

Management Of Separated Instruments In Root Canal Using Ultrasonics – A Case Series

Case Series

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Abstract

Separation of instruments in the root canal while shaping and cleaning process is one of the frequent mishaps seen in endodontic practice. Such an event has shown to compromise the success of root canal therapy as it hinders shaping and disinfection apical to the broken fragment. The use of ultrasonic has shown considerable success for management of these case scenarios. Adequate knowledge, good clinical skills, proper armamentarium and experience enable successful management of such iatrogenic events by the operator without further complications. In this report, we present four cases with separated instruments in root canal which were successfully managed with the use of ultrasonics under magnification with dental operating microscope.

Keywords: Root Canal Treatment; Instrument Separation; File Retrieval; Broken File; Ultrasonics.

Introduction

The success of an endodontic treatment depends on efficient shaping and cleaning of the root canal system [1]. Iatrogenic accidents like separation of an endodontic instrument may occur during shaping and cleaning causing procedural complications for the operator. The risk of instrument separation in the canal is due to multiple use of the same file, inexperienced operator, improper technique of instrumentation and manufacturing defects [2].

Management of separated endodontic instruments can be done by surgical or an Orthograde/non-surgical approach. The orthograde approach is preferred over surgical approach due to its lesser postoperative complications [3, 4]. The most common non-surgical management employed is the complete removal of the separated instrument fragment. If not achievable, an attempt to bypass the separated instrument is made [5].

One of the most commonly used mechanical methods of instrument retrieval is with ultrasonics. This involves generation of ultrasonic vibrations which are transmitted to the fractured fragment to loosen and liberate it from the canal [6]. If not used optimally, it can lead to perforations, decreased root strength and increased chances of vertical root fracture [7].

This case series highlights the management separated instruments in the root canal with ultrasonics, under dental operating microscope.

Case Report

Case Report 1

A 51-year-old male patient reported to the Department of Con-

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servative Dentistry and Endodontics with the chief complaint of pain in the right upper back region of the jaw. History revealed that root canal treatment was done in the same region 6 months ago, at a private clinic. Intraoral examination revealed a temporary restoration in the right maxillary second molar and was tender on percussion. Preoperative radiographic evaluation revealed presence of fractured instrument at the coronal third in the distobuccal root canal of 17 [Figure 1a]. Diagnosis of previously initiated root canal treatment with symptomatic apical periodontitis in relation to 17 was made.

Retrieval of the separated fragment using ultrasonics was decided as the treatment plan and an informed consent was taken from the patient. After removal of the temporary restoration, head of the instrument was visible in the distobuccal canal and a perforation in the buccal wall was noticed [Figure 1 b]. The access cavity preparation was modified and coronal part of the broken instrument was exposed by removing the surrounding dentine [Figure 1c]. ActeonSatelec P5 neutron ultrasonic generator with ultrasonic tip ET20 d (SatelecActeon, France) was used to trephine around the fragment at power 6 on dry setting. The entire procedure was performed under dental operating microscope (Pico; Carl Zeiss, Jena, Germany). On exposure of 1mm of instrument head, at the same power, fine tip ET25 (SatelecActeon, France) was activated along with the coolant to agitate the broken fragment. Pulp chamber was irrigated with normal saline intermittently to flush out the debris from the canal. After 15 mins of ultrasonic application, the fragment loosened and popped out of the canal [Figure 1d]. Intraoral periapical radiograph (IOPAR) was taken to confirm the removal of separated instrument [Figure 1e]. The buccal wall perforation was sealed using resin modified glass ionomer cement. Working length was determined [Figure 1f], cleaning and shap-

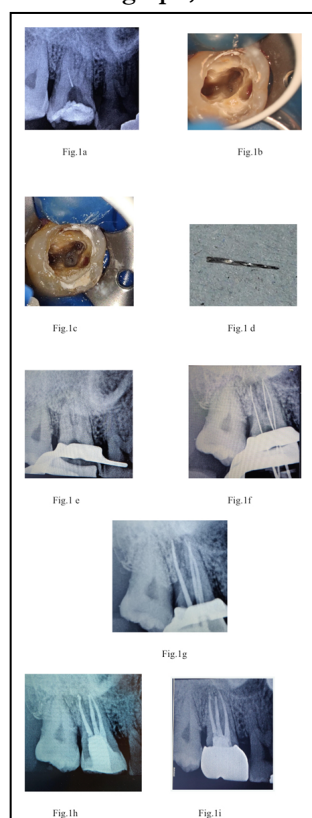
ing of the root canal system was performed using Protaper Gold (DentsplyMaillefer, Ballaigues, Switzerland). Prepared root canals were irrigated with 5.25% NaOCl and master cone was confirmed [Figure 1g]. The canals were dried with sterile paper points and obturated with AH Plus (DentsplyDeTrey, Konstanz, Germany) and gutta-percha (Diadent Group International, Inc, Chongju City, Korea) [Figure 1h]. After Obturation, the tooth was restored with composite restoration (Filtek Z350 XT Universal Restorative, 3M India) followed by full veneer crown. The patient was recalled after 6 months for follow-up and revealed no clinical and radiographic signs and symptoms [Figure 1i].

Case Report 2

A 49-year-old female patient was referred by a private practitioner to the Department of Conservative Dentistry and Endodontics for the management of broken instrument in the lower right back region of jaw. History revealed initiated root canal treatment by the referring dentist with an accidental instrument separation. Clinical examination revealed a temporary restoration in the right mandibular first molar. The tooth was not tender on percussion. Intraoral periapical radiograph (IOPAR) revealed two fractured instruments, one in the mesiolingual canal at the middle third and the other in the mesiobuccal canal at the junction of the middle and apical third of 46 [Figure 2a]. There was no periapical radiolucency associated with the tooth. A diagnosis of previously initiated root canal treatment with a normal periapical region was made with respect to 46.

Retreatment to retrieve the separated instrument from the mesiobuccal canal and bypass the instrument in the mesiolingual canal was planned. The patient was explained about the treatment

Figure 1a. Preoperative radiograph; 1b Temporary cement removal; 1c Head of the separated instrument exposed by dentin removal using ET 20d; 1d instrument removed; 1e post retrieval IOPAR; 1f Working length radiograph; 1g Mastercone radiograph; 1h post obturation radiograph; 1i 6 months follow up radiograph.



plan and an informed consent was obtained. After removing the temporary restoration, the access cavity was modified [Figure 2b]. The instrument in the mesiolingual canal was bypassed using ISO size 15 K file (Sybron endo, orange, CA) [Figure 2c]. Gates Glidden (GG) drills no. 2 and 3 (DentsplyMaillefer, Ballaigues, Switzerland) were modified by cutting the drill perpendicular to the long axis at the greatest cross-sectional diameter. Coronal enlargement of the canals to visualize the coronal aspect of the broken instrument was performed by using GG drills (nos. 1–2) (DentsplyMaillefer, Ballaigues, Switzerland), under a dental microscope (Pico; Carl Zeiss, Jena, Germany). A staging platform was then prepared at the most coronal aspect of the broken instrument using modified GG drill (no. 3) [Figure 2d]. Fine ultrasonic tips (ET25; Satelec Corp, Merignac Cedex, France) were used to trephine dentin around the fragment, 1–1.5 mm deep, to unlock it from the canal. After 15 mins of gentle agitation with the ultrasonic tip, the broken instrument popped out of the canal [Figure 2e]. IOPAR was taken to confirm the removal of the separated instrument [Figure 2f]. The endodontic treatment was performed following the same protocol as described in case 1 [Figures 2g, 2h, 2i]. After obturation, the tooth was restored with composite (Filtek Z350 XT Universal Restorative, 3M India) and referred back to the referring dentist for crown placement. The patient was recalled after 6 months for follow-up and revealed no clinical or radiographic signs and symptoms [Figure 2j].

Case Report 3

A 39-year-old female patient was referred by a prosthodontist for the management of broken instrument in upper right back tooth. Clinical examination revealed temporary restoration in the right maxillary second molar [Figure 3a] and was not tender on percussion. A diagnosis of previously initiated root canal treatment with 17 was made. IOPAR revealed fractured instrument throughout palatal canal length of 17 [Figure 3b]. No periapical

radiolucency was associated with the tooth. Retreatment aimed at retrieval of the separated instrument. The patient was explained about the treatment plan and an informed consent was obtained. The temporary restoration was removed, access cavity was modified and the head of the instrument was exposed by trephining surrounding dentine [Figure 3c] using ultrasonic tip ET20 d (SatelecActeon, France) mounted on ActeonSatelec P5 neutron ultrasonic generator at dry power setting of 6, under a dental operating microscope (Pico; Carl Zeiss, Jena, Germany). After 1mm of file head was exposed, ET25 tip (SatelecActeon, France) was used to agitate the broken fragment [Figure 3c]. Pulp chamber was irrigated with normal saline intermittently to flush out the debris from the canal. Initially, 2mm of the coronal segment of the separated instrument fractured and came out, the remaining part of the instrument was retrieved in the same manner as described in case 2 [Figure 3d]. IOPAR was taken to confirm removal of the separated instrument [Figure 3e]. The endodontic treatment was performed following the same protocol as described in case 1 [Figure 3f, 3g]. Sectional obturation of the palatal canal along with pre-fabricated metal post (Mani Inc., Tochigi-Ken, Japan) and composite restoration (Filtek Z350 XT Universal Restorative, 3M India) was done [Figure 3h and 3i]. The patient was referred back to the referring dentist for prosthodontic management.

Case Report 4

A 51-year-old male patient was referred by a general practitioner for management of fractured instrument in the lower right back tooth. History revealed initiated root canal treatment by the referring dentist with accidental file breakage. Clinical examination revealed, temporary restoration in the right mandibular first molar [Figure 4a] which was tender on percussion. IOPAR revealed, fractured instrument in the apical third extending till the middle third of mesiobuccal canal of 46 [Figure 4b]. A diagnosis of previously initiated root canal treatment with symptomatic apical

Figure 2a. Preoperative radiograph showing separated instruments in mesiolingual and mesiobuccal canals of 46 ; **2b** access cavity refinement; **2c** Instrument in mesiobuccal canal bypassed; **2d:** Staging platform prepared and instrument retrieved i.r.t mesiolingual canal ; **2e** post-retrieval IOPAR; **2f** Working length radiograph; **2g** Master Cone radiograph; **2h** post obturation radiograph; **2i** 6 months follow up radiograph.

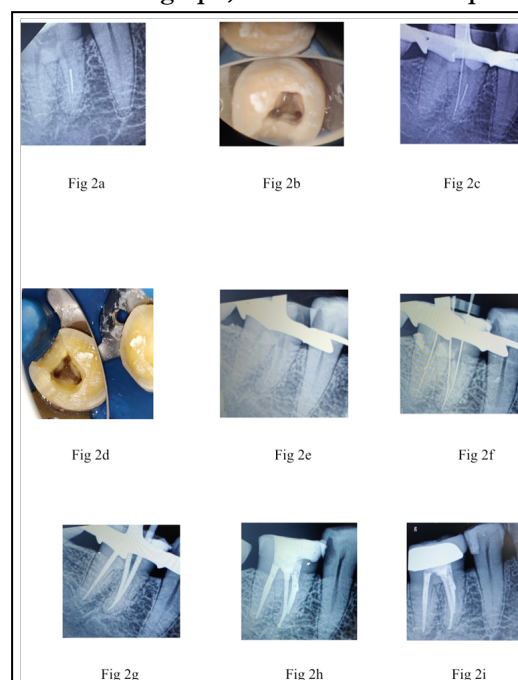


Figure 3a. Preoperative clinical photograph; 3b Preoperative radiograph access cavity preparation; 3c Removal temporary restoration, access cavity refinement and head of the instrument exposed by trephining surrounding dentine using ET20 d; 3d Instrument agitated using ET 25; 3e retrieved instrument; 3f post retrieval IOPAR; 3g Working length radiograph; 3h Mastercone radiograph; 3i post obturation radiograph with pre-fabricated metal post in palatal canal.

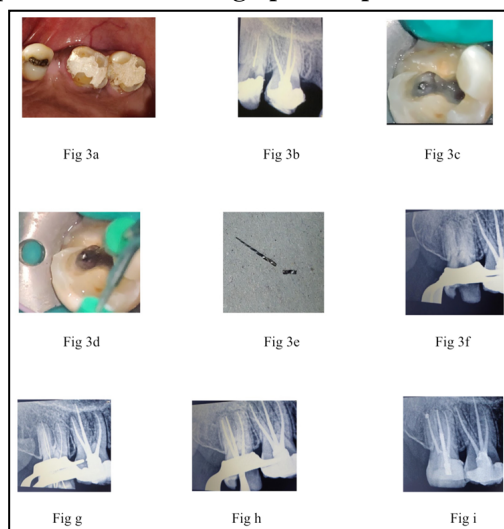
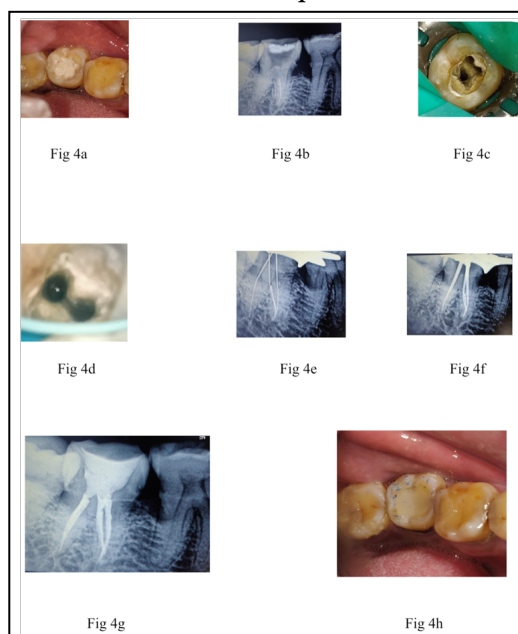


Figure 4a. Preoperative clinical photograph; 4b Preoperative radiograph; 4c access cavity refinement; 4d Instrument viewed at 10.4x magnification; 4e instrument bypassed; 4f Mastercone radiograph; 4g Obturation radiograph; 4h Composite core build up.



periodontitis with 46 was made.

Retreatment aimed at retrieval of the separated instrument from the canal. The patient was explained about the treatment plan and an informed consent was obtained. After removing the temporary restoration, the access cavity was modified [Figure 4c]. A staging platform was prepared at the most coronal aspect of the broken instrument using modified GG drill (no. 3) [Figure 4d] and fine ultrasonic tips (ET25; Satelec Corp, Merignac Cedex, France) were used to trephine dentin around the file, similar to case 2. After 45 mins of an unsuccessful attempt to retrieve the file, bypassing the file was decided. The instrument was bypassed using ISO size 15 K file (Sybron endo, orange, CA) and an IOPAR was taken to confirm the same [Figure 4e]. The endodontic treatment was performed following the same protocol as described in case 1 [Figure 4e, 4f, 4g]. After obturation, tooth was restored with composite (Filtek Z350 XT Universal Restorative, 3M India) [Figure 4h] and

referred back to the referring dentist for prosthodontic management.

Discussion

The success of an endodontic treatment is correlated with a clinician's ability to optimally clean and shape the root canal system. Currently, the most commonly employed metal for manufacturing endodontic files are nickel-titanium alloys, due to their property of shape memory, biocompatibility, super elasticity and corrosion resistance [8]. Even with these advantages, incidence of file separation is higher with nickel-titanium than stainless steel files, as their tensile and yield strength is lower to that of stainless steel [9]. During shaping, iatrogenic separation of instrument can occur during regular clinical practice. Retrieval of these separated fragments must be considered as the uttermost priority for the long term success of an endodontic treatment [10].

This case series describes management of separated instruments using ultrasonics, in a safe and conservative manner. Magnification also contributed to the success of the procedure. Successful removal of fractured instrument relies on length, composition, and position of an instrument in relation to the canal curvature [5]. Retrieval of an instrument becomes easy if it lies above the canal curvature [11]. If the broken instrument lies apical to canal curvature, the probability of instrument retrieval is reduced. Stainless steel files can be easily retrieved in comparison to NiTi files as they absorb ultrasonic energy and show bodily movement whereas the NiTi files build-up heat at the point of contact and undergo fracture [12]. In this report, case 3 shows a NiTi file fragment which breaks during application of ultrasonics.

Sometimes limited visibility or restricted space makes the removal of instrument difficult. Moreover, excessive canal enlargement during instrument retrieval can lead to weakening and fracture of the tooth, formation of an iatrogenic ledge or root perforations [13]. When separated instrument cannot be removed then bypassing the instrument should be considered (Case 4). However, care should be taken to avoid chances of iatrogenic errors such as perforation of the root or separation of the file used for bypassing. Advancement in technology and magnification has made successful instrument retrieval possible. Magnification guides instrument retrieval and minimizes damage to the radicular dentine. Under dental operating microscope, the success rate of retrieval has been seen to increase to 85.5% from 47.7% [14, 15].

This case series employs AcetonSatelec P5 neutron piezoelectric ultrasonic generator. In this the tips move in a linear, back and forth, "piston-like" motion, ideal for instrument retrieval [16, 17]. Heat generation during its use can lead to instrument fatigue and secondary fracture thus, low power settings and shorter application time is advocated [18]. The ultrasonic application below orifice was performed dry in order to maintain constant vision of the energized tip around the broken instrument in this case series. Recent trend in endodontics is usage of bio ceramic based materials using tissue engineering concepts to enhance the treatment outcomes. Our institution is passionate about the high quality evidence based research and excelled in various fields. So, in future we are planning to conduct an exhaustive research on the incidence and various approaches in management of these separated instruments.

Conclusion

Development of technology, advancement in armamentarium and clinical expertise enable successful management of fractured instrument. The ultrasonic technique renders a predictable meth-

od of retrieving separated instruments from the root canal with minimal loss of dentine.

Declaration Of Patient Consent

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

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