82.5%	3.9%	10.4%	2.8%

- In case with necrotic pulps or when the canals are pulpless, the presence of an apical rarefaction on the lateral side of the root may suggest the presence of an extra canal.
- Eccentric location of an endodontic file on a radiograph during working length determination.
- Inconsistent apex locator readings.
- A sinus tract that traces laterally away from the main canal.
- The feeling of a “catch” on the canal wall during instrumentation of a wide and unobstructed main canal.
- “Fast break” guideline – disappearance or narrowing of a canal on radiograph.

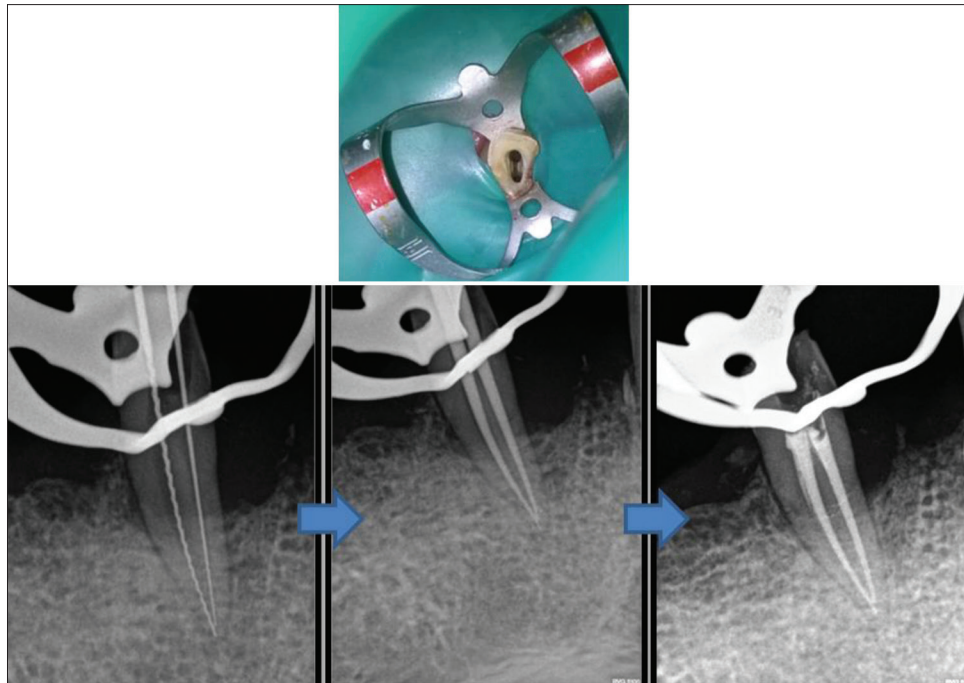


Figure 17: Access opening, working length, master cone, and obturation radiograph

Careful evaluation of two or more periapical radiographs is mandatory. These angled radiographs provide much needed information about root canal morphology.^[12]

Conventional and modified canal staining and clearing techniques are considered the gold standard method of studying root canal morphology. The CBCT has been also used as a tool to examine root canal morphology in different populations. Neelakantan *et al.* demonstrated that CBCT is as accurate as the canal staining and clearing technique in identifying root canal morphology.^[13] It provides a non-invasive and clinically applicable examination of root canal morphology. Thus, in this study, we used CBCT to reconfirm the root canal morphology of mandibular incisors.

During biomechanical preparation, instrumentation was done up to the root apex in lingual canal and up to the joining point of canals in buccal canal using standardized technique so as to prevent hourglass preparation in the apical 1/3 region which would create difficulty in gaining a good apical seal.

CONCLUSION

This case series highlights the importance of having a thorough knowledge of all possible variations in root canal anatomy. Use of CBCT imaging in endodontically challenging cases can facilitate a better understanding of the complex root canal anatomy. Teeth with complex root canal anatomies and large periapical lesion can be successfully treated with non-surgical endodontic treatment.

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