Case Report

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Retrieval of fractured Endodontic Instrument under dental operating microscope using ultrasonic tips : A Case Report

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Abstract

A Patient came with the complaint of pain in the lower right back region of the jaw. Root canal treatment was planned. While preparing for the bio-mechanical procedure, the Hand pro taper fractured in the apical third. Iatrogenic occurred as a result of the fracture of the endodontic instrument. Retrieval of the fractured instrument was planned to complete the cleaning and shaping of the canal. The removal of the fractured instrument was planned to be done under the Dental Operating Microscope. The use of an operating microscope enhanced the illumination and the magnification of the instrument. This illumination and magnification helped in the precision of removal. The ultrasonic tip enabled to reach of the fractured instrument in the canal and loosen the dentin around the fractured instrument. It allowed easy retrieval of the fractured instrument. During the retrieval procedure, the fractured instrument was bypassed before the use of the ultrasonic tip. After the removal of the fractured instrument, cleaning and shaping were completed, followed by obturation, definitive restoration, and prosthesis. As the removal of the fractured instrument enabled complete cleaning and shaping, it improved the prognosis of the case. When the endodontic instrument gets fractured, it should be analyzed over the radiograph to assess the fracture level, the anatomy of the root canal, size of the fractured instrument, check accessibility, stage of fracture, etc. If all the above criteria are met with the removal of the instrument only then, replacement should be tried. Otherwise, it may lead to a severe loss of root dentin, decreasing fracture resistance of the root.

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INTRODUCTION

Intra-canal instrument separation is an uneventful occurrence. It may inhibit efficient cleaning,

Shaping of the canal, and affect the prognosis of endodontic treatment, instrument break when they are incorrectly or overused Prevalence of separated instrument ranges around 2 to 6% by Tronstad et al (Kerekes and Tronstad, 1979). and 0.5 to 5% by Iqbal et al (Iqbal *et al.*, 2006). Fractur of stainless steel file range around 0.25 - 6%. For NiTi rotary file is 1.3 -10.0% (Madarati *et al.*, 2013). Ultrasonic tips are routinely used for the removal of canal obliteration (Hargreaves *et al.*, 2011). Success rates for

instrument retrieval by ultrasonics are 67% Nagai et al (Nagai *et al.*, 1986), 88%, and 95% by Cuje et al. (Cujé *et al.*, 2010), Fu et al. (Fu *et al.*, 2011), respectively. This case stands to great success as a fractured fragment of the endodontic instrument has been removed from apical third. The instrument fractured at apical third is not removed usually to avoid the loss of root structure.

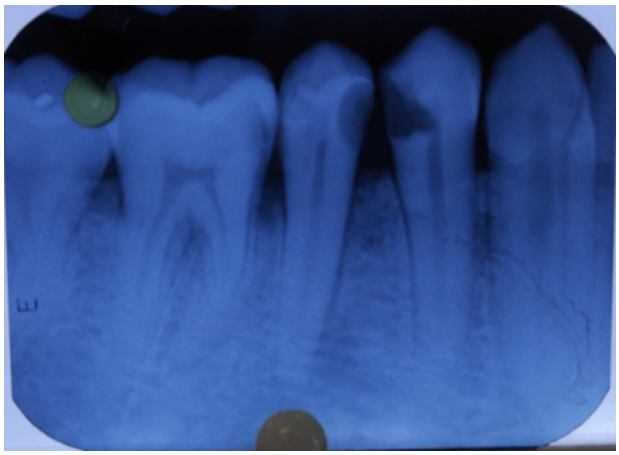

Figure 1: Preoperative Radiograph

Figure 2: rubber dam isolation with 44

Case report

A 25-year-old male patient reported to the Department of Conservative Dentistry and Endodontics" with a primary complaint of pain in the lower right back region of the jaw for 7 days. On clinical examination, proximal caries with 44, 45 was noticed with tenderness on percussion was positive with 44. On radiological examination, radiolucency was seen on the proximal surface of 44 involving enamel, dentin, and pulp along with the involvement of enamel and

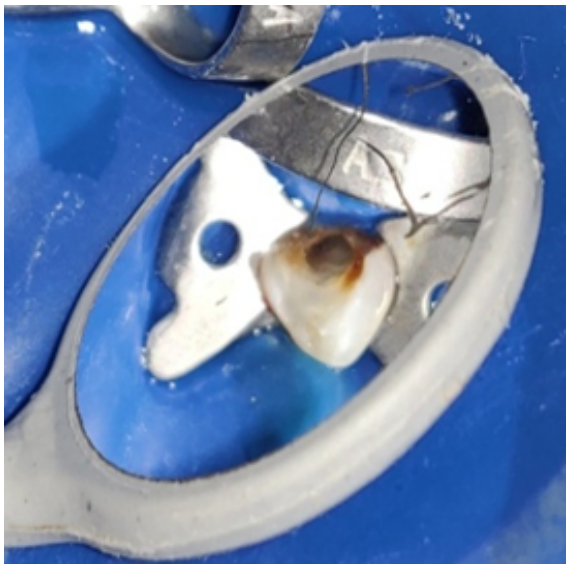

Figure 3: Access opening

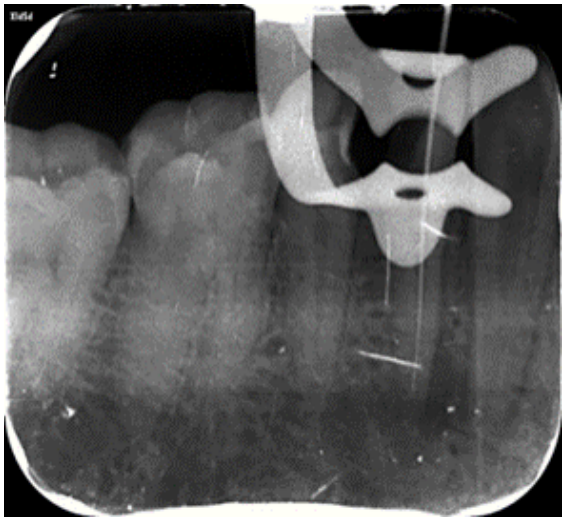

Figure 4: working length determination

Figure 5: Fractured S1 protaper in canal

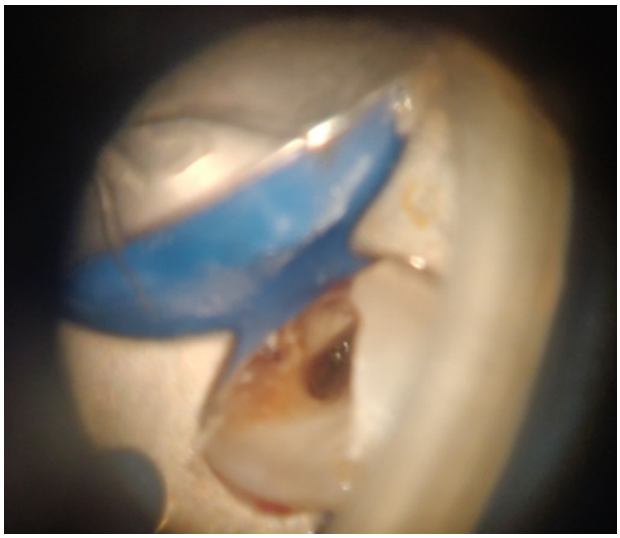

Figure 6: Fractured file located under microscope

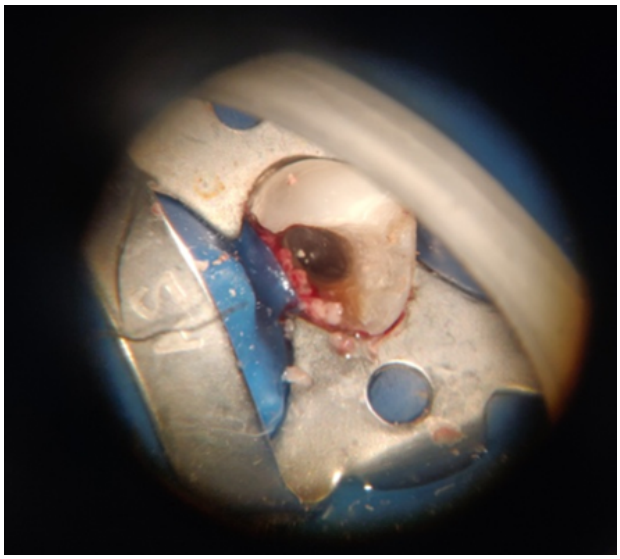

Figure 7: Fractured instrument loosen

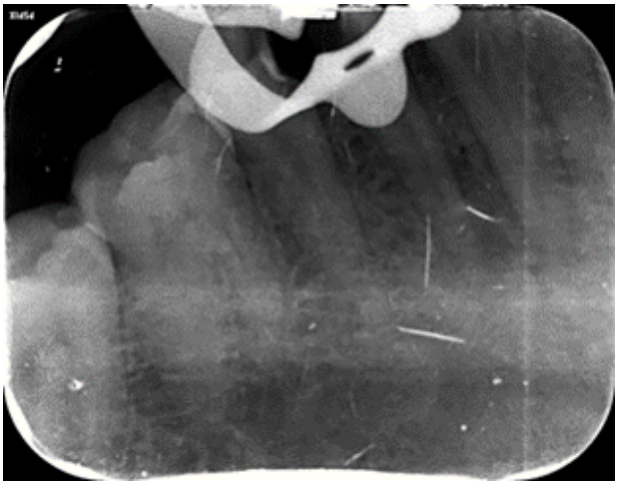

Figure 8: Instrument retrieved

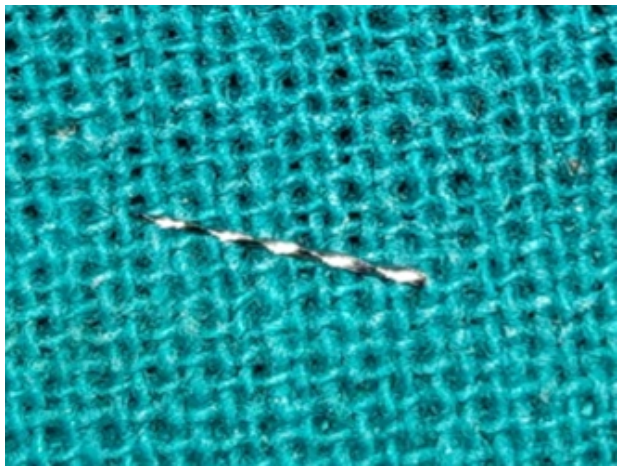

Figure 9: Retrieved instrument

Figure 10: Master cone fit

Figure 11: Obturation, postendo restoration

dentin with 45 (Figure 1). On the EPT and Heat test, 44 was seen to be non-vital. The case was diagnosed as symptomatic irreversible pulpitis with 44. Root canal treatment was planned for 44

Management

Local anesthesia was administered " 2% lignocaine with 1:80,000 epinephrine" (Reddy *et al.*, 2019). 44 was isolated using a rubber dam (Figure 2). Access opening was done using BR 45 bur with 44 and modified by EX 24 bur (Figure 3). Pulp extirpation was done using barbed broach (Mani inc Japan). Working length determination was done using 15 no K file (Mani inc. Japan) using apex locator (Dentsply) and confirmed on PSPIX, WL 21 mm (Figure 4). Biomechanical preparation was initiated using hand Protaper (Dentsply Maillefer 6% taper). During BMP, S1 pro taper got fractured at the junction of the middle and apical third of root (approximately of length 4 -5mm). Thus, Instrument separation was confirmed on a digital radiograph (Figure 5). The fractured instrument was then bypassed using 6, 8, 10, no K file (Mani inc Japan), and 17% EDTA gel and liquid (Prime Dental). The precise location of the fractured file was confirmed under the Dental operating microscope (Carl Zeiss, Germany). The coronal end of the fractured instrument was appreciated under a microscope (Figure 6). Using the GG drill no. 4 (Mani inc Japan) staging platform was created**.** The fractured file was located more towards the lingual area of the canal. Ultrasonic tip no.3 and 4 (pro ultra) at a power setting of 4 were used. It was placed between the exposed part of the file and canal wall and activated in the counter-clockwise direction, for removal of dentin around the separated file and to loosen it (Figure 7). Following ultrasonic activation, fractured files popped out from the canal. The fractured instrument was approximately 5 mm in length (Figure 9). The patency of the canal was checked under the microscope (Carl Zeiss, Germany) and digital radiograph (Figure 8). The working length was reestablished by Electronic Apex Locator (Dentsply) and confirmed radiographically (Figure 8). Biomechanical preparation was completed up to F4 (Dentsply Maillefer). 3.5% Sodium Hypochlorite (Prime dental) and saline were used for irrigation during RCT. Final rinse by 17% EDTA (Prime Dental) followed by 2% CHX(Neelkanth). Master apical gutta-percha cone (Dentsply Maillefer) fit was taken (Figure 10) (Kriplani *et al.*, 2013). Sealapex sealer was coated in the canal, and sectional obturation followed by backfill by thermoplasticised gutta-percha was done using system B (sybron Endo) (Khubchandani *et al.*, 2017). Composite resin restoration (spectrum) was done with 44 (Figure 11) (Patni *et al.*, 2016).

Discussion

Treatment options and long-term prognosis of treatment after file fracture are influenced by many factors: canal preparation stage, level of microbial contamination, and intra-canal location of the separated file, level of the fracture (Chandak *et al.*, 2018). Removal is more accessible when the fragment is found in coronal or mesial third, rather than when it is located in the apical third of the root canal (Sathe *et al.*, 2019). As far as the tooth location (Panchbhai, 2019b), the possibility of a successful instrument removal is higher for the anterior and upper teeth (Panchbhai, 2019a) compared to the posterior and lower ones (Fiore *et al.*, 2006). When the fragment lies coronally to the curvature, or at the level of the curvature, it is easily removed than being beyond the curvature (Nevares *et al.*, 2012). Finally, longer fragments are more easily removed than shorter ones (Shahabinejad *et al.*, 2013). The rate of successful fragment removal (44%-95%) is higher than that of successful instrument bypass (9%-47.7%) (Hülsmann and Schinkel, 1999). Instrument separation occurs more frequently in molars (77% - 89% of all cases) (Cohen *et al.*, 2005). A higher risk of separations with lower molar (50-55%). Regarding upper molars, the separation of endodontic instruments is three times more liable to occur in the mesiobuccal root canals than the distobuccal ones in lower molar mesiobuccal root canals is three times more common than in the mesio lingual ones (Cohen *et al.*, 2005). Frequency rises proportionally to increased curvature: 7% in straight root canals, 35% on an average in curved ones, and 58% in intensely curved ones. As far as the location of the separated fragment, a higher rate of separation is observed in the apical third (41% - 82.7%) (Cohen *et al.*, 2005) a lower one in the mesial third (14.8% - 32%) (Cohen *et al.*, 2005) and an even lower one in the coronal third (2.5% - 20%) (Cohen *et al.*, 2005). The most common separation site is 2mm from the tip of the instrument. The most common sizes of instruments undergoing separation are No 20-40 (ISO). In taper, separation most commonly happens in files with a taper between 4% and 9%. Treatment of separated instruments can be conservative/surgical (Cohen *et al.*, 2005). In manual instruments, Hedstrom files are problematic than K files due to their morphology, which causes a stronger engagement with the dentin (Torabinejad and Lemon, 2002). Concerning NiTi instruments, their removal is more complicated than removing instruments made of stainless steel. This is due to NiTi instruments usually separating at a shorter fragment length, more apically, in the curvature of narrow root canals, with

the rotation movement locking them into the dentin. NiTi instruments can further separate or shorten due to damage from ultrasonic vibration during the attempt to remove the fragment (Torabinejad and Lemon, 2002). There are three approaches to conservative treatment

1. bypass of the separated instrument,
2. removal of the fractured file,
3. instrumentation and obturation of canal coronally to the fragment (Mukherjee *et al.*, 2017).

It is also suggested that the patient should be informed about the instrument separation, the treatment to be followed, and the prognosis for the tooth (Kamble *et al.*, 2017). Bypassing the instrument is also considered to be the first step towards removing fractured files from the root canal (Torabinejad and Lemon, 2002). As it reduces contact between the fractured file and root dentin and creates space for inserting other instruments, such as ultrasonic tips, it can fully detach the fragment from the root dentin (Mukherjee *et al.*, 2017). Bypassing the separated instrument requires the use of hand files. Retrieval of the fractured file is a more favourable option. Point to be considered while selecting a technique for removal is; it should not weaken the remaining tooth structure, which might affect tooth prognosis (Kamble *et al.*, 2017). The ultrasonic technique is simple and conservative (Khatod *et al.*, 2020) with the availability of different sizes of ultrasonic tips. Ultrasound vibration is transferred to the separated instrument that leads to loosening and eventually dislodges it from the canal. Ruddle et al., reported a technique that includes modified Gates-Glidden drill, ultrasonic tips, dental operating microscope (Plotino *et al.*, 2007). GG drill with diameter slightly higher than the fractured file is selected. GG drill is modified at maximum diameter by cutting it perpendicularly. This creates a small staging flat form that facilitates the placement of ultrasonic tip. This technique is considered to be most effective for instrument retrieval. Since the canal was ovoid, the use of ultrasonic was found to create a purchase around the file and loosen it within the canal to facilitate retrieval with minimal tooth structure removal. In cases where instrument fragment resists removal, a file can be introduced along the length of the separated instrument, and ultrasonic vibration is applied to the file in an attempt to remove it. This technique is termed as indirect ultrasonic. However, caution should be exercised as complications of ultrasonic removal includes loss of dentin, file extrusion, perforation, the rise of root temperature on the outer surface (Plotino *et al.*, 2007). Ultrasonic tip activation is done at lower power to avoid tip fracture, further file breakage, and rise of temperature. Water supply is slowed down for better visibility in the canal. The use of ultrasonic at power five without water for = 60sec and at power 1 for = 90sec increased the temperature in the outer surface of the root = 10°C The use of air significantly reduced the rise of temperature in the outer surface of the tooth Adding an air spray at power 1.5 for 120sec prevented a temperature augmentation. When considering the use of air cooling for ultrasonic, the risk of air embolism must always be taken into consideration81 (Hashem, 2007). Generally speaking, the extent of temperature rise depends on the width of the root canal wall, the type of the tip used, the power, and the duration of usage (Madarati *et al.*, 2008) .

CONCLUSIONS

Retrieval of the fractured instrument is the treatment of choice, even though it depends on a variety of factors. Among the various techniques available, Ultrasonic is widely accepted due to its effectiveness. With adequate accessibility, visibility, and magnification, file retrieval turn to be a relatively easy procedure.

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Conflict of Interest

The authors have no conflict of interest.

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