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## Retrieval of Separated NiTi Instrument in Severe Curved Canal using an Ultrasonic Device: A Case Report

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## **CASE REPORT**

# **Retrieval of Separated NiTi Instrument in Severe Curved Canal using an Ultrasonic Device: A Case Report**

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## **ABSTRACT**

**Objective:** We describe how to assess the degree of canal curvature and manage a separated instrument using an ultrasonic device. **Case Report:** A 24-year-old female was referred by a general dentist for an accidentally separated Protaper F2 instrument. The mesiobuccal canal was enlarged and the separated instrument could be visualized via the dental operating microscope. Preoperative radiography revealed a separated endodontic instrument at the middle to apical third of the mesiobuccal canal. Mesiobuccal canal curvature measured 66°. After rubber dam isolation, a specific ultrasonic tip and the dental operating microscope were used to gain access around the separated instrument until it loosened. The separated instrument was agitated and accidentally sucked into the high-speed suction device. The canal was evaluated with higher magnification via the dental operating microscope and postoperative radiographs were taken to confirm removal. **Conclusion:** Retrieval of a separated instrument in the curved canal is effective using a specific ultrasonic device plus a dental operating microscope

**Key words:** endodontic, separated instrument, canal curvature, ultrasonic device, dental operating microscope

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## **INTRODUCTION**

Endodontic treatment is rapidly developing and challenging endodontists currently. The introduction of a new material leads to enhanced capability for the instrument to negotiate the curved root canal.<sup>1</sup> However, the complex root canal anatomy can be unpredictable in some cases.<sup>1,2</sup> Knowledge and experience of the operator regarding endodontic treatment can have a huge impact on its result.<sup>3</sup> The nickel-titanium (NiTi) rotary instrument commonly used among endodontists is known for its ability to undergo extensive deformation due to excessive force used during instrumentation.<sup>4</sup> Although NiTi rotary instruments have modernized the root canal treatment technique, numerous studies have addressed the unexpected fracture associated with these instrument,<sup>1,2,5-9</sup> the incidence of which has been reported to range from 0.4–3.7%, which is slightly higher compared to the 0.5–7.4% incidence of endodontic hand instruments.<sup>10</sup> A mesiobuccal root canal has a high incidence of fractured instruments occurring in the apical third of the root canal due to torque failures of the instruments, with a small apical

dimension in the slight curvature of root canals.<sup>1,2,4,6,11</sup> A separated instrument prevents optimal cleaning and shaping in the apical root canal.<sup>2,6,8,12</sup>

Treatment protocols for removing separated instruments involves an orthograde or surgical approach.<sup>12,13</sup> Instrument retrieval by an orthograde approach often is considered rather than the surgical approach and the success rate ranges from 55% to 87%.<sup>12</sup> An orthograde approach consists of bypassing the instrument and removing it using an ultrasonic device, microtube extraction, forceps/pliers, and other methods.<sup>2,12</sup> The use of a dental operating microscope to retrieve the separated instrument is essential, allowing the operator to gain better visualization of the coronal aspect of the fractured instrument.<sup>6,10</sup> The combination of a dental operating microscope and a developed technique has made separated instrument removal more predictable.<sup>2,6,8,10,14</sup>

The following case describes the clinical scenario of separated instrument removal by means of an ultrasonic device in the curved canal.

## CASE REPORT

A 24-year-old female was referred to the Specialistic Dental Hospital by a general dentist for an unintentionally separated Protaper F2 instrument. The first right maxillary tooth was diagnosed with irreversible pulpitis and at that time there were no subjective complaints. Previous dentists made several attempts at removal of the broken instrument, but visualization was inadequate and she was referred to an endodontist.

On clinical examination using a dental operating microscope, the remaining hard tissue on the tooth was still adequate. The root of the mesiobuccal canal had been enlarged and the separated instrument could be visualized under the dental operating microscope (Figure 1A). Vitality of tooth 16 revealed no response but a percussion test showed a positive response. Preoperative radiography revealed a separated endodontic instrument in the middle to apical third of the curve mesiobuccal canal (Figure 1B). Mesiobuccal canal curvature measured 66° (Figure. 1C,D). The different methods to retrieve the instrument were explained to the patient, including the advantages and disadvantages.<sup>1,7</sup> Rubber dam isolation was mandatory in this case.

At the first attempt, the separated instrument was bypassed to access the apical third canal using C-Pilot (VDW GmbH, Munich, Germany) #08 and #10. However, the mesiobuccal canal curvature made it difficult to proceed straight without producing a ledge. The next option was to use a specific ultrasonic tip in conjunction with the dental operating microscope (Opmi PICO, Zeiss, Germany), from the Endo Success Retreatment Kit (Acteon, Satelec, France). The ET20 tip (Acteon) was used in the coronal third to enlarge the orifice and gain access to the separated instrument. Then, the ET25 tip (Acteon) was used to cut a circumferential dentin around the separated instrument until it loosened and the separated instrument was then agitated. A cotton pellet placed in the other canal orifices blocked the separated instrument from incidentally lodging in another canal. However, the segment was accidentally sucked into the high-speed suction device. Higher magnification using the dental operating microscope and a postoperative radiograph confirmed the removal of the fragment (Figures. 1E–F).

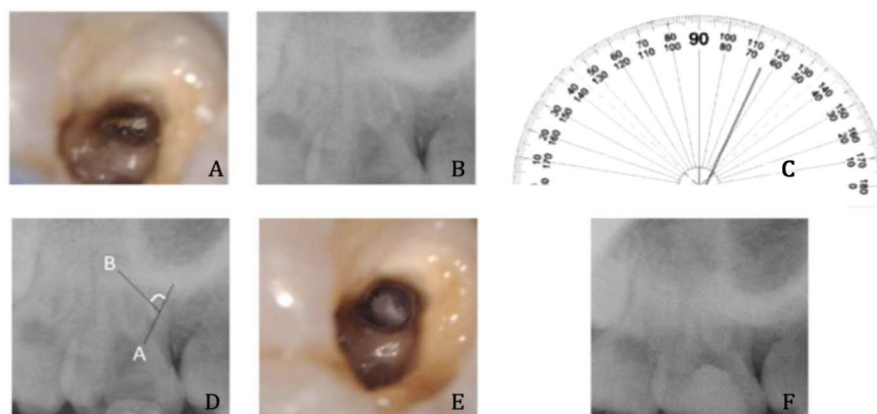
A root canal treatment was performed on the mesiobuccal canal after retrieval of the separated instrument. The last procedure created a slight ledge on the canal curvature. A glide path was established on the mesiobuccal canal using a size 10 K-file with slight prebending up to a size 15 K-file (Ready.Steel FlexoFile; Dentsply Maillefer, Ballaigues, Switzerland). The mesiobuccal canal was prepared using WaveOne Gold Primary 25.07 (Dentsply Maillefer) and slightly

bending one-third of the tip to negotiate the ledge and curved canal (Figure 2A). The glide path of the distobuccal canal was created using a size 10 K-file (Ready.Steel FlexoFile, Dentsply Maillefer) and then was prepared using WaveOne Gold Primary 25.07 (Dentsply Sirona, Baden, Switzerland; Figure 2A). The glide path of the palatal canal was created using a size 20 K-file (Ready.Steel FlexoFile, Dentsply Maillefer) and then was prepared using WaveOne Gold Medium 35.07 (Dentsply Maillefer, Figure 2B). Root canal irrigation was done using 5% NaOCl and then 17% ethylenediaminetetraacetic acid (EDTA) was used to remove the smear layer; both were activated using the sonic device for 30 seconds (EndoActivator, Dentsply International, Inc., York, PA, USA). Obturation on the distobuccal and palatal canals was done using Non-ISO 7% gutta-percha cones and AH Plus (Dentsply DeTrey GmbH, Constance, Germany) as a sealer combination with a continuous wave compaction technique (Element Obturation, SybronEndo; Figures. 2C,D). Resin-modified glass ionomer cement (Riva Light Cure; SDI GmbH, Melbourne, Australia) was used as a base followed by direct restoration using bulk-fill composite resin (Xtra Base; VoCo GmbH, Cuxhaven, Germany) and universal shade nanospherical composite resin (CeramX SphereTEC; Dentsply DeTrey GmbH; Figure. 3A–D)

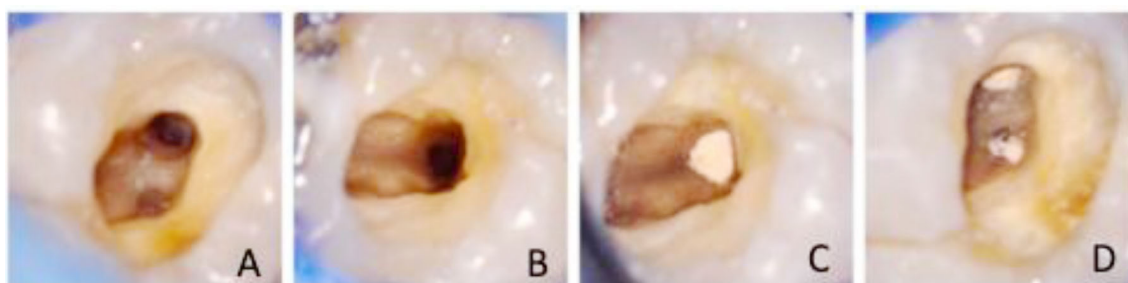
## DISCUSSION

Many studies have reported that a root canal instrument may separate due to several causes, such as the characteristics of the rotary NiTi instrument, canal geometry and tooth type, operator experience, and instrumentation technique.<sup>2-4,6,7,15</sup> Rotary NiTi instruments are believed to have more flexibility and superior resistance to torsional stress and flexural fatigue compared to stainless steel files (SS files).<sup>1,5,8,14,16</sup> However, the low yield and tensile strength of NiTi compared to SS files resulted in an increased fracture rate at lower loads.<sup>1,8,11,17</sup> The rotary NiTi instrument may separate due to torsional stress and/or flexural fatigue.<sup>1,4,6,8</sup> The cross-sectional dimensions and design of the instrument may affect the susceptibility of the instrument to fracture.<sup>1,18,19</sup> Manufacturing and processing of NiTi alloy has been shown to create an irregular surface, characterized by grooves, multiple cracks, pits, and metal rollover, that may act as a center of stress concentration initiating crack formation during clinical use.<sup>1,5,18,19</sup> Our case demonstrated that the ProTaper F2 instrument, which had the highest fracture frequency compared to other systems, also separated in the middle to apical third of the canal.<sup>5</sup> Incorrect root canal instrumentation protocol also may lead to fracture of the ProTaper F2.<sup>20</sup>

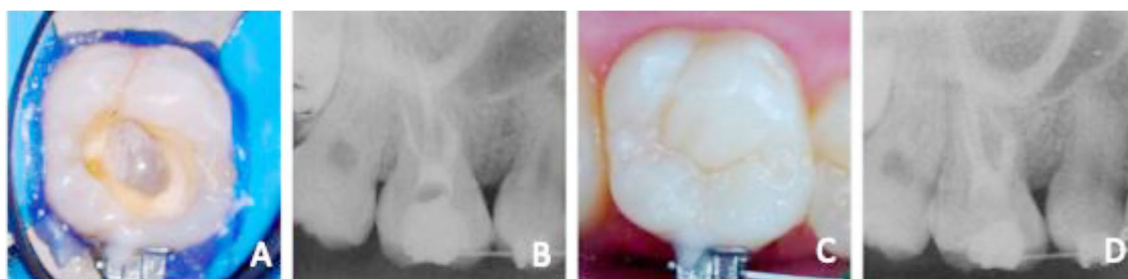
The risk of instrument separation seems to increase in cases with complex root canal anatomy, the primary



**Figure 1.** (A) Separated instrument is visible from the orifice using a dental operating microscope. (B) Preoperative periapical radiograph. Separated instrument is visible in the middle to apical third curvature ( $30^{\circ}$ – $40^{\circ}$ ) mesiobuccal canal. (C) Using a ruler arch to measure the angle formed. (D) The angle formed by intersection of lines A and B is measured, the angle is  $66^{\circ}$ . (E) Separated instrument was removed from the root canal. (F) Postoperative periapical radiograph after retrieval of the separated instrument



**Figure 2.** (A) Mesiobuccal and distobuccal canals shaped using WaveOne Gold Primary (25.07). (B) Palatal canal shaping using WaveOne Gold Medium (45.05). (C,D) All canals were obturated using wave-vertical condensation technique



**Figure 3.** (A) RM-GIC material used as a base. (B) Postoperative periapical radiograph after obturation and application of base. (C) direct restoration using bulk-fill material combined with universal shade nanospherical composite resin. (D) Postoperative periapical radiograph after direct restoration

reason being the curvature degree of these root canals.<sup>1,4,18,21</sup> Molars have more roots and a higher degree of curvature compared to incisors, canines, and premolars.<sup>1,11</sup> Most instrument fractures occur in the mesiobuccal root canals of molars (39.5%) and occur three times more often than in the distobuccal canal.<sup>1,11,18</sup> In our case, the mesiobuccal canal had a severe curvature in the middle third (angle  $>20^{\circ}$ ) based on Schneider's classification. In this case the curvature measured  $66^{\circ}$  using a digital protractor. The value was obtained through measurement based on an imaginary

line created on a radiographic image. A curvature  $>25^{\circ}$ – $30^{\circ}$  increased the susceptibility for instrument fracture inside the root canal up to 54.3%.<sup>16,22</sup> Moreover,  $>50\%$  of all NiTi instrument separation were in a severely curved canal.<sup>11</sup> It is suggested that when curvatures existed, the operator should proceed with root canal instrumentation more cautiously.<sup>16,21</sup>

Operator experience is a key factor that can influence instrument failure leading to separation.<sup>2,3,22</sup> Inexperienced operators have a higher tendency to



fracture the NiTi rotary instrument compared to experienced operators.<sup>16</sup> However, it is important for operators to improve their skill through training exercises, experience, and understanding of the current endodontic instrumentation techniques and materials.<sup>3,6,16</sup> To reduce the possibility of a separated instrument, the use of a crown-down technique instead of a step-back technique has been proposed.<sup>1,21</sup> Enlarging the coronal aspect of the canal before apical preparation and finishing can reduce the possibility of the instrument locking or jamming, which can lead to torsional fracture.<sup>1,16</sup> It is important for practitioners to apply the technique as standard operational procedure before introducing the NiTi instrument into the canal.

The use of ultrasonic in conjunction with a microscope in this case has become the most conservative method of removal by creating a staging platform (sufficient space) to allow the specialized ultrasonic tips to trephine around the coronal aspect of the separated instrument, and in so doing agitating, loosening, and unwinding the fractured instrument.<sup>6,23</sup> The use of a dental microscope can result in direct and illuminated visualization of the separated instrument in the coronal aspect.<sup>6,16</sup> It can allow the operator to remain centered within the canal and reduce the possibility of canal perforation.<sup>2</sup>

## CONCLUSION

Retrieval of a separated instrument using a specific ultrasonic device in conjunction with a dental operating microscope is an effective way to remove a separated instrument in the curved canal. It is better to prevent a separated instrument by understanding the characteristics of the rotary NiTi Instrument, canal geometry and tooth type, operator experience, and instrumentation technique. Most separated instruments can be removed using the correct technique and armamentarium.

## REFERENCES

1. McGuigan MB, Louca C, Duncan HF. Endodontic instrument fracture: causes and prevention. In: British Dental Journal. Vol 214. Nature Publishing Group; 2013:395-400.
2. McGuigan MB, Louca C, Duncan HF. Clinical decision-making after endodontic instrument fracture. In: British Dental Journal. Vol 214. Nature Publishing Group; 2013:395-400.
3. Saleh AM, Tavanafar S, Vakili-Gilani P, Al Sammerraie NJ, Rashid F. Influence of operator's experience level on lifespan of the WaveOne Primary file in extracted teeth. Restor Dent Endod. 2013;38(4):222-6.
4. Khurana P, Khurana K. Effect of curvature angle and rotational speed on fracture of various Ni-Ti rotary files used in extracted molars. J Restor Dent. 2013;1(2):49.
5. Farid H, Khan FR, Rahman M. ProTaper rotary instrument fracture during root canal preparation: a comparison between rotary and hybrid techniques. Oral Health Dent Manag. 2013;12(1):50-5.
6. Mcguigan MB, Louca C, Duncan HF. The impact of fractured endodontic instruments on treatment outcome. NatPubl Gr. 2013;214(6):285-9.
7. Choksi D, Idnani B, Kalaria D, Patel RN. Management of an intracanal separated instrument: A case report. Iran Endod J. 2013;8(4):205-7.
8. Andrabi SM-U-N, Kumar A, Iftekhar H, Alam S. Retrieval of a separated nickel-titanium instrument using a modified 18-gauge needle and cyanoacrylate glue: a case report. Restor Dent Endod. 2013;38(2):93-7.
9. Aboud LRL, Ormiga F, Gomes JACP. Electrochemical induced dissolution of fragments of nickel-titanium endodontic files and their removal from simulated root canals. Int Endod J. 2014;47(2):155-62.
10. Panitvisai P, Parunnit P, Sathorn C, Messer HH. Impact of a retained instrument on treatment outcome: A systematic review and meta-analysis. J Endod. 2010;36(5):775-80.
11. Ungerechts C, Bardsen A, Fristad I. Instrument fracture in root canals - where, why, when and what? A study from a student clinic. Int Endod J. 2014;47(2):183-90.
12. Vivekananda Pai A, Mir S, Jain R. Retrieval of a metallic obstruction from the root canal of a premolar using Masserann technique. Contemp Clin Dent. 2013;4(4):543.
13. Pop I. Oral surgery : part 2. Endodontic surgery. Nat Publ Gr. 2013;215(6):279-86.
14. Shiyakov KK, Vasileva RI. Success for removing or bypassing instruments fractured B=beyond the root canal curve - 45 clinical cases. Summary: JIMAB. 2014;20(3):567-71.
15. Gambarini G, Glassman G. In vitro analysis of efficiency and safety of a new motion for endodontic instrumentation: TF Adaptive. Roots Int Mag Endodontology. 2013;9(3):12-5.
16. Fiore PM Di. A dozen ways to prevent nickel-titanium rotary instrument fracture. Scanning. 2007;138(February):196-201.
17. Moreinos D, Dakar A, Stone NJ, Moshonov J. Evaluation of time to fracture and vertical forces applied by a novel gentlefile system for root canal preparation in simulated root canals. J Endod. 2016;42(3):505-8.
18. Boutsioukis C, Lambrianidis T. Management of fractured endodontic instruments.; 2018.
19. Parashos P, Messer HH. Rotary NiTi instrument fracture and its consequences. J Endod. 2006;32(11):1031-43.

20. Brito-Junior M, Normanha JA, Camilo CC, et al. Alternative techniques to remove fractured instrument fragments from the apical third of root canals: Report of two cases. *Braz Dent J.* 2015;26(1):79-85.
21. Balani P, Niazi F, Rashid H. A brief review of the methods used to determine the curvature of root canals. *J Restor Dent.* 2015;3(3):57.
22. Wu J, Lei G, Yan M, Yu Y, Yu J, Zhang G. Instrument separation analysis of multi-used ProTaper universal rotary system during root canal therapy. *J Endod.* 2011;37(6):758-63.
23. Ruddle CJ. Broken instrument removal. The endodontic challenge. *Dent Today.* 2002;21(7):70-81.

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