Original Article

Esthetic Rehabilitation Of Discolored Maxillary Central Incisors With Open Apex Using Two Novel Treatment Modalities-Case Reports

[1]Dr. Prakriti Jaggi, [2]Dr. Renuka Jadhao, [3]Dr.SanjyotMulay, [4]Dr. Anita SanapTandale, [5]Dr.Rutuja Patil

[1,2,3,4,5]Dr. D.Y. Patil Dental College and Hospital, Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India

Corresponding author: Dr. Anita SanapTandale, Dr. D.Y. Patil Dental College and Hospital, Dr. D.Y. Patil Vidyapeeth, Pimpri, Pune, Maharashtra, India **E-mail:** anita.tandale@gmail.com
DOI: 10.47750/pnr.2023.14.S02.98

Abstract

This case series details the management of three teeth with a history of trauma. All the three teeth had an open apex and were disinfected with Triple antibiotic paste /calcium hydroxide – iodoform paste prior to gaining an apical seal with an MTA plug and a definitive coronal seal. Bleaching, veneers, and full coverage crowns were used to restore the affected tooth to their original form and function.

The cases were followed for a period of more than one year, to ascertain continued healing of lesion, apical root development, and non-recurrence of further symptoms.

This case report intense to highlight the usage of good infection protocols and several restorative techniques to successfully manage the patient. It also highlights a strict adherence to clinical protocol, along with a good standard of care, leading to a successful outcome.

INTRODUCTION

The ultimate aim of an endodontic treatment is to obtain a complete seal in the coronal and apical third and prevent re-infection. However, the clinician may come across some complex cases in their daily clinical practice which hinders the goal of obtaining complete obturation of the canal space.[1]Anatomically, most teeth have conical shaped root canals that taper towards the apical end. Nevertheless, in case of absence of sufficient root development, the canal fails to taper apically and forms a blunderbuss or a non-blunderbuss canal. In the former type, the canals are flaring and divergent towards the apical third when compared to the coronal end and form a funnel shape. In the later type, the walls of the canal are parallel to each other or with a little convergence as they move apically.[2] Open apex is a result of various reasons, in younger children, any dental trauma which may lead to damage to the developing dentition. As a consequence, the Hertwig's epithelial root sheath is damaged which causes pulp necrosis with further arresting the root development. A periapical lesion also may alter the morphology of the pre-existing canal to make it wider at the apical end.[3]Other causes could be, but not limited to orthodontic treatment leading to periapical pathosis or trauma during the periradicular surgical procedures and due to over instrumentation during root canal procedure.[3,4] Open apex becomes a challenge to operator because the wide canal possesses difficulties in complete debridement and obturation. The taper of the instruments does not comply with the wide anatomy of the canal. Additionally, the canal disinfection also cannot be achieved to substantial standards. Further, these canals always hold a risk of damage to the periapical tissues due to extrusion of the irrigating solution beyond the apex.[5]

The production of mineralised tissue in the absence of apical constriction usually presents naturally, it is essential to create a barrier in the apical area which would be three-dimensional. Apexification is one such procedure that

seeks to induce a calcified barrier at the apical end to form an apical seal. The procedure introduces intracanal dressing material like calcium hydroxide into the root canals, which is renewed periodically until the barrier is achieved.[6] However, the time required to form this barrier completely depends on the host, the presence of infection and the size of the apical foramen.[7]Antibacterial pastes like Triple antibiotic paste have effectively encouraged apexification. For single step apexification Mineral trioxide (MTA), Biodentin, Tricalcium phosphate, etc are the widely used materials in endodontics. The present case report discusses about a young patient with open apex and describes the protocol followed for its management.

CASE REPORT

This case series follows the PRICE 2020 and CARE Guidelines.

CASE 1

A 24 yearold male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of discolored tooth in the upper front region of the jaw.Upon taking further detailed history, it was reported that the patient had a history of trauma eight years back, after which the tooth began to discolour. Patient did not visit any clinic or seek treatment before for the same complaint. However, there was no pain or sensitivity reported by the patient with the upper front teeth. On clinical examination, there was fracture of enamel and dentin with presence of tooth discoloration and sinus tract with 21. This was provisionally diagnosed with Ellis class IV (Non vital tooth) with 21 secondary to dental trauma. Mucosa displayed a sinus tract in relation to 21 (Figure 1a). Additionally, tooth 31 presented Ellis Class III fracture. Past dental history revealed root canal treatment with 31.

INVESTIGATIONS

Patient underwent radiographic investigation for confirmation of the diagnosis in 21 and 31. Intraoperative periapical radiograph presented an incomplete root formation and presence of open apex with 21. A distinct radiolucency was observed in the periapical region of 21 (Figure 1b).

The radiographic examination helped in arriving at a final diagnosis and the patient was then diagnosed with chronic alveolar abscess with Ellis class IV associated with 21 secondary to trauma.

TREATMENT

After obtaining informed consent from the patient, endodontic treatment was initiated for 21 first and whole procedure was performed under rubber dam isolation. Access cavity was prepared on the upper left central incisor and the working length was measured using electronic apex locator (Root ZX, Morita) with K-file #20 (Dentsply Maillefer, Ballaigues, Switzerland)by bending the file to 90^0 at the apical end and sliding it along each root canal wall, averaging 18 mm length. The same was confirmed with periapical radiograph. (Figure 1c). The canal preparation was then initiated by cleaning the walls with H files (Dentsply Maillefer, Ballaigues, Switzerland) and the irrigation using 5.25% NaOCl (Prime Dental Pvt Ltd) and normal saline(Fresenius Kabi) intermittently. This was followed by 17% EDTA solution (Prime Dental Pvt Ltd) to remove the smear layer within the canals. Once thorough cleaning of the canals was performed, Calcium hydroxide (Prime Dental Pvt Ltd) intra-canal medicament was placed for one week as it is aqueous based and fast acting medicament. Additionally, Triple antibiotic paste (Metronidazole, ciprofloxacin and Minocycline) was also placed as an intra-canal medicament for the next 3 weeks.

A 4 mm apical plug was made using MTA (MTA Angelus®) and placed using MTA carrier (Whaledent). Thermoplasticized obturation technique was used to fill the remaining root canal with gutta percha. (E & Q, Meta BioMed) (Figure 1d).

At the next visit, 2mm of gutta percha from the CEJ was removed to allow placement of GIC barrier for intra-coronal bleaching. Citric acid (Prime Dental Pvt Ltd) was used to clean the pulp chamber before inserting the bleaching agent in order to open up the dentinal tubules and enhance the bleaching effect. Non-vital bleaching was done using 35% Hydrogen Peroxide (Opalescence Endo) and the agent was changed twice after a week to obtain the desired whitening effect. For indirect veneer of 21, the Dentin shade was selected at the cervical area followed by shade selection of the enamel shell. Minimum tooth preparation was done to accommodate the enamel shell without involving proximal walls with 21.

Apart from this, 31 was rehabilitated with post and core(Dentsply Sirona) of # 1 size and was luted inside the canal using self adhesive resin luting cement (Rely X U200, 3M ESPE) (Figure 1e).

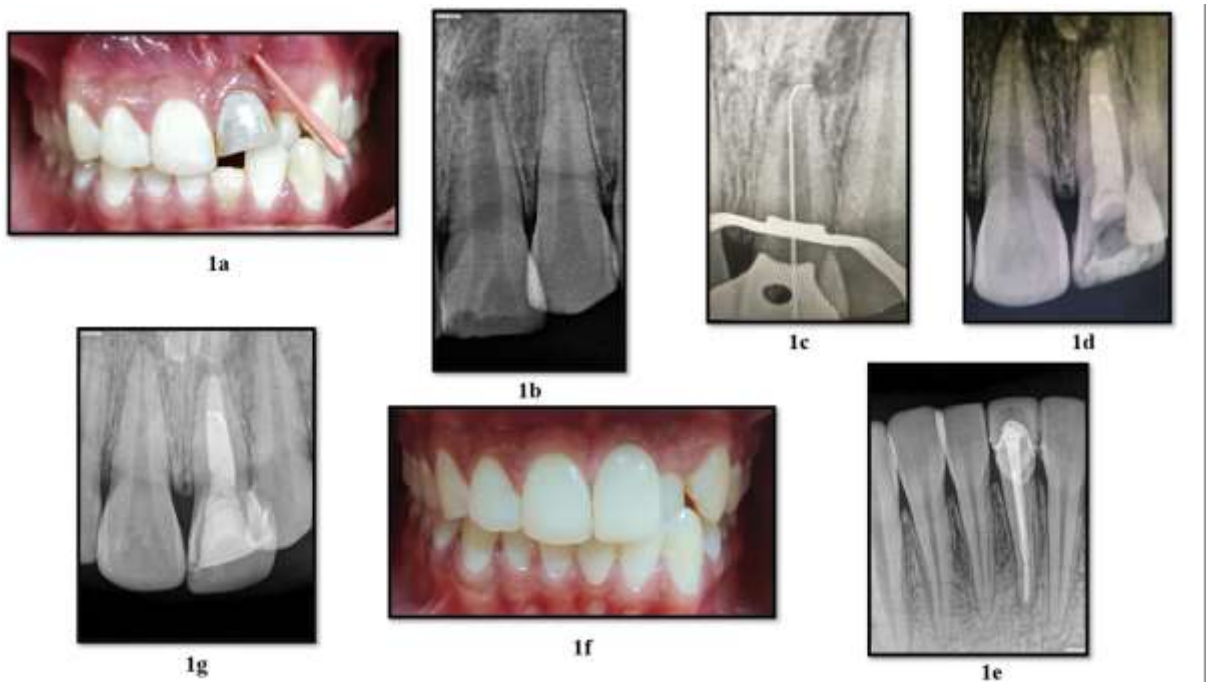

Fig 1- (1a) Clinical picture showing maxillary and mandibular anterior teeth and gingival tissue with sinus tract and tracing, (1b) Radiographic representation of maxillary central incisor with periapical radiolucency, (1c) Radiograph representing of working length determination, (1d) Radiograph representing of apical plug and obturation, (1e) Radiograph representing post and core with 31, (1f) Post – operative picture of 21 and 31, (1g) Post –operative radiograph of 21 at 1.5 year follow-up.

The laboratory procedure included preparation of mock-up with 21 and 31. At first trial, marginal fit, shape and shade of the enamel shell and crown were checked on respective teeth and necessary modifications were done, followed by finishing and polishing.

For veneer cementation, the tooth surface was cleaned and the etchant (35% phosphoric acid) was applied on the prepared tooth surface for 15 to 20 seconds. Enamel shell and crown were etched with porcelain etchant (porcelain conditioners- 10% Hydrofluoric acid) for 60 seconds. Bonding agent (3M ESPE) was applied to the etched enamel surface and was light cured for 15 sec using LED Curing light (Woodpecker)^{TM}. Silane coupling agent (3M ESPE) was applied on inner surface of the enamel shell and crown for 60 sec and air dried. Veneers were positioned, tack cured for 5 sec and excess resin cement (RelyX^{TM} U200, 3M ESPE) was removed and was further light cured for 40 seconds on each surface. Patient was followed up for a period of 1.5years to observe healing of periapical tissue clinically and radiographically (Figure 1f and 1g). This extruded Metapexmaterial doesn't seem to cause any complication. (Fig 2f).

CASE 2

A 28 year old male patient reported to the Department of Conservative Dentistry and Endodontics with a chief complaint of dark tooth in the upper front region. Detailed case history revealed that the patient had a history of trauma 15 years back, after which the tooth began to discolour. Patient also gave the history of incomplete root canal treatment as suggested by the previous dentist. There was no pain or sensitivity with the upper front teeth. On clinical examination, fracture of enamel and dentin was evident along with tooth discoloration with 11 and 21. Perforation was also seen on the buccal portion of crown with respect to 11 (Fig 2a). This was provisionally diagnosed with Ellis class IV (Non vital tooth) with 11 and 21 secondary to dental trauma.

INVESTIGATIONS

Patient underwent radiographic investigation for confirmation of diagnosis in 11 and 21. Intraoral periapical radiograph presented an incomplete root formation and presence of open apex with 11 and 21. A distinct radiopacity was seen in the apical third of 11 and 21 suggestive of a foreign material. A distinct radiolucency was observed in the periapical region of 11 and 21 (Fig 2b).
The radiographic examination helped in arriving at a final diagnosis and the patient was then diagnosed with chronic alveolar abscess with Ellis class IV associated with 11 and 21 secondary to trauma.

TREATMENT

After obtaining informed consent from the patient, Endodontic treatment was initiated for 11 and 21i.e, upper left and right central incisor under rubber dam for isolation. Access cavity was modified and the foreign material (toothpick) was retrieved. After that working length was measured using electronic apex locator (Root ZX, Morita) with K-file #60(Dentsply Maillefer, Ballaigues, Switzerland)measuring 20 mm and 21 mmin length respectively. The same was confirmed with periapical radiograph. The canal preparation was done as described in the first case. Once thorough cleaning of the canals was performed, calcium hydroxide was placed as an intra-canal medicament for one week. After that patient was recalled after 7 days and calcium hydroxide dressing was removed and calcium hydroxide-iodoform oil based(Metapex, META Biomed Co. Ltd, Korea)intra-canal medicament was placed, which was accidentally extruded into the periapical lesion.The patient was then recalled after three weeks. (Fig 2c)
A 4 mm apical plug was made, thermoplasticized obturation was done as mentioned in the first case, followed by post endodontic restoration using composite resin- Filtek Z350 XT (3M ESPE) (Fig 2d). After that crown preparation was done for 11 and 21 and polyvinyl siloxane impression was taken along with the shade selection (A2 shade was selected for both 11 and 21) and the impression was sent to laboratory for the zirconia crown fabrication.
Trial of crowns for the fit, shape and shade of the crown waschecked on both the teeth and necessary modifications were done. Finishing and polishing was done by the laboratory technician.
Before crown cementation, the tooth surface was cleaned as described in the first caseThe crown was cemented using Self-Adhesive Resin Cement (RELYX™ U200,3M™ ESPE). (Fig 2e)
After endodontic treatment, the patient was seen again at 6 &12 months. At 2-year recall, the patient was completely asymptomatic and intraoral periapical radiograph of the same tooth revealed complete resolution of the lesion, except the extruded intracanal medicament.

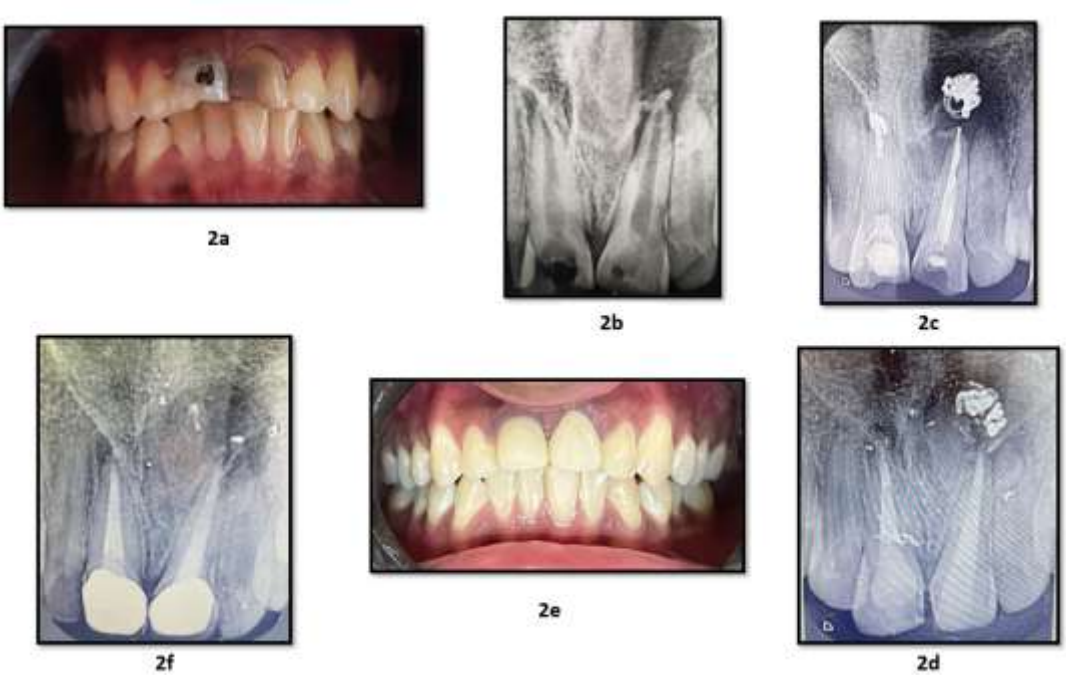

FIG 2- (2a) Clinical picture showing maxillary anterior discolored teeth, (2b) Radiographic representation of maxillary central incisors with periapical radiolucency (2c) Radiographic

representation of unintentional overextrudedmetapex. (2d) Radiograph representing apical plug, obturation and post endodontic restoration. (2e) post operative clinical picture of 11 and 21, (2f) Post – operative radiograph of 11 and 21 at 2 year follow-up.

DISCUSSION

Discoloration of tooth is surely a major concern in all ages of life as it affects the esthetics. Poor esthetics makes the patient insufficiently confident that influence his/her mental health and quality of life. In this case series patient came with a chief complaint of discoloration of the anterior tooth. On examination it was observed that the teeth were non-vital. When treating a non-vital tooth, the priority should be given to elimination of long standing bacteria. With the tooth having open apex, the cleaning and shaping becomes a challenge. In such situations, the clinician has to rely to a greater extent on the irrigating solutions for chemical disinfection and calcium hydroxide being the gold standard medicament for intracanal therapy.[8]

The open apices create a number of challenges for the clinicians to obtain a successful root canal treatment outcome. The large openings at the apex make it difficult to determine the working length as the file used for this purpose may extend apically beyond the apex. The wide canals pose difficulty in taking a decision on the root canal preparation. Achieving control during obturation also adds to the challenges faced. Additionally, the dentinal walls of teeth with open apex are thin and tend to fracture easily before, during and also after the endodontic treatment. Since the root development is hampered due to trauma or pulp necrosis, short formed roots compromise the crown-root ratio and affect the long term prognosis of the treatment. It further increases the risk of crown fracture thereby compromising esthetics.[3,9]

In the present case, NaOCl was used as an irrigating solution. With the acidic nature of this solution and an increased risk of the solution to extrude beyond the apex due to wide apical region, the solution was used in combination with normal saline to provide a diluted form. In the present practice, calcium hydroxide intracanal medicament is considered to be the first choice of clinicians. The calcium hydroxide releases calcium and hydroxyl ions which have low solubility in the tissue fluids, since its aqueous based it dissociates fast within 2-5days. The high pH of the material makes it acceptable by the tissues when it comes in direct contact. The calcium ions are responsible for inducing hard tissue formation and also acting as an antibacterial agent. The hydroxyl makes the medicament highly alkaline thereby making it difficult for the bacteria to survive.[10]

Though calcium hydroxide has been used widely but it demonstrates some disadvantages when used for apexification procedure to treat open apex. The patient has to be followed up with radiographic examination multiple times over months to observe the signs of calcific bridge formation. Since the tooth is placed with a temporary restoration, the risk of infection in the canal is high. Additionally, the studies have also reported that the apical barrier formed by calcium hydroxide is porous giving “Swiss cheese appearance” and may even contain soft tissues to some extent.[5]

Hence, in this case report the goal was to achieve complete disinfection of the root canal first followed by single step apexification procedure.

In the first case the patient was recalled after a period of 1 week. Amixture of three antibiotics ie ciprofloxacin, metronidazole and minocycline with 1:1:1 ratio in distilled water, was prepared with a powder to liquid ratio of 1:3. This triple antibiotic paste was then placed in the root canal for another 3 weeks. The results obtained in this case were similar to the results reported in studies by other authors. [11,12] Since the tooth was non-vital in the present case, a single antibiotic may not seem to disinfect the canals completely. In such cases, using a single antibiotic may suppress the microorganisms but will also provide an opportunity for the other organism to populate and canal space. In order to make the canal sterile, and also prevent the antimicrobial resistance, a combination of antibiotics was necessary. [13] The triple antibiotic paste creates an environment into the canals that induces regeneration of the tissues. Studies have been reported on its success with triple antibiotic paste showing significant increase in root canal length. There is also evidence on the increase in dentin thickness due to this paste.[14]

In the second case report after an initial intracanal dressing of calcium hydroxide for a period of 1 week, Metapex was injected directly into the canal. Metapex contains premixed paste of calcium-hydroxide- iodoform which shows the excellent antibacterial effect and radiopacity. However, there was an unintentional extrusion of Metapex into the periapical lesion which showed no detrimental effect even after a follow up of two years. This outcome was similar to the case report documented by Galhotra in 2015. [15]

The outcome of the treatment regarding formation of apical barrier solely depends on the diameter of the apical foramen, underlying infection of the host and a pre-existing periapical infection. A study reported that a larger diameter of the apical foramen and relatively small apical plug increases the microleakage of the apical barrier. [16] The uniqueness of this case was treatment of non-vital tooth with open apex using triple antibiotic paste, various vehicles for calcium hydroxide intracanal medicament and single step apexification, performing non-vital bleaching and labial veneer as post-endodontic esthetic restoration.

CONCLUSION

Clinical cases withopen apex as a consequence of dental trauma can be successfully managed using a multimodality approach like Single step apexification using Triple antibiotic paste, Metapex, preparation of apical plug using MTA and obturation with thermoplasticized gutta percha followed by esthetic rehabilitation. Proper diagnosis and treatment planning in the management of open apex cases along regular follow-up of the patient is crucial for favorable prognosis.

ACKNOWLEDGEMENTS

Nil

CONFLICTING INTEREST

Nil

SOURCE(S) OF SUPPORT

Nil

PATIENT DECLARATION OF CONSENT STATEMENT

Informed patient consent was taken and duly signed by the patient

REFERENCES

1. Young GR, Parashos P, Messer HH. The principles of techniques for cleaning root canals. Aust Dent J. 2007; 52:52–63.
2. Gupta R, Tomer AK, Cecilia LL. Challenges and Treatment Strategies of Open Apex. IOSR-JDMS. 2021; 20:20-24.
3. Trope M. Treatment of the immature tooth with a non-vital pulp and apical periodontitis. Dent Clin North Am. 2010; 54:313–24.
4. Topkara A, Karaman AI, Kau CH. Apical root resorption caused by orthodontic forces: A brief review and a long-term observation. Eur J Dent. 2012; 6:445-53.
5. Andreasen JO, Farik B, Munksgaard EC. Long-term calcium hydroxide as a root canal dressing may increase risk of root fracture. Dent Traumatol. 2002; 18:134–7.
6. Goldstein S, Sedaghat-Zandi A, Greenberg M, Friedman S. Apexification &apexogenesis. N Y State Dent J. 1999; 65:23-5.
7. Felippe MC, Felippe WT, Marques MM, Antoniazzi JH. The effect of renewal of calcium hydroxide paste on the apexification and periapical healing of teeth with incomplete root formation. Int Endod J. 2005; 38:436-42.
8. Hülsmann M, Rödig T, Nordmeyer S. Complications during root canal irrigation. Endod Topics. 2007; 16:27–63.
9. Jain JK, Ajagannanavar SL, Jayasheel A, Bali PK, Jain CJ. Management of a fractured nonvital tooth with open apex using mineral trioxide aggregate as an apical plug. Int J Oral Health Sci. 2017; 7:44.
10. Farhad A, Mohammadi Z. Calcium hydroxide: a review. Int Dent J. 2005; 55:293–301.
11. Sharma R, kumar Hans M, Paul R, Garg AK. Nonsurgical management of large periapical lesions having open apex using one step apexification with mineral trioxide aggregate as an apical barrier: a case report. University J Dent Scie 2018; 4:130-134.
12. Vijayran M, Chaudhary S, Manuja N, Kulkarni AU. Mineral trioxide aggregate (MTA) apexification: a novel approach for traumatised young immature permanent teeth. BMJ Case Reports. 2013:10; 2013:bcr2012008094.
13. Mohammadi Z, Jafarzadeh H, Shalavi S, Yaripour S, Sharifi F, Kinoshita JI. A Review on Triple Antibiotic Paste as a Suitable Material Used in Regenerative Endodontics. Iran Endod J. 2018 Winter; 13:1-6.
14. Bose R, Nummikoski P, Hargreaves K. A retrospective evaluation of radiographic outcomes in immature teeth with necrotic root canal systems treated with regenerative endodontic procedures. J Endod. 2009; 35:1343–9.
15. Effect of Unintentional Periapical Extrusion of Metapex in Immature Teeth- A Case Report. Galhotra et al. JCDR 2015 Jan,9(1): ZD01-ZD02.
16. Valois CR, Costa ED Jr. Influence of the thickness of mineral trioxide aggregate on sealing ability of root-end fillings in vitro. Oral Surg Oral Med Oral Pathol Oral RadiolEndod 2004; 97:108−11.