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Retrieval of separated endodontic instruments using two different techniques: A case series

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Abstract
One of the most frequent mishaps during root canal procedure is the separation of an endodontic instrument during biomechanical preparation occurring in 2% to 6% of cases. It prevents proper debridement of the canal apical to the fragment and compromises the success of the treatment. Several devices and techniques have been developed to retrieve the fractured instruments, but none are consistently successful. In this report, we present three cases with separated instruments in the middle third and apical third of root canal which were successfully retrieved with the use of ultrasonics under dental operating microscope.

Keywords: File sepration, file retrival, ultrasonics, braiding technique

Introduction

Endodontic treatment of teeth has an overall success rate of up to 98%. Failures in endodontics can be regarded as the re-appearance of clinical symptoms in a previously treated tooth and the presence of periapical radiolucency. Incomplete cleaning and debridement of the canal is one of the significant cause of endodontic failure. A poorly designed access cavity, missed supernumerary canals, iatrogenic procedural errors such as ledges, perforations, separated instruments can be a few of the many causes for such failures [1].

Intra-canal separation of endodontic instruments is a common unfortunate occurrence which may reduce the possibility of attaining successful cleaning and shaping of the root canals. The factors responsible for separation of endodontic instruments are excessive curvature of root canal, design of instrument, manufacturing process, instrument use, instrumentation techniques, and operator skill. Reports suggest that the prevalence of fracture of convectional SS hand files is 0.25 to 6.6% [2, 3, 4]. While that of NiTi rotary files is 1.3% to 10.0% [3, 4]. Retrieval of SS files is easy in comparison to NiTi files. This may be due to NiTi files having a tendency for secondary fracture during retrieval. The success rate of retrieving stainless steel files is 55%–70%·Prognosis is dependent on the level of separation, the status of cleaning of canal attained at the instance of separation, periapical status of a tooth, and pre-operative tooth vitality. Management of separated endodontic instrument within the canal can be done by any one of the 4 treatment protocols that have been mentioned in the literature depending on the case:

1. The fragment can be allowed to be retained in the canal while cleaning and debriding accessible portion of the canal
2. Creating a passage between the broken fragment and the canal wall.
3. Complete retrieval of the fragment followed by endodontic treatment of the tooth.
4. Surgical approach [5]

Ultrasonics along with magnification has been proved to be successful in retrieval of separated instruments [6]. The tip attached to ultrasonic instrument vibrates and loosens the separated instrument within the canal with minimal damage to the radicular dentin. The design of the tips makes their introduction even into the apical third of the canal possible.

This case report presents clinical cases involving retrieval of separated intra-canal instruments using ultrasonics and braiding technique.

Case 1

A 35 year old female patient reported to the Dept. of Conservative Dentistry and Endodontics with the chief complaint of pain in left upper back tooth region. The patient provided with a history of Root Canal Treatment (RCT) being carried out at a private clinic in the same region, one month back and unrelieved pain. On intraoral examination temporary restoration was seen with left maxillary first molar. Tenderness on percussion was present with the involved tooth. Intraoral periapical RVG showed presence of a fractured file fragment in the middle third of MB root canal of 26 [Figure 1a]. Retreatment where-in the fractured instrument was to be attempted for retrieval was scheduled, and the patient was informed about the fractured instrument and treatment plan. Re-access opening was done along with pre-endo buildup with 26 [Figure 1b]. The treatment was done under a Dental Operating Microscope (DOM). DTE D600 Ultrasonic unit (Woodpecker, Germany) with DTE Ultrasonic tip ED87 (Woodpecker, Germany) was used to trough around the fragment at a low power setting. Normal saline as an irrigant was used between ultrasonic activations to clean the canal of debris and to reduce the intra-canal temperature. The mobility of the fragment within the canal increased gradually with the fragment finally 'jumping' out of the canal. Confirmation of the canal free of the broken fragment was done using radiograph [Figure 1c]. Working length determination was done using an electronic apex locator (EAL) (Root ZX mini,

J Morita, Japan) and confirmed radiographically[Figure1 d], Biomechanical prepration was done using ProTaper gold rotary files(Dentsply, Maillefer, Switzerland) upto size F2 and master cone fit was checked[Figure 1e]. Obturation was done with Gutta-percha cones (Dentsply, Maillefer, Switzerland) and AH Plus sealer (Dentsply Sirona, USA) using the single cone obturation technique. Post endodontic restoration was done using resin composite [Figure 1f].

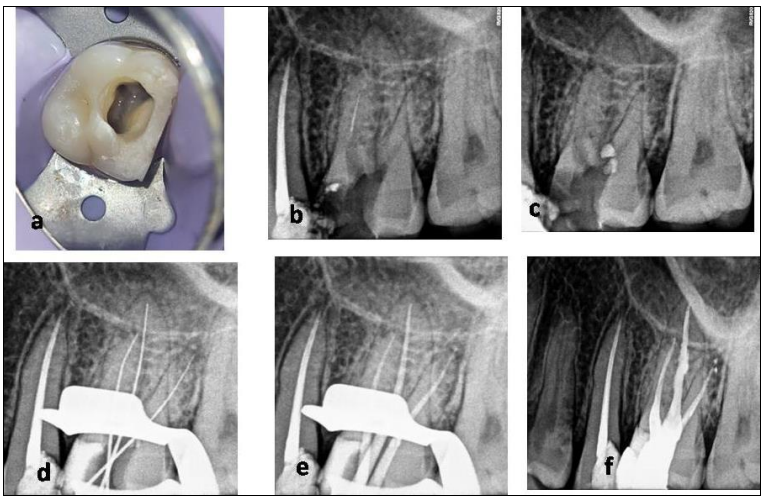

Fig 1: Sequence of fragment removal in case 1. (a) Access opening image (b) RVG showing separated instrument in mesiobuccal canal of 26. (c) Retrieval of separated instrument (d) Working length determination (e) Master cone fit in all the canals (1) Postoperative image

Case 2

A female patient aged 33 years reported to the dept. of Conservative dentistry and Endodontics with decayed tooth in the right lower back tooth region. The patient had no contributing medical history. Clinically, there was deep caries mesio-occlusally with tooth #47. Radiographically, there was radiolucency involving pulp space and PDL widening in the periapical region with tooth #47. The tooth did not respond to heat and cold pulp sensibility tests. The tooth was diagnosed as pulp necrosis with asymptomatic apical periodontitits. RCT was initiated with the involved tooth. Access opening was done and 3 canal orifices were located (mesio-buccal (MB), mesio-lingual (ML) and the distal). Initial canal patency was gained using #10 K-file. During canal orifices enlargement using S_x (ProTaper Gold, Dentsply, Maillefer, Switzerland) file separation of 4mm occurred in the ML canal at the middle third. The fractured fragment was decided to be attempted for retrieval using ultrasonics under DOM. The orifices of the ML canal was enlarged using GG drill. The head of the fractured instrument was exposed upto 2mm length by troughing around the instrument using DTE Ultrasonic tip ED87 (Woodpecker, Germany) attached to DTE D600 Ultrasonic unit (Woodpecker, Germany) was used on the fragment on the surface corresponding to the outer wall of the canal viewing under the DOM. Short 1-2 seconds of ultrasonic tip activation using the same tip when in contact with the fragment was done. The fragment loosened in the canal and popped out into the pulp chamber. The endodontic treatment was continued. Working length determination was done using an EAL (Root ZX mini, J Morita, Japan) and confirmed radiographically. Intra-canal Calcium hydroxide dressing was placed and temporarization was done using Cavit. The patient was recalled after a period of 1 week. Biomechanical preparation was done using Protaper Gold files (Dentsply, Maillefer, Switzerland) upto size F2. Obturation was done with Gutta-percha cones (Dentsply, Maillefer, Switzerland) and AH Plus sealer (Dentsply Sirona, USA) using the single cone obturation technique. Post endodontic restoration was done using resin composite.

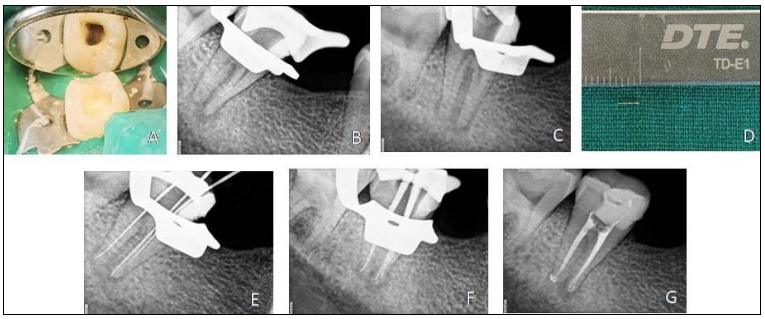

Fig 2: (A) Access opening; (B) File fracture in mesial root; (C) & (D) Fragment retrieved; (E) Working length determination; (F) Master-cone selection; (G) Obturation and post endodontic restoration

Case 3

A 35-year-old male patient reported to the dept. Of Cons and Endo with chief complaint of pain in the lower left back tooth region for the past three days. Patient complained of pain which was sudden in onset, throbbing type and continuous in nature, relieved on taking medications. Sensibility tests revealed no response. A diagnosis of pulpal necrosis with symptomatic apical periodontitis in 36 was made. RCT was initiated under local anesthesia (LA) and rubber dam isolation. Access to the pulp chamber was

gained [Figure 3a] Size 10 and 15 K files were used for the initial negotiation and biomechanical preparation was done till F2 ProTaper gold file. During biomechanical preparation, F2 ProTaper gold file of an approximately 4 mm was fractured and got lodged in the distal canal of #37. RVG revealed that the file was fractured in the apical third of the canal beyond the apical foramen [Figure 3b]. Initially the separated file was bypassed using size 8 and 10 K files, and the canal was enlarged with subsequent files until 20 K file. RVG with a 10 K file was used for confirmation. [Figure 3c]. Recapitulation was done with ISO sized #8 and #10 Kerr files to check the canal patency. The file was retrieved using braiding technique and RVG was taken [Figure 3d]. Determination of the working length was done using an EAL (Root ZX mini, J Morita, Japan) and confirmed radiographically [Figure 3e]. Cleaning and shaping of the canals were performed using ProTaper gold rotary files(Dentsply, Maillefer, Switzerland) upto size F2[Figure 3f].Obturation was done with Gutta-percha cones (Dentsply, Maillefer, Switzerland) and AH Plus sealer (Dentsply Sirona, USA) using the single cone obturation technique. Post endodontic restoration was done using resin composite. [Figure 3g].

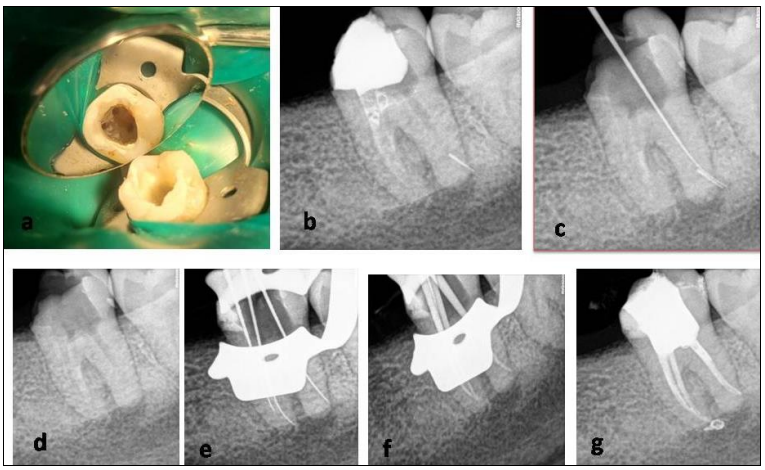

Fig 3: Sequence of fragment removal in case 3. (a) Access opening (b) RVG showing separated instrument in distal canal of mandible 2nd molar. (c) Bypassing using 10k file (d) Retrieval of separated instrument (e) Working length determination (F) Master cone fit in all the canals (g) Postoperative image

Discussion

Factors responsible for instrument separation include degree of curvature of the canal, anatomic variations such as bifurcations and trifurcations, practitioner skill and expertise, patient co-operation, over-usage of files, improper torque and speed settings and excessive forces applied during preparation [7]. The timing of the instrument fracture depending on the extent of cleaning and biomechanical preparation achieved is of critical importance in the prognosis of the treatment post instrument fracture [8].

There is no standard procedure for separated instrument retrieval and hence numerous techniques and tools have been suggested such as the Masserann kit, Endo Extractor, wire loop technique, braiding technique and ultrasonics. Successful removal of seperated instrument depends on the canal curvature, length, type, and location of fragment with respect to the canal curvature [8].

Richman in 1957 introduced ultrasonics in endodontics. Ultrasonic hand pieces operate at an amplitude of1–8 kHz producing less shear stress causing less alteration on the canal surface. In the first 2 cases presented here, the separated instruments were retrieved with Ultrasonic tip ED87 attached to a piezoelectric ultrasonic unit. The tips act in an up-down, “piston-like” motion. Heat generated on canal walls may lead to temperature rise in the PDL space causing damage to the PDL fibres. Also increased temperature of the fractured instrument in contact with ultrasonic tips during troughing may lead to weakening of the fragment and secondary fracture. Therefore, comparatively lower power settings of the ultrasonic unit with short application periods are preferred. Success rate for fragment removal using ultrasonic’s technique were reported to range of 67% by Nagai *et al*[9] to 88% and 95% by Cuje *et al* [10] and Fu *et al* [6].

Braiding technique is a procedure wherein the separated instrument when positioned deep in the canal and having low visual accessibility can be engaged and retrieved by inserting 2-3 Hedstrom files or K files besides to and in contact with the fragment within the canal. Here, the clinician must rely completely on tactile sense. The first file engages the fragment by “screwing” it into its flutes, while the remaining files intertwine to form a braided structure [9, 11] and a short outward pull results in the instrument being removed from the canal.

Advancement in technology and magnification has increased the success rate retrieval of separated fragments. The use of DOMs and dental loupes provide enhanced visualization and precise placement of retrieval instruments in the canal. According to Nevares *et al*. when the head of fractured fragment was seen with the use of DOM, the success in retrieving the fragment was 85.5% when compared to without use of DOM for visualization which was 47.7% [13, 14]. Ideally the most preferred treatment option of a separated fragment is its retrieval, but this is not always possible based on the complexity of the root canal anatomy, fragment position in the canal, etc.

Conclusion

File retrieval is a complex procedure with risks involved such as excessive dentin removal, perforation of tooth during instrument retrieval and even pushing of the fragment into the peri-radicular space. These risks should always be balanced against benefits, when retrieval is planned [5].

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