Management of clinical complications following pulp canal obliteration: a report of two cases

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ABSTRACT

Introduction: Pulp canal obliteration (PCO), is defined as a deposition of hard tissue within the root canal space. This may occur idiopathically or following direct pulp capping or trauma. In such situations, the clinician may be faced to a difficult or impossible to negotiate root canal and there is clearly a potential for a higher frequency of treatment failures than normally is the case. In this complex scenario, the clinician must be prepared to employ different approaches in order to save the tooth, and when an esthetic region is compromised, the efforts should be even more judicious. This report aimed to present and discuss the methods employed in clinical resolutions of two previously complicated pulp canal obliterated cases in maxillary central incisors.

Keywords: Traumatology. Periapical periodontitis. Dental pulp calcification.

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

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Introduction

Pulp canal obliteration (PCO), which is also known as calcific metamorphosis (CM), is characterized by the loss of root canal space due to the dystrophic deposition of hard tissue along the root canal walls and the pulp space proper. As a result, the pulp tissue may become partially or completely calcified. Direct pulp capping or trauma are closely related to PCO[1,2] and this calcification process is believed to be related to damage to the neurovascular supply of the pulp.[3,4]

Pulp necrosis has been reported with ranges varying from 1% to 16%[5] and tooth discoloration is a normal complaint in cases of PCO.[6] Periapical lesions developments are described in 7.3% to 24% of these cases within 4 years after initial traumatic injury.[5,7]

In such situations, a clinician may be faced with a difficult or impossible to negotiate root canal. Traumatized tooth should be monitored for the potential development of signs and symptoms of PCO. It must be emphasized that in totally obliterated teeth there is clearly a potential for a higher frequency of treatment failure than is normally the case. However, the pros and cons of early prophylactic root canal treatment in cases of PCO is still a matter of debate.

Using an operating microscope in combination with ultrasonic tips has been advocated for the localization of calcified root canals. Modified instruments and angulated radiographs have also been reported as tools that can be used in the management of teeth that present signs of PCO.[8] However, the localization of patent canal and its complete debridement and sealing in full extension is not always possible. In certain circumstances, the clinician is challenged with technical complications, such as instrument fracture and root perforation. Periradicular healing in root-perforated teeth is reported to fail in 50% of cases.[9] In this complex scenario, the clinician must be prepared to employ varying approaches to save a tooth, and when an esthetic region is compromised, the efforts should be even more judicious.

This report aimed to present and discuss the methods that were employed in achieving clinical resolution of two complicated obliterated pulp canal cases in maxillary central incisors.

Case 1

A 20-year-old man presenting a totally obliterated right maxillary central incisor with apical radiolucency was referred to a private dental office for endodontic evaluation (Fig 1A,B). The patient's primary complaint was periapical discomfort and tooth discoloration. After receiving careful details of possible treatments, the patient consented to endodontic therapy. Access to pulp canal tissue was created with low-speed burs. After radiographic confirmation of root canal position (Fig. 1C-E), a scout instrument was used to enhance the patent canal. After each 2 mm advance of the instrument, a new orthoradial radiograph was taken to confirm that the instrument was correctly placed inside of the root canal (Fig 1F). However, the radiograph that was taken after root canal filling showed apical deviation and root canal perforation (Fig 1G). After four years of follow-up, the radiolucent periapical image persisted, and swelling was noticeable (Fig 1H).

The tooth was then submitted to periapical surgery. A Newman's surgical access flap was created, and curettage of the periapical lesion was conducted (Fig 2A). A 3-mm apical resection was then performed without a bevel in an attempt to remove apical ramifications, lateral canals and necrotic, infected tissue. The presence of perforation in the root surface was confirmed with the use of a micro mirror and view magnification on the operating microscope (Fig 2B). A cavity was prepared using an ultrasonic tip under copious irrigation with sterile saline to unify the perforation and the original canal path (Fig 2C). A 2% chlorexidine gel was inserted into the canal for 2 minutes and then washed with saline (Fig 2D). The cavity was then filled with white mineral trioxide aggregate (MTA) (WMTA; Angelus, Londrina, Brazil) (Fig 2E,F). The flap was repositioned and sutured. The extracted periapical lesion was histopathologically evaluated and diagnosed as a regular cystic inflammatory lesion. After one month, improvement was observed in the patient's clinical signs and symptoms, and radiographic evaluation showed a complete periapical healing one year later (Fig 3B).

After confirmation of the success of the surgical treatment and an absence of root resorption, the tooth was submitted to internal bleaching. Coronal access was created, and a 2 mm cervical plug with Coltosol (Vigodent Coltene Rio de Janeiro, RJ, Brazil) was placed. A sodium perborate P.A and saline paste was inserted into the pulp chamber and then sealed with Coltosol. The paste was renewed every 15 days for a period of 45 days (Fig 3C). Following this, the tooth was finally restored with composite resin. Routine reviews showed absence of symptomatology, radiographic alterations and crown discoloration.

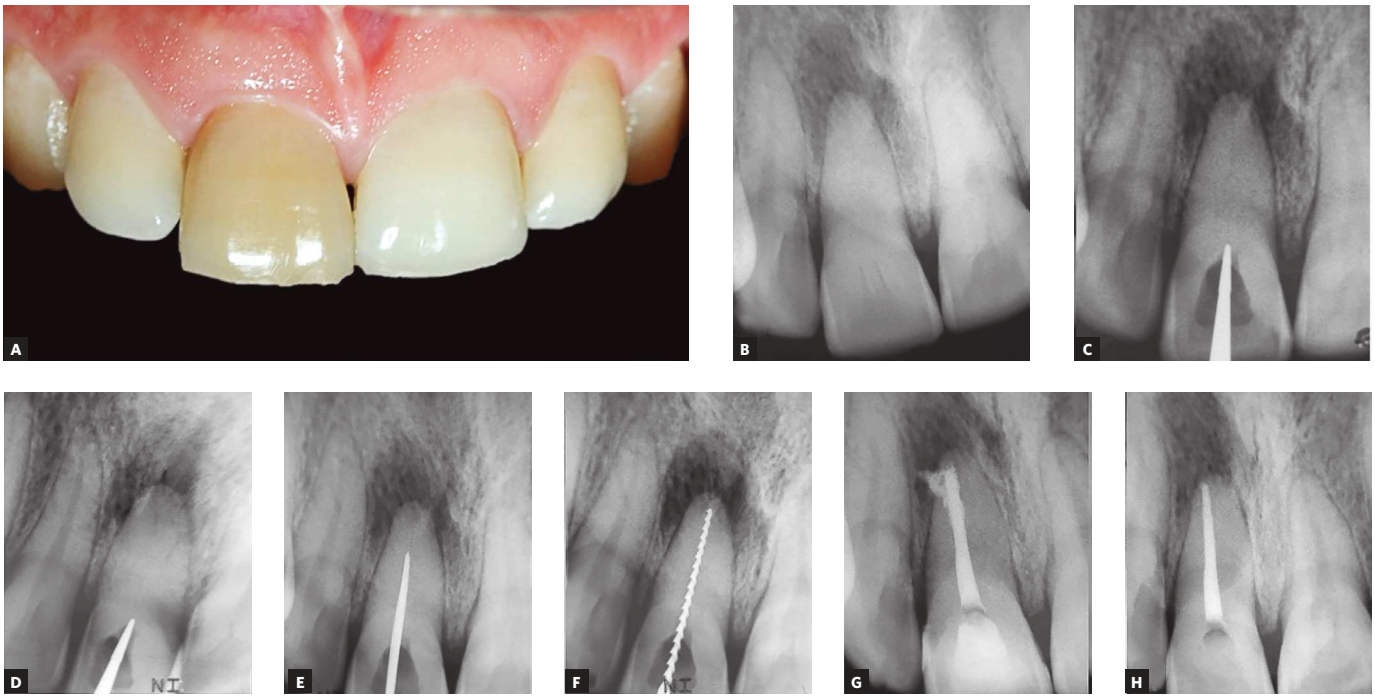

Figure 1. **A**) Initial clinical aspect demonstrates discolored right central incisor. **B**) Complete pulp canal obliteration with periapical radiolucency. **C-E**) Scout instruments in position. **F**) Instrument inserted to confirm working length. **G**) Angulated radiograph shows an apical deviation. **H**) Four-year follow up radiograph reveals periapical radiolucency maintenance.

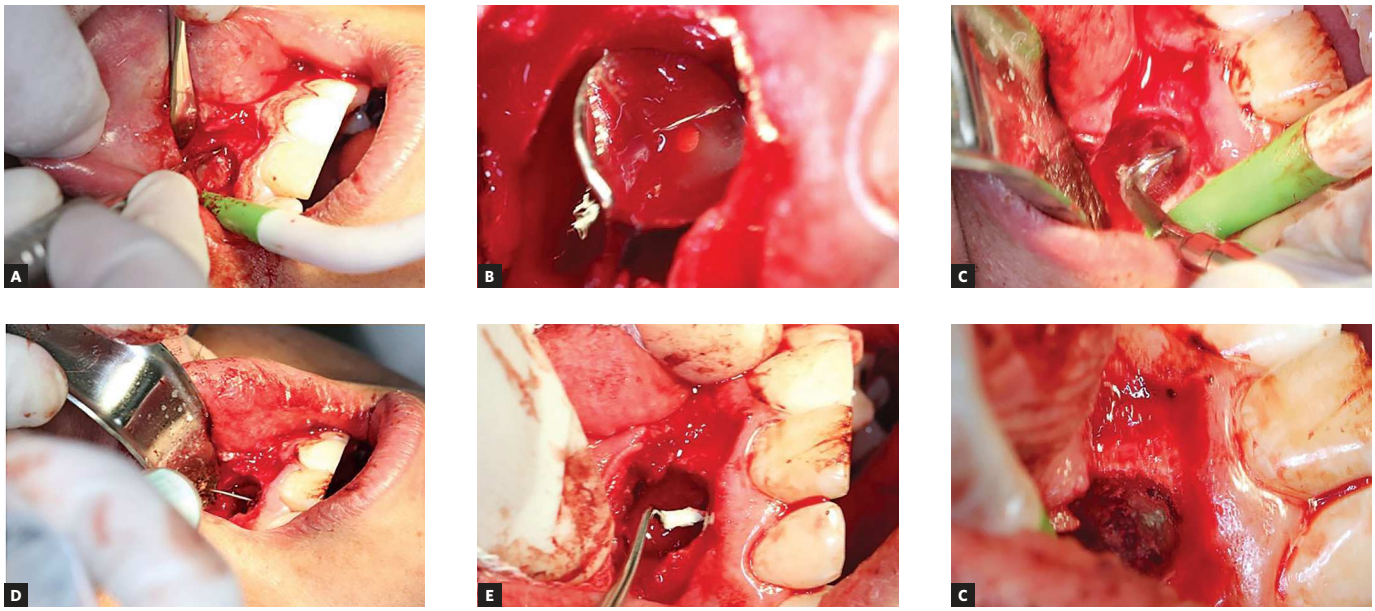

Figure 2. **A**) Periapical lesion curettage. **B**) After 3-mm apical resection the use of a micro mirror reveals confirmation of deviation. **C**) Ultrasonic retroprepare. **D**) 2% Chlorhexidine gel. **E**) Insertion of white MTA. **F**) Retrofilling material in position.

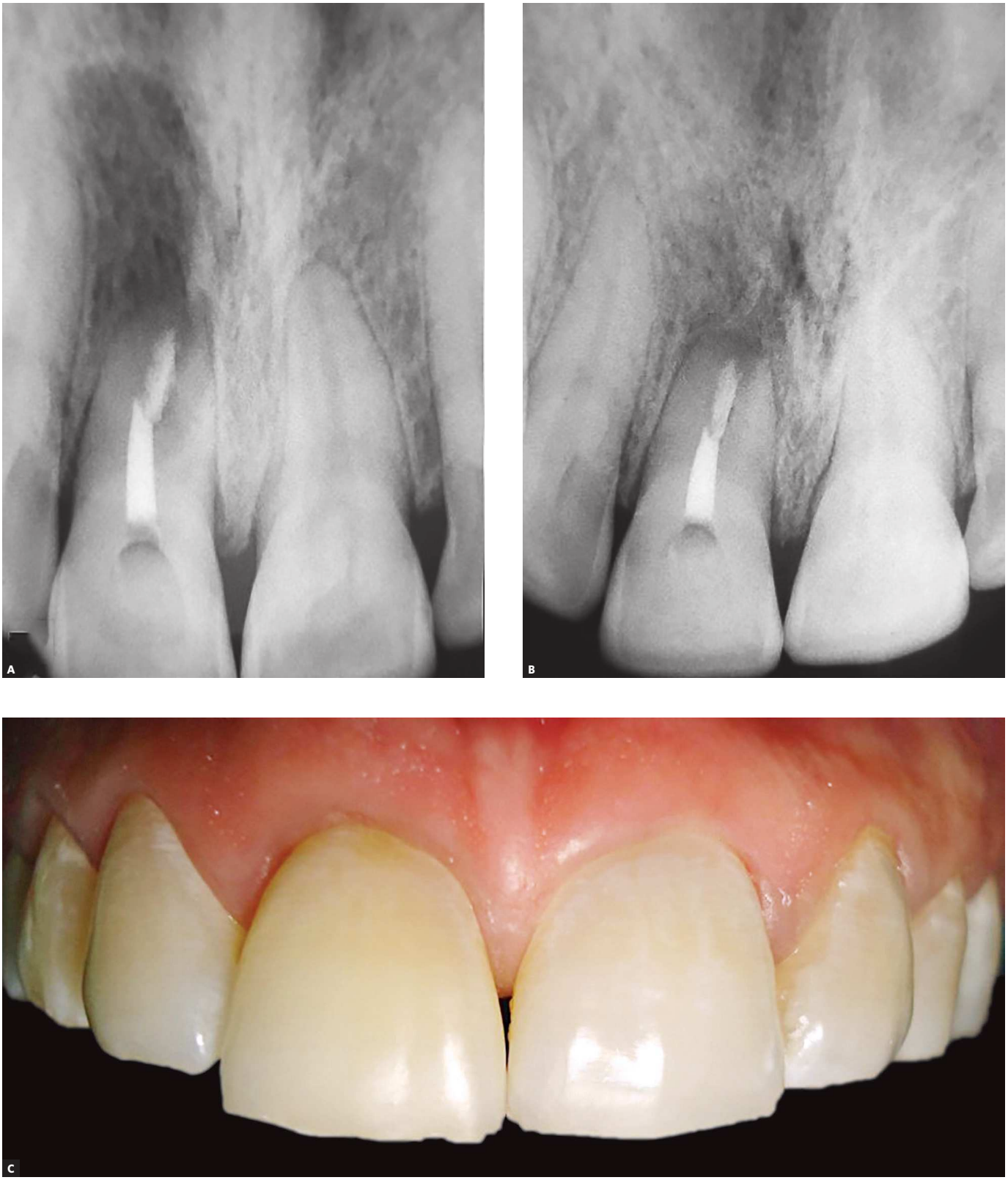

Figure 3. **A**) Immediate post operative radiograph. **B**) One-year follow up. **C**) Clinical aspect after internal dental bleaching.

Case 2

A 16-year-old male patient was referred to a private dental office. Another professional had unsuccessfully attempted to access the pulp canal space of the patient's maxillary left central incisor. The patient was experiencing local, intermittent discomfort. Clinically, the tooth was sensitive to palpation and percussion tests. A fistula was observed, and a radiographic exam suggested that the perforation existed in the cervical portion (Fig 4A).

When intermediate restoration was removed, a local iatrogenic perforation was confirmed (Fig 4B). It was probably caused by a misjudgement in the labial-palatal position of the root canal.

After tooth isolation, the access cavity was improved with a diamond ultrasonic tip under visual magnification (Fig 4C). The selective grinding of dentin was directed to the palatine. Centered and angulated periapical radiographs were taken with a K file that was in position to confirm the direction of grinding. After localization of the root canal, the tooth was instrumented with ProTaper NiTi files (Dentsply, Ballalgues, Switzerland) through the F3 instrument under copious irrigation with 5% sodium hypochlorite. The tooth was dressed with calcium hydroxide for 15 days.

At the second appointment, the fistula was absent and no tenderness to percussion or palpation were observed. The root canal filling was performed with a vertical warm condensation technique (Fig 4F), and the perforation was sealed with white MTA (Fig 5B). As the perforation was large in extension, the surface of the MTA was covered with a thin layer of Coltosol (Fig 5C). A wet cotton pellet was inserted into and left in the pulp chamber for 48 hours over the Coltosol to ensure that it completely cured. In the last appointment, a glass fiber post was cemented, and the tooth was finally restored with composite resin (Fig 5D). The tooth was asymptomatic and the mucosa was normal in the one month follow up visit (Fig 6).

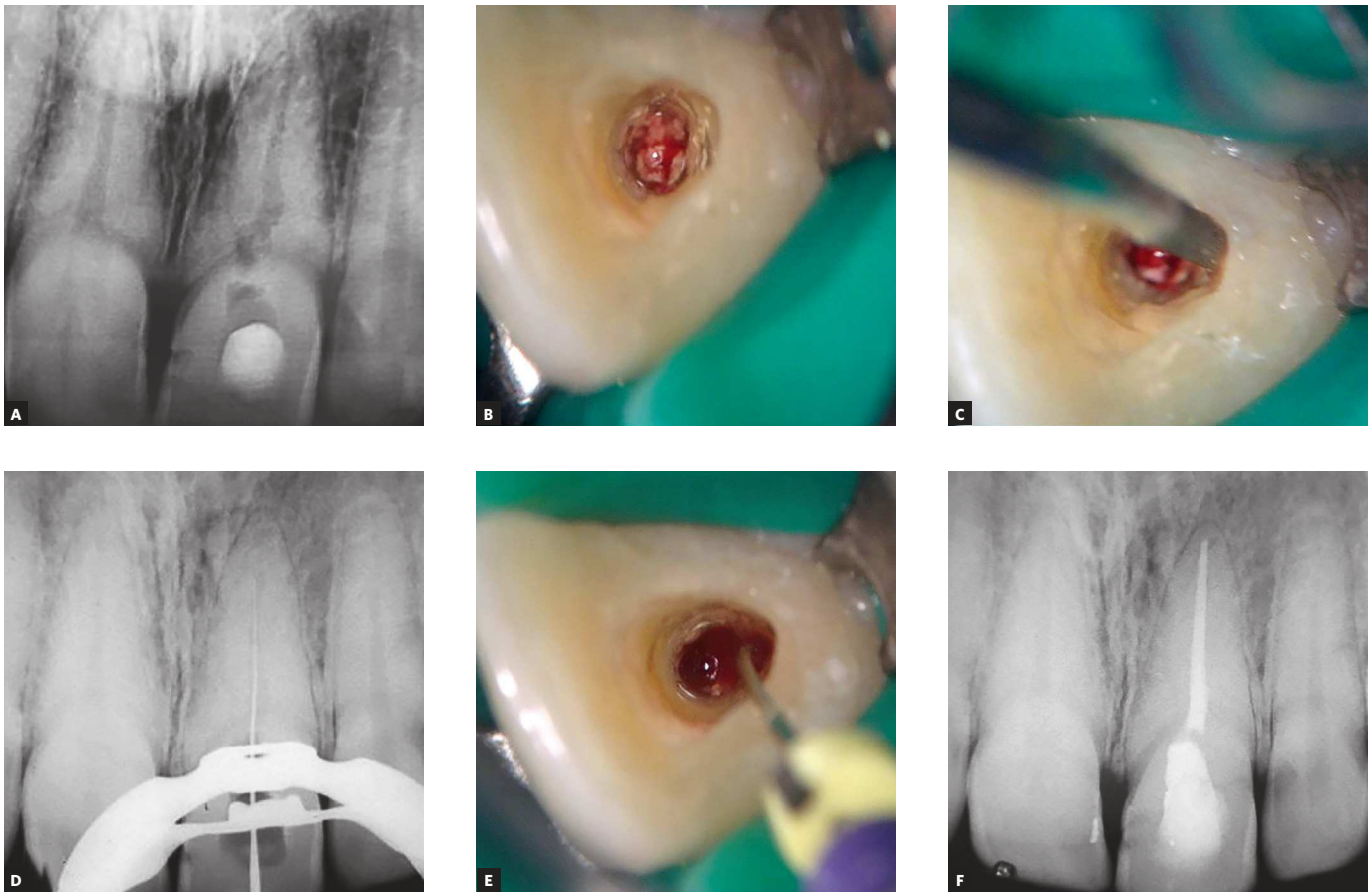

Figure 4. **A**) Initial radiograph demonstrating deviation in access cavity. **B**) Confirmation of iatrogenic perforation. **C**) Diamond ultrasonic tip inserted following the root long axis used to locate the patent canal. **D**) Confirmation of canal localization. **E**) K file in the patent canal. **F**) Root canal filling.

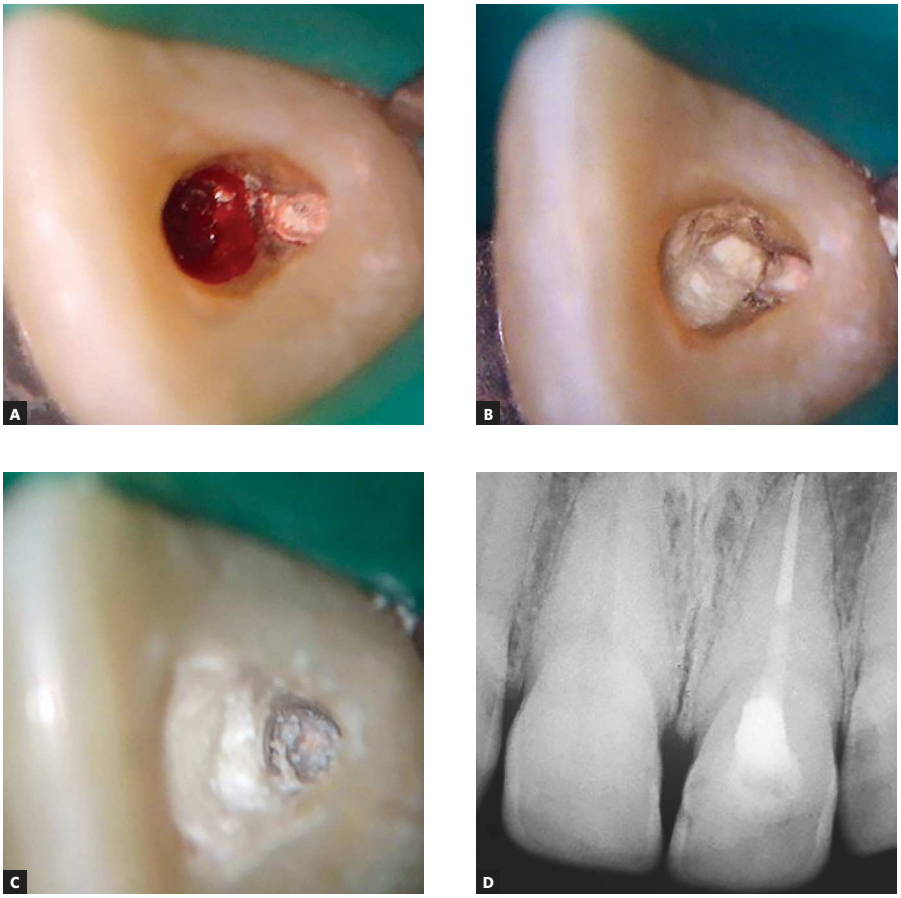

Figure 5. **A**) Clinical aspect of cervical perforation. **B**) Perforation sealed with white MTA. **C**) Thin layer of Coltosol covering the MTA. **D**) Radiograph exam after fiberglass post and final restoration.

Figure 6. **A**) Initial clinical aspect demonstrate a cervical fistula below the gingival attachment (arrow). **B**) One month follow up reveals normal mucosa.

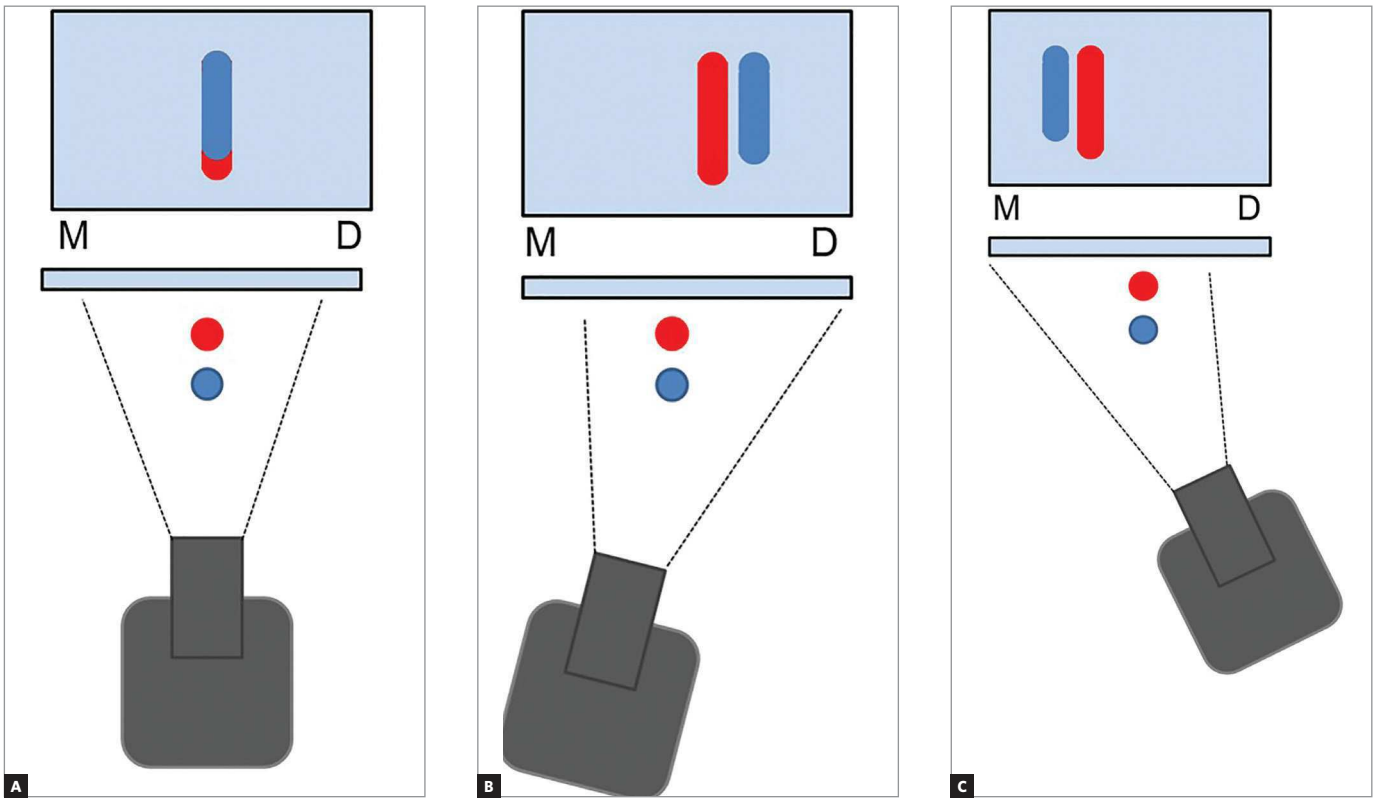

Figure 7. The buccal object rule: **A**) orthoradial radiograph. **B-C**) The position of the radiographic images of two separate objects changes when the projection angle at which the images are made is changed. The object (blue) furthest from the film (the buccal) moves a greater distance on an X-ray projection taken with the cone angled in the horizontal plane than does the object closer (red) to the film (the lingual).

Figure 8. **A**) Orthoradial radiograph shows the file superimposed to the root canal, suggesting that the same was correctly positioned. **B**) Disto-angulated radiograph evidences that the file was actually labially dislocated. **C**) Patent canal reached after the direction of file insertion was corrected.

Discussion

Teeth with pulpal obliteration fall into the high difficulty category of the American Association of Endodontists Case Assessment criteria.[10] The localization of patent canal in obliterated pulps is always a clinical challenge. Various techniques have been described in the management of such cases,[8,11,12] and numerous clinical reports have highlighted the difficulties that are encountered in such treatments.[2,13,14]

In case 1 that was presented above, the patent canal was not encountered. A false canal path was prepared, which resulted in root perforation in the apical third. Although based on radiographs the file appeared to be correctly positioned, the two-dimensional aspect of the radiographic exam was underestimated. Orthoradial radiographs alone show the mesio-distal position of a given instrument. However, as described by Tavares et al.[8], the use of angulated radiographs is paramount to the localization of obliterated canals. The buccal object rule, which is also referred as Stanley's rule, describes how the relative position of radiographic images of two separate objects changes when the projection angle at which the images are made is changed. The object (e.g., root or canal) furthest from the film (the buccal) moves a greater distance on an X-ray projection taken with the cone angled in the horizontal plane than does the object closer to the film (lingual)[15,16] (Fig. 7).

Combining orthoradial and angulated radiographs provides an impression of three-dimensional anatomical space. If both centered and angulated radiograph images show the file in the same position relative to the root canal or centered in the long axis of the root then the scouter instrument can be safely apically advanced. Conversely, if a deviation is noted, the file position must be corrected. For example, if a disto-angulated radiograph indicates that the file is distally dislocated in relation to the root canal, it means that the file is palatally dislocated in relation to the root canal. In deviated cases, the instrument can be visualized as superimposed on the root canal in the orthoradial radiograph; however, when angulated images are taken, the deviation can then be noticed (Fig 8).

After a follow-up period of 4 years, the periapical lesion persisted. In this case, a modern endodontic microsurgery protocol[17,18] was indicated. The use of microsurgery in surgical endodontic cases leads to minimized trauma and improved results.[19] With this approach, a greater understanding of apical anatomy has been gained, and a success rate of over 90% has been reported.[20] The present cases support the protocol of modern endodontic microsurgery, and complete apical healing was observed after one year.

After confirmation of healing and an absence of symptomatology, dental bleaching could be performed as esthetically required. Several bleaching systems have been introduced, and current techniques are based on the direct use or slow release of hydrogen peroxide.[21] Regardless of the technique used, the bleaching action is obtained via a reaction between active oxygen and the organic matrix of tooth. Although effective esthetically, these bleaching techniques are questionable when considering their toxicity to periodontal tissues.[22] The choice of sodium perborate in this case was based on its bleaching effectiveness and biocompatibility when compared to other agents. The risk of external resorption after internal bleaching was even higher in this case due to a previous loss of cementum and dentin that was caused by the surgical procedure. Although the color obtained after bleaching was not identical to that of the homologue, the cost-benefit of a prolonged bleaching treatment was evaluated, and the risk of inducing root resorption motivated the shortened bleaching protocol.

The primary cause of root canal perforation in case 2 was misjudgement of the position of the root canal. Obtaining access to pulp space in maxillary or mandibular incisors with calcified chambers is always a difficult step. The clinician must be aware of this and must always consider that a high risk of perforation in the labial face of the root exists in such cases. An inexperienced clinician tends to insert instruments and burs according to the angulation of the crown when the pulp chamber is not promptly reached. However, it must be considered that the roots of incisors are palatally or lingually angulated in relation to their crowns, and iatrogenic perforation in these cases frequently occurs in the labial root surface somewhere below the gingival attachment.[5] In the present case, the ultrasonic tip that was used to reach the patent canal was arranged parallel to the long axis of the tooth and was inserted palatally to the perforation.

The magnified view that was achieved in combination with the use of a diamond ultrasonic tip enabled the selective grinding of dentin. It is notable that the use of an operating microscope in procedures that are

performed on incisors requires a mirrored indirect view. In such circumstances, the head of the contra-angle can disrupt the view of the operator when low speed burs are used for access. Conversely, as shown in Figure 4C, the use of an ultrasonic tip allowed a clear view of the operating field when the indirect view was practiced, which guaranteed that it could be used safely.

Depending on the extent of an iatrogenic perforation, a surgical repair is necessary. In the above presented case 2, however, a via-canal insertion of white MTA and its covering with Coltosol were able to hermetically seal the perforation, and this facilitated healing of the periodontium.

External resorption of inflammatory origin has been associated with endogenous bleaching, as discussed above. In the present case, as the perforation was localized cervically, the imminent risk of an induction of external root resorption by internal bleaching agents contraindicated this procedure. In this case, a full or partial coverage restoration may be considered to re-establish esthetics.

In summary, the reported cases reinforced the importance of centered and angulated radiographs for the evaluation of selective dentin grinding and instrument depth. Additionally, knowledge of tooth morphology and the use of an operating microscope combined with diamond ultrasonic tips are important components of endodontic treatment in obliterated canals. The extent of esthetic resolution of obliterated, discolored teeth depends on the degree to which the dental structure is comprised and the risk of external resorption.

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