

# Clinical management of teeth with incomplete root formation

Siju Jacob discusses treatment techniques for teeth with incomplete root formation



## CPD Aims and objectives

This clinical article aims to present three case studies illustrating different treatment methods for teeth with incomplete root formation (commonly referred to as open apices).

## Expected outcomes

Correctly answering the questions on page 42, worth one hour of verifiable CPD, will demonstrate you understand treatment techniques for teeth with incomplete root formation.

## Introduction

Teeth with incomplete root formation (commonly referred to as open apices) pose several clinical challenges and require altered clinical protocol compared to routine endodontic cases. When re-vascularisation techniques are not practical, not essential, or have failed, these teeth can be managed in three different ways:

1. Orthograde MTA placement without surgery
2. Surgery with orthograde/retrograde MTA placement
3. Traditional apexification.

This article illustrates each of these techniques using clinical cases with recalls.

## Case one

### Orthograde MTA placement

A 28-year-old male patient reported to the clinic with a history of intermittent pain, swelling and discolouration in the left upper front teeth. He gave a history of previous endodontic therapy followed by surgery on these teeth. Clinical examination revealed discoloured left maxillary central and lateral incisor teeth. Both teeth were tender to percussion and probing depths were within normal limits.

Radiographs showed a previously endodontically-treated left maxillary central and left lateral incisor (Figures 1a and 1b). The previous endodontic therapy appeared poorly done and there seemed to be evidence of previous root resection.

The treatment options were discussed with the patient and a decision was made to perform non-surgical retreatment endodontics in both teeth. Since the apex appeared resected,

the option of using MTA as an obturating material was included in the treatment plan.

After local anaesthesia and rubber dam application, the old restoration and gutta percha were removed in both teeth (Figure 2). Both canals were cleaned and shaped using hand and rotary nickel titanium files. Gauging of the apex revealed that the lateral incisor, despite the previous root resection, was no larger than ISO size 40 at the apex and adequate resistance form and cone fit achieved. The central incisor, however, had an open apex through which a size 80 file passed through easily. There was also profuse bleeding at the apex of the central incisor (Figure 3). It was decided to obturate the lateral incisor with gutta percha and the central incisor with MTA. The canals were irrigated with 5.2% sodium hypochlorite, 17% EDTA and 2% chlorhexidine. Care was taken to keep sodium hypochlorite and EDTA irrigation restricted only to the coronal portion in the tooth with the open apex. The canals were dried using paper points and a calcium hydroxide paste (Ultracal, Ultradent) was placed in the canals (Figure 4). The access cavity was sealed with a layer of Cavit (3M Espe) followed by glass ionomer cement (Fuji VII, GC).

The patient was recalled two weeks later. Both teeth were asymptomatic. It was decided to obturate the lateral incisor with gutta percha and the central incisor with MTA.

The calcium hydroxide was removed from the central incisor. Inspection of the apical area through a surgical microscope showed absence of any bleeding (Figure 5) and an environment conducive to placing MTA. MTA (Proroot MTA, Dentsply) was placed at the apical area with the help of Dovagan's MTA carrier (Figure 6) and condensed using pluggers. Indirect ultrasonics was applied to improve the density of packed MTA. The apical MTA pack was verified through the microscope as well as radiographically (Figures 7a and 7b). The remainder of the canal was backfilled with MTA (Figure 8) and a composite core build-up done (Figure 9).

The lateral incisor was obturated using gutta percha and AH Plus sealer (Dentsply) in warm vertical condensation. The access cavity was sealed using a dual-cured resin (Luxacore, DMG) (Figures 10a and 10b).

The patient was recalled after two years and a recall radiograph taken to verify healing (Figures 11a and 11b).

## Case two

### Orthograde MTA placement and immediate surgery

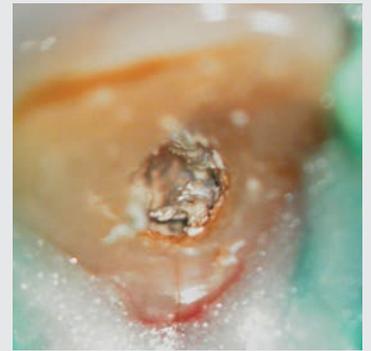
A 27-year-old male patient reported to the clinic with a history of persistent swelling and pain in the upper front teeth. He gave a history of previous endodontic therapy and

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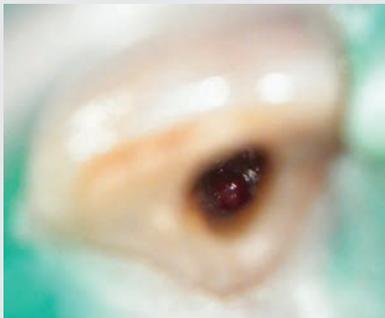
**Case one**



**Figures 1a and 1b:** Preoperative radiographs show poorly done endodontic therapy with evidence of root resection



**Figure 2:** Old restoration and gutta percha removed



**Figure 3:** Bleeding seen at the open apex



**Figure 4:** Calcium hydroxide placed



**Figure 5:** Two weeks later. Bleeding and inflammation under control in the open apex area



**Figure 6:** MTA placement using Dovgan carrier



**Figure 7a**

**Figures 7a and 7b:** MTA placed at the apex and verified both through the scope as well as radiograph



**Figure 7b**



**Figure 8:** Canal backfilled with MTA



**Figure 9:** Core build-up done with composite resin

Case one



**Figures 10a and 10b:** Postoperative radiographs. Lateral incisor obturated with gutta percha and central incisor with MTA



**Figures 11a and 11b:** Two-year recall radiographs

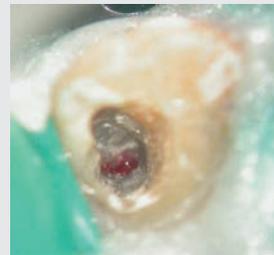
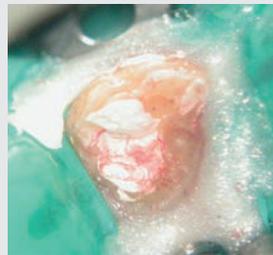
Case two



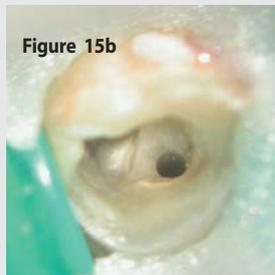
**Figure 12:** Left and right maxillary central incisor teeth with crowns and a labial swelling



**Figure 13:** Preoperative radiograph



**Figures 14a and 14b:** Removal of old gutta percha in the left central incisor reveals perforation



**Figures 15a, 15b and 15c:** Original canal located



**Figure 16a:** Perforation repaired with MTA



**Figure 16b:** Perforation repaired with MTA



**Figure 16c:** Original canal obturated with gutta percha



**Figure 16d:** Core build-up done with composite resin



**Figure 16e:** Postoperative radiograph after treatment of the left central incisor

**Case two**



**Figure 17a**

**Figures 17a and 17b:** Old gutta percha removed from the right central incisor



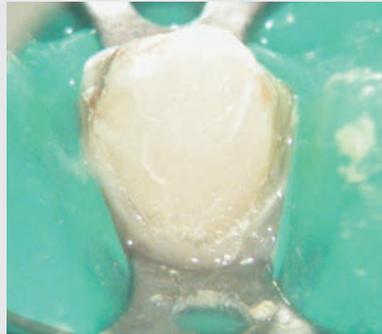
**Figure 17b**



**Figure 17c:** Open apex seen through the surgical microscope



**Figure 18a:** Canal filled with MTA



**Figure 18b:** Core build-up done with composite resin



**Figure 18c:** Postoperative (pre-surgical) radiograph showing slight over-filling of MTA



**Figures 19a and 19b:** Apical portion of the root visualised under the microscope. Rough margins smoothed. Uniformity and hardness of MTA checked



**Figure 20a:** Preoperative radiograph



**Figure 20b:** Post-surgical radiograph



**Figure 20c:** Two-year recall shows complete healing

crowns followed by surgery on these teeth performed three years ago. Clinical examination revealed crowned left and right maxillary central incisor teeth with a labial swelling (Figure 12). Both teeth were tender to percussion and probing depths were within normal limits.

Radiographic examination revealed previously endodontically-treated left and right maxillary central incisors (Figure 13). The right maxillary central incisor showed evidence of previous root resection. The left central incisor appeared calcified and showed what looked like a previous, unsuccessful attempt to locate the canal.

The treatment options were discussed with the patient. The patient had travelled from abroad and wanted the entire treatment to be completed in nine days. Considering the limited time available, it was decided to perform retreatment endodontics followed by immediate surgery.

The left maxillary central incisor was treated first. Removal of the old gutta percha filling revealed a perforation (Figures 14a and 14b). The original canal was located distal to the previous attempt (Figures 15a-15c). Once the canal was located, it was cleaned, shaped and obturated with gutta percha in warm vertical condensation. The perforation was repaired with MTA and the coronal build-up was completed using dual-cured composite resin (Figures 16a-16e).

The left maxillary central incisor was treated next. Removal of previous gutta percha revealed an open apex (Figures 17a-17c). The canals were cleaned using 2% chlorhexidine. Sodium hypochlorite was not used because of the danger of apical extrusion. The entire canal was then obturated with MTA delivered through a Dovgan syringe and condensed using wet microbrush and pluggers assisted by indirect ultrasonics. The coronal build-up was completed using a fibre-post and composite resin (Figures 18a-18c).

The patient was scheduled for surgery two days later. A papilla preservation flap was raised, the periapical lesion curetted, the excess MTA removed and the remaining MTA in the canal checked for hardness and uniform seal (Figures 19a and 19b). The entire surgery was done using a surgical microscope. Healing was uneventful and the sutures were removed six days later.

A two-year recall showed complete healing of the periapical lesion (Figures 20a-20c).

### Case three

#### Traditional apexification

A 22-year-old female patient reported to the clinic with a history of intermittent pain and swelling in the upper front teeth. She gave a history of previous endodontic therapy and crown on one of these teeth when she was 10 years old.

Clinical examination revealed a crowned right maxillary central incisor. The right maxillary central incisor and right lateral incisor were tender on percussion. Probing depths were within normal limits.

Intraoral periapical radiographs revealed a large lesion involving the right maxillary central and lateral incisor and the left maxillary central incisor (Figures 21a and 21b). The endodontically-treated maxillary incisor appeared to have an open apex. In addition to the previously endodontically-

treated right maxillary central incisor, the right lateral incisor also tested non-vital. All other anterior teeth were vital.

Treatment options were discussed with the patient and a decision was made to perform endodontic therapy on the right lateral incisor and non-surgical retreatment endodontics on the right maxillary central incisor.

Because of the size of the lesion and the additional problem of the open apex, a decision was made to treat this tooth conservatively with long-term placement of calcium hydroxide. The two main objectives of long-term calcium hydroxide placement were:

1. To promote healing and repair thereby reducing the size of the lesion
2. To induce apexification to facilitate obturation.

The right lateral incisor was treated first. Endodontic therapy was done in a single session. The canal was filled with gutta percha and the access sealed with composite resin (Figures 22a, 22b, 22c and 22d).

Retreatment endodontics was initiated on the right central incisor through the existing crown. A decision was made to temporarily retain the existing crown for aesthetic reasons. The old gutta percha filling was removed and the canals rinsed with 2% chlorhexidine. A part of the old gutta percha was inadvertently extruded periapically. Efforts to retrieve the extruded fragment were not successful. The canal was packed with calcium hydroxide and the access closed with Cavit followed by pink glass ionomer (Fuji VII) (Figures 23a-23g). A small amount of calcium hydroxide was unintentionally extruded periapically because of the open apex. This was expected to be resorbed.

The patient was recalled after two weeks. The extruded calcium hydroxide was found to be resorbed completely. A second round of calcium hydroxide was placed in the canals and the access closed with Cavit followed by glass ionomer (Figures 24a-24c).

Calcium hydroxide medication was replaced twice at two week intervals after which the patient failed to turn up for subsequent appointments. She eventually reported to the clinic two years later because the incisal edge of the right maxillary right lateral incisor had chipped off. A radiograph taken during this visit showed complete healing of the apical lesion, resorption of the extruded gutta percha and evidence of a dense apical barrier in the right maxillary central incisor (Figures 25a and 25b).

A decision was made to reaccess the canal in the central incisor, remove the calcium hydroxide, evaluate the apical barrier under the scope and complete treatment, if possible.

The old glass ionomer filling and Cavit were removed to reveal calcium hydroxide (Figures 26a and 26b). Removal of the calcium hydroxide and observation of the apical area under the microscope revealed a dense, uniform apical barrier (Figures 27a and 27b). Physical verification of the barrier was done using a gutta percha cone (Figures 28a and 28b). The canal was obturated using thermo-plasticised gutta percha injected from the obtura gun and condensed using large pluggers. The barrier was found to be firm and withstood condensation forces without any apical extrusion (Figures 29a and 29b). A large fibre glass post was placed to

**Case three**



Figure 21a



Figure 21b

**Figures 21a and 21b:** Preoperative radiographs



Figure 22a



Figure 22b



Figure 22c

**Figures 22a, 22b, 22c and 22d:** Endodontic therapy of the right lateral incisor completed



Figure 22d



Figure 23a

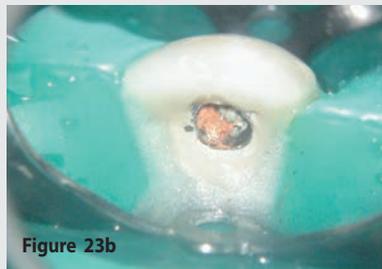


Figure 23b

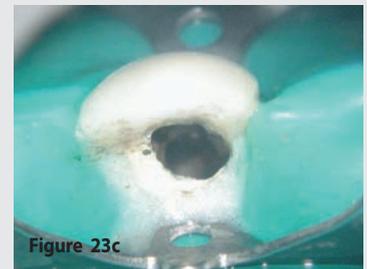


Figure 23c

**Figures 23a, 23b and 23c:** Re-treatment of the right central incisor started. Access made through existing crown. Old gutta percha removed

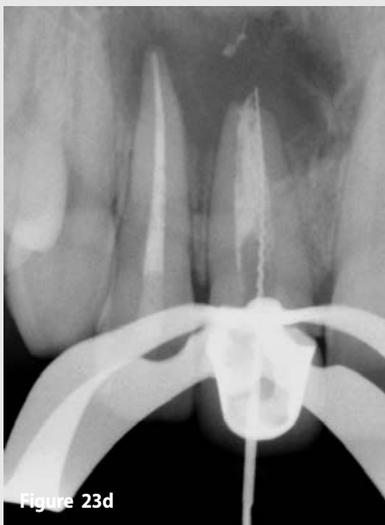


Figure 23d



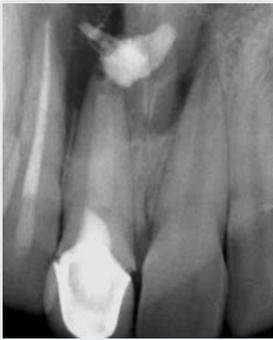
Figure 23e

**Figures 23d and 23e:** Intraoperative radiographs taken at periodic intervals to verify gutta percha removal



**Figure 23f:** Gutta percha unintentionally extruded periapically

Case three



**Figure 23g:** Postoperative radiograph after first visit. Note minimal extrusion of calcium hydroxide



**Figure 24a:** Two weeks later, extruded calcium hydroxide is completely resorbed



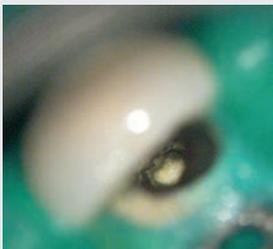
**Figures 24b and 24c:** Calcium hydroxide re-packed. Access closed with Cavit and glass ionomer



**Figures 25a and 25b:** Two-year recall radiographs showing complete healing of periapical lesion, resorption of extruded gutta percha and evidence of apical barrier formation in the right central incisor



**Figures 26a and 26b:** Pink coloured glass ionomer makes re-accessing the canal easier. Removal of glass ionomer and Cavit shows canal filled with calcium hydroxide



**Figure 27a:** Uniform apical barrier visualised through the surgical microscope



**Figure 27b:** Radiographic picture of the apical barrier



**Figures 28a and 28b:** Physical verification of the apical barrier using a gutta percha cone



strengthen the root. The fibre glass post was placed inverted to fit the large width of the canal. The core build-up was done using dual-cured composite resin (Figures 30a-30d).

The patient was referred to her general dentist for a new crown.

**Discussion**

Management of the open apex requires variations from conventional endodontic therapy. The treatment protocol depends on the size of the periapical lesion, time factor and patient cooperation.

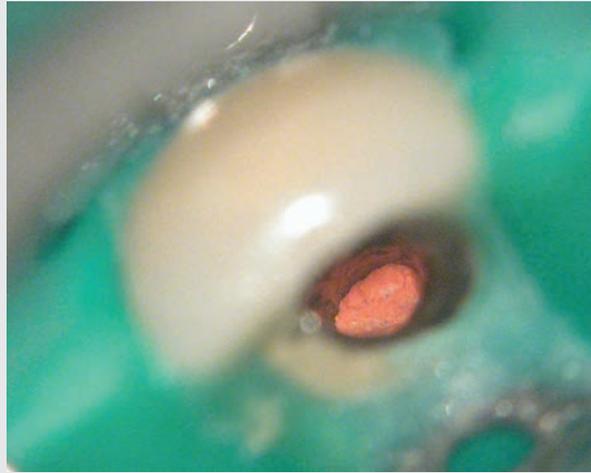
In the first case described in this article, the periapical destruction of bone was minimal. The aim was to control

apical periodontitis and obturate the canal predictably. Therefore, short-term placement of calcium hydroxide followed by obturation with MTA at the root apex was a predictable procedure. Surgery is rarely required in these cases.

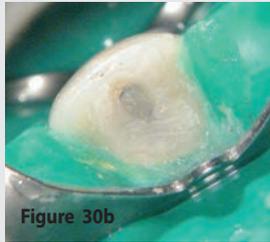
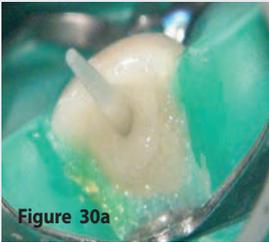
In the second case described in this article, the time available for the patient was a very important factor to consider. For patients who live in remote places and have to travel to access quality endodontic care, immediate surgery combined with orthograde/retrograde MTA placement can be a very predictable alternative.

Today, with improved magnification and special microsurgical techniques, the success rate of surgical

### Case three



Figures 29a and 29b: Apical barrier resists vertical condensation forces during obturation by thermo-plasticised gutta percha



Figures 30a, 30b, 30c and 30d: Large fibre post inverted and cemented with dual-core composite resin to strengthen the root



Figures 31a and 31b: Comparison of preoperative and postoperative radiographs

endodontics is fairly high. The disadvantage is that in large lesions, surgery might be a radical option and might require additional procedures on adjacent teeth and surrounding hard and soft tissues.

In the third case described, considering the large size of the lesion and incomplete root formation, long-term calcium hydroxide therapy was the most conservative treatment. Patient follow-up is the most difficult part in apexification cases, as the waiting period is long and some patients have a tendency to miss appointments once the symptoms subside. However, all other factors being uniform, it is a

good rule to keep surgery as the last alternative and limited to cases that do not respond to non-surgical retreatment endodontics.

Apexification is a fairly predictable procedure. However, there have been studies concerning the reduced fracture resistance of teeth treated with long-term calcium hydroxide. These cases should, therefore, be evaluated on a risk versus benefit basis.

There needs to be modification of irrigation protocol for open apex cases. It is virtually impossible to control the apical extrusion of any irrigant in open apex cases. Therefore,

caution is advised when using solutions that can cause severe periapical tissue damage and irritation. Apical extrusion of sodium hypochlorite can cause severe complications and it is probably best to irrigate these cases with 2% chlorhexidine.

MTA is a proven material for management of open apex cases. The ability to set in the presence of moisture makes it the material of choice for open apex cases. There have been numerous studies that affirm MTA as an excellent root-end

filling material.

**Conclusion**

An open apex can pose numerous treatment challenges to a clinician. A correct diagnosis, followed by a suitable treatment plan, taking into account the various factors discussed in this article can help improve treatment outcomes. ■

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