Case Report

Removing a Fractured Instrument from the Root Canal Using Ultrasonic Tips

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ABSTRACT

Background: Fractured instruments, especially endodontic files, are a common problem in daily practice. A broken file causes a canal blockage that impedes the cleaning and shaping process. Therefore, an attempt to remove the broken file should be considered in most cases. Nowadays, with advances in technology, such as ultrasonic tips, fractured instruments can be easily retrievable. **Case Report:** This case report presented a 15-year-old female patient with a complaint of a large cavity in the left mandibular region who presented to the department of conservative dentistry and endodontics. The clinical diagnosis was pulp necrosis, and a root canal treatment was performed. During the shaping procedure, a file was broken in the mesiolingual canal. **Conclusion:** The broken file was removed using ultrasonic tips with a dental operating microscope. After the instrument was retrieved, the obturation was performed successfully.

Keywords: *Broken file, obturation, ultrasonic*

Background

In daily endodontic practice, at any treatment step, many kinds of unwanted procedural difficulties and accidents can occur. One example of a common procedural problem is the fracture of an instrument inside the root canal. This could include endodontic files, Gates-Glidden burs, spreaders, and paste fillers. The materials can be nickel–titanium (NiTi) or stainless steel. Fractures usually happen because an endodontic instrument is incorrectly used or overused, and the highest incidence is in the apical area of the third root canal.[1] Root canals are commonly prepared using NiTi rotary instruments. The advantages of NiTi rotary instruments are their ability to produce a well-centered canal with smooth walls and their ability to cause a minimal risk of transportation, thus keeping procedural errors to a minimum. However, one disadvantage is the risk of file breakage. Many methods with varying results have been proposed to remove obstructions from the root canal.[2] Ruddle reported a technique using modified Gates-Glidden burs and ultrasonic with an operating microscope as a visualization aid that has been quantified both *in vitro* and *in vivo* as a good technique for removing broken instruments. For this technique, the dentin is removed in varying degrees in order to gain access to the obstruction and remove it.[3] The potential and safety of "microsonic" techniques to remove the broken instruments are improved when a dental operating microscope is combined with ultrasonic instrumentation.[4]

Case Report

A 15-year-old female patient presented to the Department of Conservative Dentistry and Endodontics at Trisakti University in Jakarta, Indonesia, with a tooth cavity in the left posterior mandible. The intraoral clinical examination showed a profound Class I caries of the mandibular left first molar (tooth #36) [Figure 1a]. The tooth responded negative to percussion, while the pulp responded negatively to the thermal cold test (ethyl chloride). The radiographic examination showed a profound caries extending to the pulp cavity with no radiolucency in the periapical region [Figure 1b]. Based

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on the examination results, a diagnosis of necrotic pulp was made. The treatment plan was to perform a root canal treatment. The patient has received and signed all of the proper consent forms.

Isolation of the tooth was performed with a rubber dam. The access to the orifice was accomplished with an endo-access bur. K-file #10 and K-file #15 were used to perform the initial exploration of the canal. The working length of the canal was established and confirmed using K-file #15. A ProTaper Universal rotary instrument (Dentsply Endodontics, Tulsa, OK, USA) was used to prepare the canals. However, an instrument fracture occurred during the shaping of the mesiolingual canal with an NiTi rotary S1 file (#17/.02; Dentsply Endodontics). A radiographic examination showed that the instrument's location was extended from the apical third to the middle third of the mesiolingual root canal [Figure 2]. The patient was informed about the incident, and the treatment plan included the removal of the fragment.

The cavity was re-accessed, and straight-line access to the canals was made with a Endo-Z Bur (Dentsply Maillefer, Ballaigues, Switzerland) [Figure 3a]. Gates-Glidden drills (#3; Dentsply Maillefer) were used to create an enlargement coronal to the instrument fragment, so that the broken instrument could be visualized using the operating microscope [Figure 3b and c]. To bypass the obstructed mesiolingual canal, a #10 C + file (Dentsply Maillefer) bent at the apical 2 mm was used.

Straight-line access was accomplished with a safety-end fissure bur, and then, the preparation of the canal was conducted. Canal irrigation was performed alternatively with a 2.5% sodium hypochlorite solution and RC-Prep solution (Premier EC Representative; Medical Device Safety Service GmbH, Hannover, Germany). In the microscopic field (16X, OPMI dental operating microscope; Carl Zeiss Meditec AG, Jena, Germany), the file fragment was visualized within the middle third of the mesiolingual canal. The NiTi fragment was removed with a Newtron P5 ultrasonic device (Satelec, Acteon Group, Mérignac, Aquitaine, France) equipped with ET25, ET25 S, and ET25 L EndoSuccess ultrasonic tips (Satelec, Acteon Group) [Figure 3d]. The ultrasonic tips were rotated in a counterclockwise direction using lower power. Copious irrigation proceeded until the instrument segment was withdrawn.

The fragment was removed, and the condition of the tooth was evaluated radiographically [Figure 4a and b]. The working length was determined with an apex locator (VDW Gold; VDW, Munich, Germany), and it was confirmed using periapical radiography.

The four root canals were prepared with ProTaper Universal rotary files (Dentsply Maillefer) up to

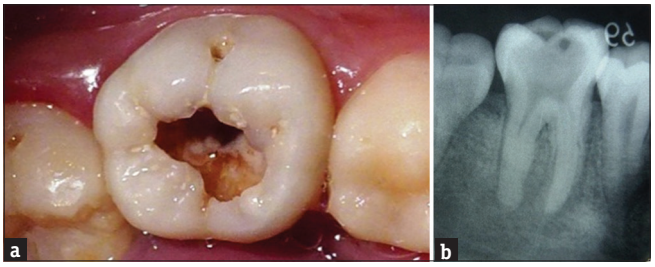

Figure 1: (a) Occlusal view of the mandibular left first molar. (b) Radiograph shows profound caries extending to the pulp space with no periapical radiolucency

Figure 2: The separated nickel–titanium instrument segment is shown in the middle third of the mesiolingual root canal

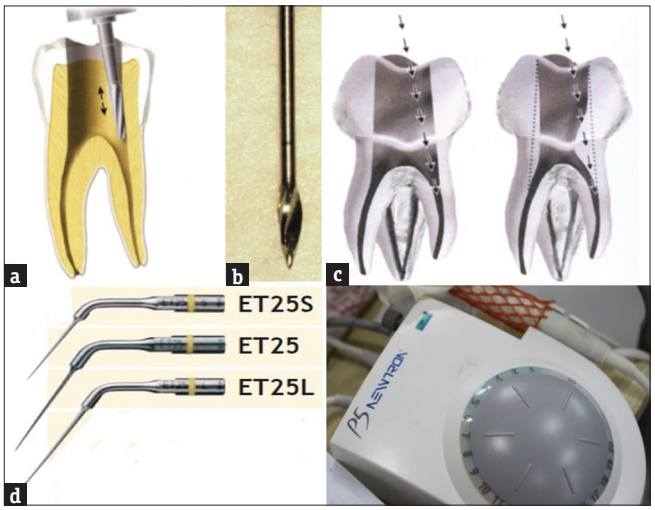

Figure 3: (a) A safety-end fissure bur was used to access the crown (arrows) of the mandibular molar. (b and c) a Gates-Glidden drill was used to achieve straight-line access in the coronal third of the molar (arrows). (d) The EndoSuccess kit of ultrasonic tips features novel titanium–niobium instruments consisting of ET25 S, ET25, and ET 25 L tips and a piezoelectric ultrasonic generator (Suprasson Newtron P5)

size F2 (0.25 mm in diameter, 0.08 taper). Calcium hydroxide paste (UltraCal XS; Ultradent, South Jordan, UT, USA) was used to sterilize all of the canals. At the following appointment, the irrigation sequence

consisting of 2.5% sodium hypochlorite solution, distilled water, 17% ethylenediaminetetraacetic acid solution (SmearClear; Kerr Endodontics, Orange, CA, USA), and 2% chlorhexidine (Cavity Cleanser; Bisco Dental, Schaumburg, IL, USA) was performed before the obturation. The canals were dried using paper points. The obturation materials included ProTaper gutta-percha (Dentsply Maillefer) [Figure 5a] with calcium hydroxide sealer (Sealapex; SybronEndo, Orange, CA, USA). These were used to obturate the four canals using a lateral gutta-percha compaction method [Figure 5b]. The intracanal barrier and base were formed using glass-ionomer cement (GC Fuji I; GC Corporation, Tokyo, Japan) [Figure 5c] and were confirmed by periapical radiographic imaging [Figure 5d]. The cavity access was then filled using direct composite resin material (Premise; Kerr Dental, Brea, CA, USA) [Figure 5e].

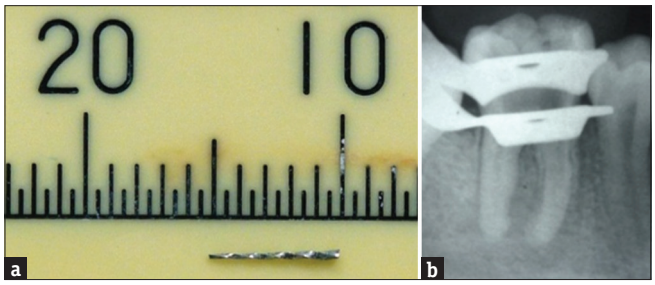

Figure 4: (a) Length of the broken instrument (approximately 5.5 mm). (b) Mesiolingual canal free of the fragment

Discussion

One of the many procedural accidents and difficulties that can occur in daily endodontic treatments is a fractured instrument. This can include files, spreaders, spiral paste fillers, or Gates-Glidden burs made of NiTi, stainless steel, or carbon steel. The development of NiTi rotary files did not decrease the incidence of broken instruments because a fracture is mostly the result of an instrument being used incorrectly or overused. There was a perception that fracture of NiTi rotary instrument could happen suddenly, but fractures are caused many other factors. The most important factor is the clinician's decision to overuse the instrument. The clinician may overuse the instrument for a specified number of times or until the instrument has undergone deformation, such as unwinding, a torsional fracture, or a flexural fracture.[5]

Certain factors, such as the depth of the canal, the type of fractured instrument, the pulp status, and canal infections, determine the successful removal of a fractured instrument. The most significant factor is the position of the instrument in relation to the canal curvature.[6,7] The removal of broken NiTi fragments is more difficult than the removal of stainless steel fragments.[6,8] The removal of a fractured fragment from the root canal requires skilled hands, good instruments, and a clear knowledge of the root canal anatomy.[1,6,9,10]

Nevertheless, the endodontic prognosis is not reduced if a decision is made to leave the fragment within the root canal if a periapical pathology is absent. However, the prognosis is worse if there is a periapical pathology

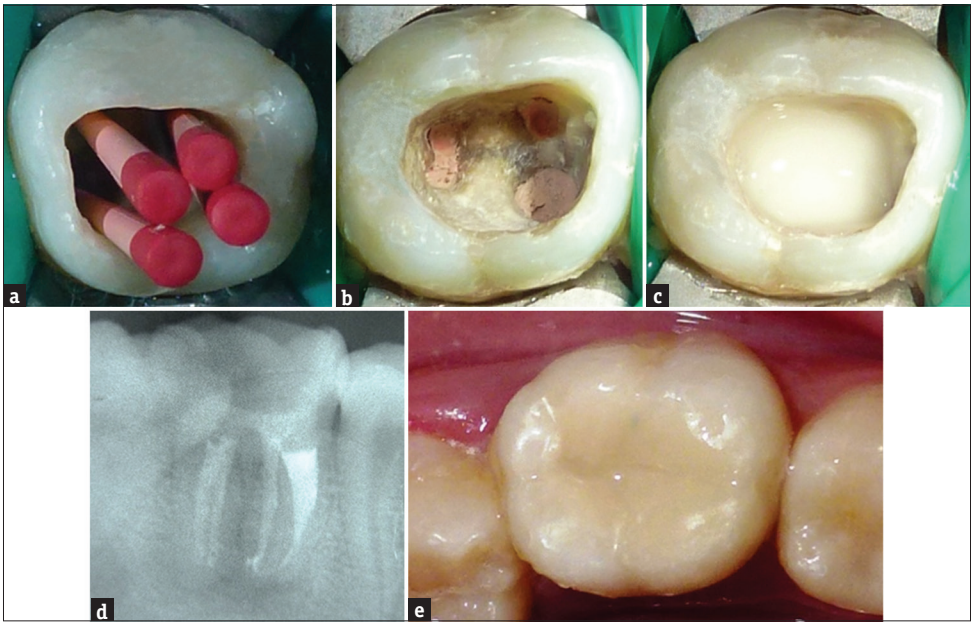

Figure 5: (a) Four ProTaper gutta-percha cones are fitted into the canals. (b) The gutta-percha was cut from 1 mm under the orifice. (c) The intracanal barrier and base were sealed with glass-ionomer cement. (d) Periapical radiographic film shows the intracanal barrier and base. (e) The cavity was restored with direct resin composite occlusal coverage

and effective canal disinfection is compromised.[5,11] Therefore, one can conclude that, rather than the fractured instrument, the more clinically significant prognostic indicator is the presence of preoperative radiolucency in the periapical region.[5]

Instrument fracture happens most often in the apical third.[5] There is a reason why instrument separations are so common in the middle or apical third of the mesial canals of the mandibular molars and the mesiobuccal roots of the maxillary molars. In the two-dimensional view from a periapical radiograph, root canals are usually curved distally. However, a radiograph cannot show the lingual curve of a mesiobuccal canal or the buccal curve of a mesiolingual canal. If the curve is severe, more dentin can be removed than what is considered to be the limit of a "safe" wall.[10]

Nevertheless, the removal of an instrument fragment may be dangerous due to excessive dentin removal from the root canal, ledge formation, over-enlargement, periapical displacement of the fractured instrument, and root canal transportation. A file removal apical to the curve should not be attempted routinely because of the limited success, and there is a greater risk of root perforation and reduced root strength.[1,2,5]

If a file withdrawal is considered, the chances of success should be weighed against potential complications. The success of a file removal is greater in the coronal and middle thirds of curved canals, but it is much lower in the apical third. This is because the removal procedure, if the file is located in the middle or apical third of the root, reduces significant root dentin, and therefore, reduces root strength. Files in the coronal and middle thirds of the root, however, can be removed consistently without major complications.[2]

Recently, developed techniques and the aid of a dental operating microscope for visualization have made the removal of fractured instruments more predictable. Most often, a dental microscope is used to observe the location of an MB2 under high magnification.[1,5,9] Research conducted by Gencoglu and Helvacioglu concluded that to increase the success of fractured instrument management, visualization using an operating microscope is important, because a gap between the fractured instrument and the canal wall can be observed. Nevertheless, because K-file #15 could not be used, ultrasonic tips were used.[12]

Numerous methods have been used to remove fractured stainless steel or NiTi rotary files. In more recent times, specialized devices and techniques have been developed, such as the Masserann kit, Endo Extractor (Brasseler USA Inc., Savannah, GA, USA), wire loop technique (Roig-Greene, 1983), the Canal Finder System (Fa. Societé Endo Technique, Marseille, France), long shank burs and ophthalmic needle holders, and ultrasonic devices, but they have all shown limitations.[1,9]

Establishing coronal access comes first in the withdrawal of broken instruments. Straight-line access to all of the canal orifices is made using high-speed, friction grip, surgical length burs. The axial wall that is near the canal holding the broken instrument should be flared carefully using microsonic techniques. The second step is establishing radicular access.[6] Before starting with the radicular access, a few concepts must be understood. The lengths of the majority of teeth range from 19 to 25 mm, with few exceptions. Of this, most clinical crown lengths are approximately 10 mm, and most root lengths range from 9 to 15 mm. If the root is divided into coronal, middle, and apical thirds, each third is between 3 and 5 mm in length.

The maximum size of canal flaring that can be made without creating an iatrogenic problem is often questioned. File fracture mostly occurs 3-5 mm from the root canal apex, regarding to the greatest curvature of the root canal position. Therefore, the head of the fractured instrument is usually located at the junction of the middle and apical thirds, even if it breaks at the full working length. Straight-line access must be created through the coronal two-thirds of a canal to access the head.[6]

The preferred armamentarium for broken file removal, out of all of the instruments developed and tried, consists of Gates-Glidden drills. Gates-Glidden drills (Dentsply Maillefer), sizes 1–6, have maximum diameters of 0.5, 0.7, 0.9, 1.1, 1.3, and 1.5 mm, respectively. These drills are used to access the apical region in a uniform tapering funnel to the separated instrument. In the range of ultrasonic devices, the piezoelectric ultrasonic unit of choice is the Satelec Newtron P5 (Dentsply Tulsa Dental, Tulsa, OK, USA). This device is excellent for performing endodontic treatments and retreatment procedures because it enables precise working accuracy, and it has a broad power range that can be adjusted. It also has a unique "feedback" system that measures the resistance of the tip, regulates the movement of the tip, and therefore, lowers the tip breakage potential.[4] Nevertheless, the sealing ability properties of the obturation material are not determined by the broken instrument but rather by the coronal seal and by the absence of irritant apical to the separated instrument.[13]

Conclusion

Fractured endodontic file instruments remain a problem in any root canal treatment, especially those made of

stainless steel materials. When an accident does occur, the successful removal of canal-embedded instruments can be achieved with ultrasonic devices under a dental operating microscope. A dental operating microscope and ultrasonic tips are to be used adjunctively to increase the chance of removal and to ensure that the tooth structure remains sound. It is best to prevent instrument separation in order to avoid stress and anxiety. If a separation does occur, there are numerous methods to retrieve it safely, or a bypass should be done. This case report showed a withdrawal or bypass in the coronal and middle thirds of a tooth which has been shown to be more successful compared to those in the apical third of the canal.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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