CASE REPORT

Guided Endodontics in the Management of Intracanal Separated Instruments: A Case Report

Antonietta Bordone[1], Manuela Ciaschetti[2], Cyril Perez[3], Cauris Couvrechel[4]

Abstract

Aim: The aim of this case report is to describe the removal of a fractured file in mandibular right first premolar through the application of an endodontic template to guide a trephine until the file.

Background: The fracture of an endodontic instrument is a rare complication that requires therapeutic management. Removal procedures often cause excessive dentine loss. To limit this inconvenience, several techniques describing the removal of fractured files in the coronal third of the canal have been proposed. The guide facilitates the use of the Zumax removal kit (Zumax Medical Co. Ltd., Suzhou, China).

Case description: A 30-year-old patient was referred to dental office for the endodontic retreatment of his mandibular right first premolar. The tooth was painful to percussion and buccal palpation. The periapical radiograph showed a periapical lesion, a defective root canal treatment, and the presence of a fractured file. It was decided to use the Zumax kit in order to remove the instrument. By using digital implantology software, a guide was constructed with a tube to guide a trephine and achieve straight-line access. The trephine was later driven by the resin guide. After completing the drilling, the instrument was removed with the Zumax extractor and the canal was then prepared, disinfected, and filled.

Conclusion: The current case describes the removal of a separated instrument by use of a new approach that is planned on computer software and guided by a resin guide.

Clinical significance: The guided endodontic technique avoids excessive loss of dental structure and simplifies the procedure by reducing chair time and increasing the operator's confidence.

Keywords: Broken instrument, Cone-beam computed tomography, Digital planning, Endodontics, Guidance, Template.

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Background

The fracture of an endodontic instrument is a rare event (<2%), but nonetheless, it may cause operational stress and, potentially, litigation.[1,2] Dental School of Athens Fractured instruments are reported to have little influence on endodontic success, but it must be noted that the success rate decreases if there are preoperative endodontic lesions.[3,4]

Such occurrences might be managed by retrograde endodontic treatment or by orthograde endodontic treatment.[5] Several approaches to removing an endodontic fragment have been developed with the use of various instruments such as ultrasonic devices, microtubes, or a trephine and forceps used alone or in combination with the aid of a dental microscope to facilitate visibility.[6,7] One constant is the need to create straight-line access to the head of the broken file.

Implantology planification software has recently been proposed to manage endodontic situations like pulp canal obliteration or fiber-post removal.[8] This case report describes the use of the guided endodontic technique to create straight-line access with a surgical template and the use of a trephine bur to easily remove the separated endodontic file.

Case Description

A 30-year-old female patient presented to private practice in Paris, France, on April 2019 for endodontic retreatment of her mandibular right first premolar. The clinical examination revealed that the tooth was tender to percussion and buccal palpation. The periapical radiograph showed a periapical lesion, an incomplete treatment associated with a broken file (Fig. 1). The tooth was diagnosed as symptomatic apical periodontitis. Upon the patient's informed consent, it was decided to retreat the tooth and remove the instrument with a guided technique using the Zumax removal kit (Zumax Medical Co. Ltd., Suzhou, China).

A cone-beam computed tomography (CBCT) and an optical scan of the tooth surface were obtained and exported, respectively, as DICOM and STL files. They were imported into the implant planning software Blue Sky Plan (Blue Sky Bio, LLC; Grayslake, IL, USA) and merged. Based on the CBCT information, a custom virtual 1-mm implant corresponding to the trephine diameter was placed to create straight-line access to ensure 2 mm of the head of the file (Fig. 2A). Then, a virtual guide based on two teeth on either side was generated with a guided tube of the same dimensions. Additional windows were created on the guide (Fig. 2B). Next, the STL was exported and sent to a Formlabs 2 3D printer (Formlabs Inc.; Somerville, MA, USA).

[1]Private Practice, 232 Avenue du Prado, Marseille, France

[2]Private Practice, Edinburgh, Scotland

[3]Private Practice, 14 Rue des Capucines, Paris, France

[4]Private Practice, 42 Rue Bonaparte, Paris, France

Corresponding Author: Cyril Perez, Private Practice, 14 Rue des Capucines, Paris, France, Phone: +33 627717742, e-mail: dr.perez.cyril@gmail.com

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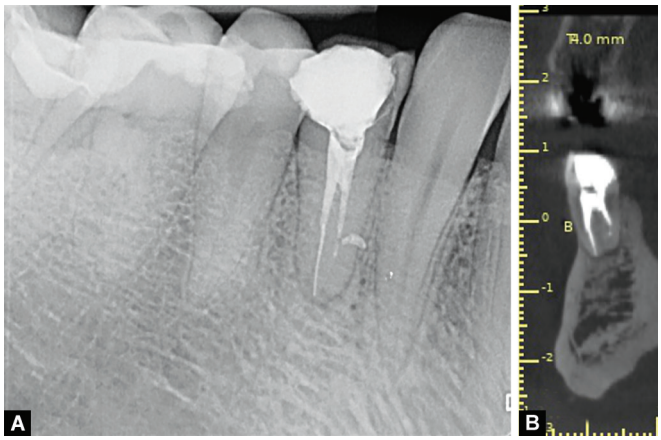
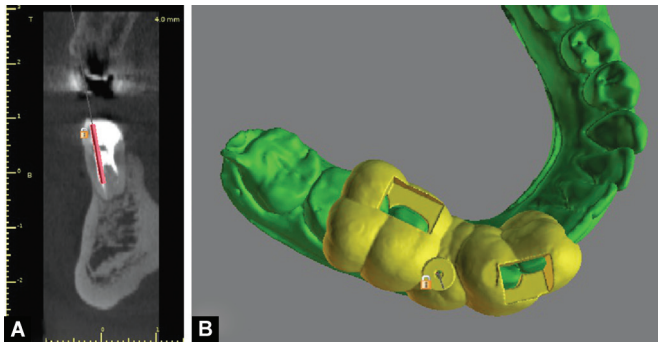
After local anesthesia and rubber dam placement, we confirm the good stability and used the windows to check for a good fit of the guide. The 1-mm-diameter trephine was mounted on a blue ring handpiece inserted into the guide, and run at 500 rpm anticlockwise. The resin guide directed the progress of the trephine according to the digital planning. The trephine moved forward, following a 4-step approach, until the exposure of 2 mm of the head of the separated instrument was achieved. At each step, the guide was removed, the root canal was irrigated with sodium hypochlorite to thoroughly clear it of debris, and the trephine was cleansed (Figs 3A to C). An intraoperative radiograph was made to check the good pathway (Fig. 3D).

The extractor was chosen on the basis of the diameter corresponding to the trephine used (1 mm) (Figs 4A and B). The instrument was then removed by using the specific extractor (Figs 4C and D). We shaped the root with Protaper Gold (Dentsply, Ballaigues, Switzerland) and cleaned it with a solution of 17% EDTA (Vistadental, Radice, Wisconsin, USA) followed by a solution of 3% sodium hypochlorite (Vistadental, Radice, Wisconsin, USA). Afterward, the canals were filled using the vertical condensation technique (Fig. 5A). The patient was referred to her general practitioner for prosthetic rehabilitation. The tooth was finally restored with a post-core and a crown within 1 month of the treatment.

The 1-year follow-up reported clinical healing, the patient reported disappearance of the pain. The radiograph revealed periapical healing (Fig. 5B).



Figs 1A and B: Radiographs wrt 44 (A) Preoperative intraoral periapical radiograph; (B) Transverse CBCT view: note the separated file in the vestibular canal



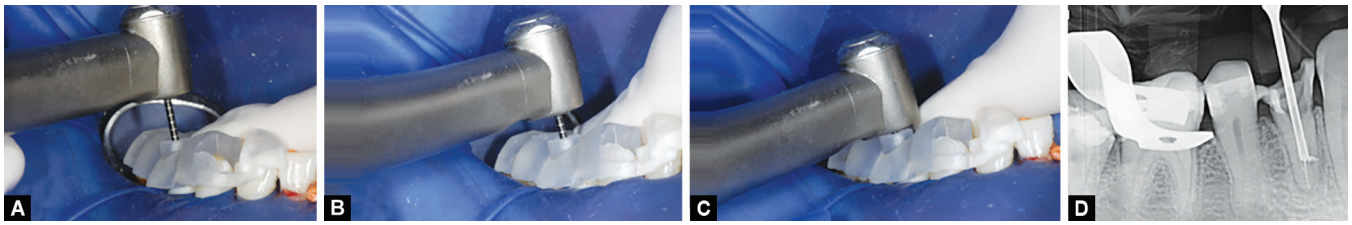
Figs 2A and B: (A) Access planification; (B) Surgical template generated on the STL

Discussion

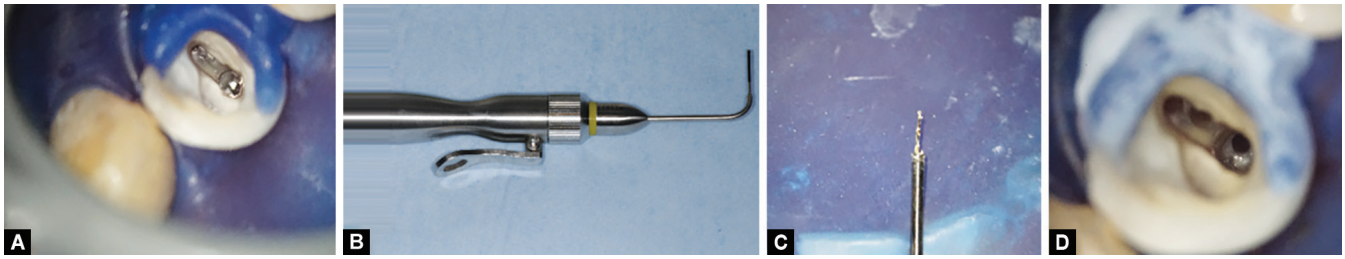
The problem of fractured instruments present is that they obstruct apical access and thus prevent the clinician from shaping and correctly disinfecting the canal.[9]

If the orthograde approach is chosen, it is either possible to bypass the instrument or remove it, depending on the position of the separated instrument in the canal. These techniques could lead to perforation, stripping, or enlargement of the root. Studies have shown that fractured instrument removal in the middle or apical third leads to a reduction of the mechanical resistance of the tooth, this is directly related to the loss of substance caused by conventional operative maneuvers.[4,5]

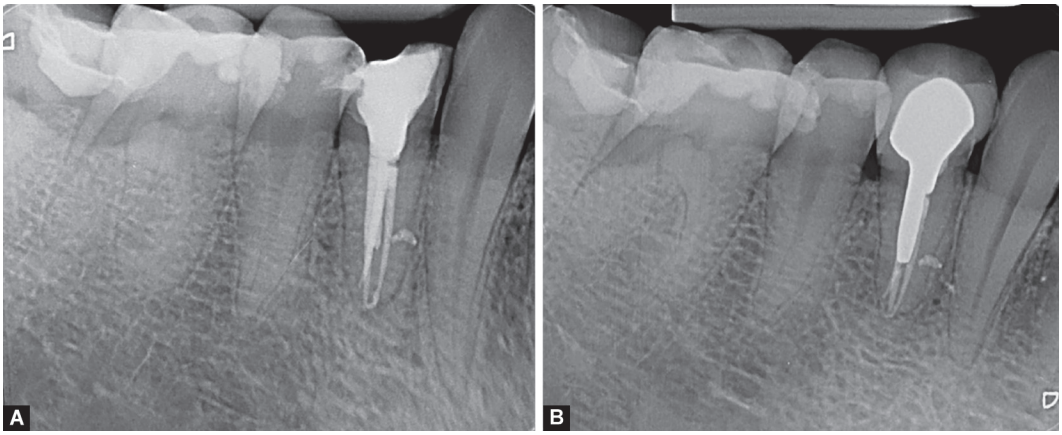
The use of ultrasonic tips is considered a conservative method, thanks to better visibility, but the vibrations generate heat and



Figs 3A to D: (A to C) Intraoperative guidance of the trephine; (D) Intraoperative radiograph showing the trephine (wrt 44)



Figs 4A to D: (A) Disengagement of the head of the file by the trephine; (B) Extractive tube; (C) Instrument removed; and (D) Clinical view after root canal preparation



Figs 5A and B: Intraoral periapical radiograph wrt 44 (A) Postoperative radiograph and (B) 1-year follow-up radiograph

microcracks and can damage periodontal tissues.[10,11] Compared with ultrasonics, the use of a trephine and extractor requires less time but also provides less visibility.[12]

The Zumax removal kit was used in this case. This kit's system has two phases. The first aims to obtain straight-line access up to the fractured instrument. It was carried out with a trephine available in three sizes: 0.8 mm, 1 mm, and 1.2 mm. In this case, the 1 mm trephine was chosen. In retrospect, the use of a 0.8 mm trephine would have been safer. One disadvantage of trephine use is the lack of visibility, which is conducive to a deviation of the unguided instrument.

This drawback explained our choice to plan the trephine guidance. The surgical template was planified with the use of the CBCT, optical scan, and planning software. This technique is already proposed to treat difficult endodontic cases such as searching pulp canal obliteration as proposed by Krastl et al., access dens invaginatus by Zubizarreta Macho et al., or fiber-post removal by Perez et al. with success.[13–16] Moreover, this solution reported good agreement between planning and drill path for pulp canal obliteration with deviation less than 0.7 mm as described by Buchgreitz et al., Zehnder et al., and Connert et al.[14,17,18]

The second step of the Zumax removal system is the removal of the instrument with an extractor, which is inserted into the pathway previously made with the trephine. The technique is stress-free, safe, reproducible, and fast. The microscope and the experience of the operator favor the success of the technique in removing fractured instruments. The use of the guided technique lessens the number of intraoperative mistakes and enables straight-line access and dentin preservation. The limitation of this technique is that it does not allow removal of a broken instrument placed after a root curvature.

The technique enhanced patient comfort by limiting chair time, it also improved the tooth prognosis by reducing the risks of mistakes conducted to enhance the durability of the tooth in the mouth and delayed implant solutions.

Conclusion

This report describes the removal of a separated instrument by use of a new approach that is planned on a computer and guided by a resin guide. The guided endodontic technique avoids excessive loss of dental structure and simplifies the procedure by reducing chair time and increasing the operator's confidence.

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