

Ultrasonic Technique to Retrieve a Rotary Nickel-Titanium File Broken Beyond the Apex and a Stainless Steel File from the Root Canal of a Mandibular Molar: A Case Report

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Abstract

During endodontic treatment, clinicians may face endodontic procedural mishaps such as broken instruments, which is a complex situation especially when the file breaks beyond the apex. This condition is associated with potential risk of contamination, which compromises the healing process. Management of a broken instrument beyond the apex is difficult and time consuming and requires creativity as well as clinical knowledge and skills. Several devices and techniques have been developed to retrieve the fractured instruments, but none are consistently successful. This case report describes a technique using modern ultrasonic tips for retrieval of broken instruments separated beyond the apex.

Keywords: Retreatment; Retrieval; Ultrasonics

Journal of Dentistry, Tehran University of Medical Sciences, Tehran, Iran (2015; Vol. 12, No. 7)

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Received: 23 January 2015

Accepted: 28 May 2015

INTRODUCTION

During root canal treatment, clinicians face various unwanted procedural mishaps that can occur at any stage of treatment. Of all, instrument fracture within the root canal system and more rarely fractured piece protruding beyond the apex are among the most troublesome and frustrating errors. Fractured instrument extending beyond the apex causes a great concern for both the patient and dentist [1].

Rotary nickel titanium (NiTi) files are extensively used for cleaning and shaping of the root canals because of their higher flexibility compared to stainless steel (SS) files. Despite the superior qualities of NiTi rotary files, there is always a potential risk of breakage of NiTi instruments without visible warning [2]. NiTi rotary files fracture because of excessive cyclic fatigue, torsional failure or a combination of both while most of SS instruments fracture due to excessive torque [3].

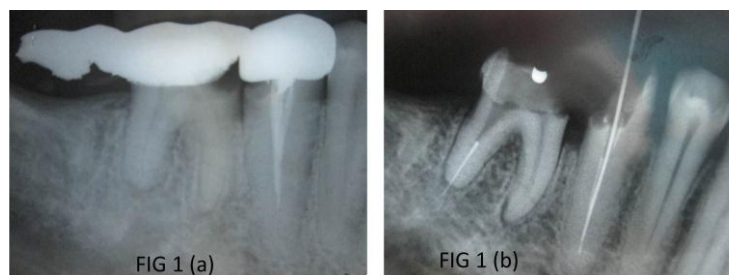


Fig. 1. (a) Pre-operative radiograph **(b)** Retreatment and the fractured file

Various factors that predispose the files to fracture are instrument design, dynamics of instrument use, the manufacturing process, canal configuration, cleaning and sterilization process and frequency of usage of instrument [4]. Fractured fragments do not necessarily lead to the failure of endodontic treatment.

A previous study [5] documented no adverse effect of the broken fragment retained in the root canal system on healing of endodontically treated teeth while another study [6] reported lower rate of healing when broken instrument remained in the canal. Presence of preoperative periapical radiolucency, inadequate size and apical extent of fractured instrument are some of the prognostic factors affecting the outcome of root canal treatment in such cases. Proper cleaning and shaping of the root canals are hindered or prevented by presence of fractured fragments inside the root canal [4].

Retrieval of fractured instruments is usually very difficult and impossible at times, with a reported success rate of 55 to 79% [1]. Several devices and techniques have been introduced for retrieval of separated instruments such as Ruddle IRS™ (Dentsply, Tulsa, OK, USA), Masseran™ Endodontic Kit (Micro-Mega, Lynnewood, Washington, USA) and the Cancellier Instrument Removal System™ (SybronEndo, Orange, CA, USA). Newly developed ultrasonic tips used with piezoelectric ultrasonic units are used for conservative removal of dentin surrounding the separated instrument; moreover, their vibrations facilitate the removal of fractured instrument [7].

The Endo Success™ Retreatment kit (Satelec Acteon, Mérignac, France) was recently developed for use in Satelec Acteon piezoelectric ultrasonic device (Satelec Acteon, Mérignac France) to assist in retrieval of fractured instruments, amongst many other uses. Endo Success™ Retreatment kit consists of six titanium-niobium mini-tips, designed for retreatment available in different lengths and tapers. Herein, we describe a clinical scenario of instrument retrieval broken beyond the apex of a mandibular molar tooth using Endo Success™ ultrasonic tips.

CASE REPORT

A 38 year-old female patient was referred by her local dentist to the Endodontics Department of Manubhai Patel Dental Hospital, for retrieval of a fragment of a NiTi ProTaper file (F1, Dentsply Maillefer, Ballaigues, Switzerland) broken during root canal enlargement and embedded in the distal canal of the mandibular right first molar extending beyond the apex (tooth #46). During clinical examination, there was an access cavity filled with a temporary filling material and the tooth was sensitive to percussion. One of the two intra-oral periapical (IOPA) radiographs brought by the patient revealed incomplete root canal treatment of the right mandibular second premolar and first molar (Fig. 1a). The other IOPA radiograph (Fig. 1b), showed attempted endodontic retreatment in both premolar and molar and also the separated instrument in the distal canal of the mandibular right first molar extending beyond the apex.

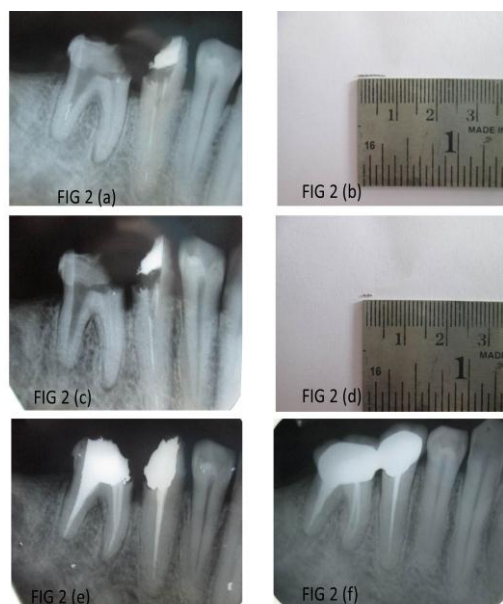


Fig. 2. (a) Retrieved rotary NiTi file (b) The 7mm rotary NiTi file fragment retrieved (c) Retrieved H file (d) The 2mm H file fragment retrieved (e) Obturation (f) One year follow-up

After rinsing the patient's mouth with 0.2% chlorhexidine solution, local anaesthesia was administered and isolation was done with rubber dam. Access cavity was modified using a safe-end fissure bur (Dentsply, Maillefer, Ballaigues, Switzerland) to obtain a straight line access to the canals. Then, using a modified Gates Glidden drill (size 3, Dentsply Maillefer, Ballaigues, Switzerland), a staging platform was created. This was done to expose the file and the surrounding dentin to allow thinner ultrasonic tips to trough deeper around the file. After staging, ET25 tip of Endo Success™ Retreatment kit was attached to the ultrasonic device and was activated first at the inner dentinal wall of the distal canal to create a tiny pocket approximately 1.0 mm deep from the severed surface of the file fragment. Once this narrow space was obtained, a shallow groove was cut along the outer dentinal wall such that there was no obstruction to keep the fragment from being pulled coronally.

Then, two H files were inserted in an attempt to grab the fractured fragment and pull it out with an anti-clockwise motion. But, unfortunately it led to fracture of one H file inside the canal.

EDTA solution was introduced inside the canal to enhance the cavitation and acoustic streaming effect of ultrasonics.

Ultrasonic vibration was applied to the separated file in the space created between the fragment and the inner wall of the canal, and moved in "push and pull" motions until the separated instrument jumped out of the canal. A radiograph was taken to confirm retrieval of the file fragment (Fig. 2a).

The retrieved file fragment was 7 mm long (Fig. 2b). But still, the fractured H file was inside the canal, which was retrieved using the ultrasonic vibration. Again, a radiograph was taken and retrieval of both fractured instruments was ensured (Fig. 2c). The retrieved H file fragment measured 2 mm in length (Fig. 2d).

After instrument retrieval, working length was determined using an apex locator (Propex, Dentsply, Maillefer, Ballaigues, Switzerland) and radiographs. The root canals were cleaned and shaped in a crown-down manner using rotary NiTi files (ProTaper, Dentsply Maillefer, Ballaigues, Switzerland). Next, 2.5% sodium hypochlorite and 2% chlorhexidine were used for irrigating the root canals and calcium

hydroxide (Calcicur, VOCO, Cuxhaven, Germany) as an intracanal medicament was placed. In the second visit, obturation was carried out by lateral compaction technique using gutta percha points (ProTaper, Dentsply, Maillefer, Ballaigues, Switzerland) and AH-Plus sealer (Dentsply, Maillefer, Ballaigues, Switzerland). The access cavity was restored with amalgam (Fig. 2e) and the patient was referred to her general dental practitioner for the permanent coronal restoration of this tooth and endodontic retreatment of the second premolar. The tooth had normal function one year after the endodontic treatment (Fig. 2f).

DISCUSSION

Fracture of an endodontic instrument during root canal treatment hinders further cleaning and shaping of the root canal system. Such inability to further clean and shape the root canal system can compromise the outcome of the treatment. In such cases, it is said that the prognosis depends on the condition of the root canal (vital or non-vital), canal anatomy, type of pulpal pathology, periapical status, degree of cleaning and shaping at the time of separation, the level of file separation in the canal and type of fractured instrument. The prognosis of these teeth is generally lower than that of a tooth with normal endodontic treatment [8].

Orthograde and surgical approaches are the two methods recommended for managing cases with broken instruments. Bypassing the instrument, removing the instrument or preparation of the canal and obturation to the level of the fractured instrument are phases of an orthograde approach. In our case as the patient was referred by some other dentist, we did not know the actual extent of canal disinfection when the instrument broke, and thus, bypassing or retrieving the separated instrument deemed necessary. As the separated instrument extended beyond the apex, bypassing the instrument or obturation to the level of the fractured instrument would not serve the purpose. Considering the non-surgical

endodontics being the more conservative approach, the retrieval of instrument was attempted [8].

Diameter, length and position of the fragment within the root canal influence the nonsurgical removal of a broken instrument [9]. Also, the thickness of root dentin, the depth of external concavities and the root canal anatomy influence the removal of the broken fragment. Instruments that lie in the straight portions of the canal can be typically removed [10]. In this case report, instrument was fractured in the distal canal, which was a straight canal with the least curvature.

Material type of the fractured instrument is also an important factor to be considered during its removal. The SS files do not fracture upon removal with ultrasonics, while NiTi instruments may undergo further fracture due to heat build-up when ultrasonic devices are used for their removal. The SS fragments will show early movement as they absorb the ultrasonic energy bodily, while in case of NiTi fragments, only the point of contact with the tip absorbs the energy.

Tu et al. [11] reported a case in whom, a separated Ni-Ti instrument was retrieved using several ultrasonic tips under a dental operating microscope from the distolingual root canal of a mandibular first molar. The instrument was separated at the middle third of the canal whereas in our case the file broke in the apical third extending beyond the apex, which made its retrieval more difficult. Recently, a case was reported by Shenoy et al, [12] where a separated hand instrument extended beyond the apex was retrieved from the mesiobuccal canal of a second molar. They extracted the tooth atraumatically, retrieved the instrument and reimplanted the tooth again in the socket. In our case, instrument was retrieved without surgical reimplantation, minimizing trauma to the patient. Several methods and instrument retrieval systems have been proposed for retrieval of broken instruments from the root canals. However, none of them can guarantee

100% success or can be considered the gold standard for instrument retrieval. Due to various advantages of ultrasonics in instrument retrieval such as minimal dentin damage and compatible tip designs, which can reach the apical third of the canal, ultrasonic retrieval was attempted in our case. However, one must consider that with the advent of rotary NiTi files, the occurrence of broken instruments has increased, especially in the hands of inexperienced clinicians. Proper training of new techniques and adherence to the established principles and guidelines of clinical usage can reduce the incidence of NiTi instrument fracture.

CONCLUSION

The ultrasonic technique was successful in removing the rotary NiTi file fractured beyond the apex and the stainless steel H file from a mandibular molar tooth.

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