

# Mitigating the Iatrogenic: Endodontic Management of Separated Instruments- A Consecutive Case Series

## Abstract:

Instrument separation is a common procedural complication in endodontic treatment that can impede thorough cleaning and shaping of the root canal system. If not properly managed, it may compromise treatment success by restricting access to the apical third of the canal. The decision to retrieve, bypass, or leave the fragment in situ depends on several clinical factors, including the location and type of the separated instrument, canal anatomy, and the tools available. With recent advancements in magnification and ultrasonic technologies, conservative management techniques have become increasingly effective and less invasive. Approaches such as ultrasonic activation and file braiding enable clinicians to remove or bypass fractured instruments while preserving tooth structure. The success of such procedures largely depends on the operator's skill, visibility of the fragment, and the ability to maintain canal patency throughout the treatment. In this case series, separated instruments were successfully managed using both retrieval and bypass techniques, highlighting the importance of a strategic and minimally invasive approach in endodontic practice.

**Key-words:** Instrument separation, Root canal treatment, Endodontic mishaps, File retrieval, Bypass technique, Ultrasonics in endodontics, Fractured endodontic instrument, File braiding technique

## Introduction:

Instrument separation is a challenging complication encountered during endodontic therapy, often compromising effective cleaning, shaping, and obturation of the root canal system. A variety of instruments—including endodontic files, spreaders, Gates-Glidden drills, and burs—can fracture due to factors such as excessive canal curvature, repeated use, improper technique, or manufacturing defects. Nickel-titanium (NiTi) instruments, while advantageous for their flexibility and shape memory, have shown higher rates of separation compared to stainless steel counterparts.

The clinical implications of a separated instrument depend on its location within the canal, the stage of treatment at which the separation occurs, and the canal anatomy. When a fragment obstructs access to the apical portion of the canal, it may prevent thorough debridement and sealing, thereby increasing the risk of treatment failure. Prompt diagnosis and appropriate management are critical to improving prognosis and preserving the tooth.

Multiple techniques and tools have been developed to manage fractured instruments, including ultrasonic systems, retrieval kits like the Masserann or Terauchi kits, chemical solvents, and manual approaches such as the file braiding technique or hypodermic needle method. When direct retrieval is not feasible, bypassing the fragment is considered a conservative and effective alternative that allows continued cleaning and shaping of the canal without extensive removal of dentin.

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Magnification tools such as dental operating microscopes, combined with ultrasonics, have significantly improved visibility and precision during retrieval procedures, enhancing success rates. The choice between retrieval and bypass depends on the location, visibility, and mobility of the fragment, as well as the clinician's expertise and the tools available.

In this case series, two clinical scenarios are presented where separated instruments were successfully managed using conservative approaches—retrieval in one case and bypass in the other—highlighting the importance of proper technique selection based on case-specific factors.

### Case Report 1 - Retrieval of Separated instrument from middle 3<sup>rd</sup> of mandibular 1<sup>st</sup> molar

#### Patient Information & Chief Complaint:

A 22-year-old female visited to the department of conservative dentistry and endodontics of HPGDC, Shimla with the chief complaint of severe pain in the lower left back jaw region for the past 5 days. The pain was spontaneous, sharp and nocturnal in nature.

#### Clinical & Radiographic Findings:

Upon clinical examination, tooth #36 showed carious exposure involving the distal cusp. The diagnosis of Symptomatic irreversible pulpitis was made and RCT was initiated.

#### Clinical procedure:

Following local anaesthesia via inferior alveolar nerve block, an isolation with rubber dam was placed. Complete caries removal and access refinement were performed using a high-speed handpiece with a Dentsply Endo-Access diamond bur and a safe-ended Endo-Z bur. During exploration, a C-shaped canal configuration was observed in the mandibular first molar, characterized by a single mesial and a single distal canal. During orifice enlargement, there was iatrogenic separation of S<sub>x</sub>Protaper file in distal canal of said tooth. (Figure 1a). The patient was informed about the tooth's condition and the recommended treatment plan, and a written, informed consent was obtained prior to starting the retrieval of instrument.

Under the (Labomed Magna) dental operating microscope, the distal canal was visualized and the file's head could be seen within it. The head of the file was visible to the naked eye as well. (Figure 1b) Sequential coronal flaring was performed using Gates-Glidden drills #2, #3 and then #4. It was then attempted to bypass the fractured instrument with H-files,

progressing incrementally from size 20 up to size 40. After completely bypassing the file, endodontic ultrasonic tips were used to loosen the instrument fragment. (Figure 1b)

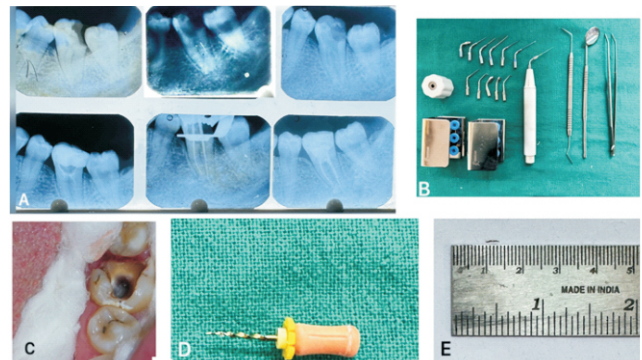


Figure 1

After the fragment was loosened, the created space was used to employ “Braiding technique” in order to retrieve the file. Two H files (no. 10 and no. 15) were inserted in the canal and twisted around the separated file and then pulled upwards towards the orifice. After several attempts, the file came out of the canal and was retrieved with the help of steiglitz forceps. The fragment was 3.5 mm in size. (Figure 1d and 1e)

Confirmation of retrieval of complete fragment was done by taking an intra oral periapical radiograph. Working length was taken using apex locator (J.MORITA DENTAPORT ZXII) and confirmed on IOPAR. Calcium hydroxide dressing was placed in the canal after completion of BMP. The patient was recalled after a week and since she was completely asymptomatic, the canals were obturated and post endodontic restoration was also done.

### Case report 2 - Retrieval of separated instrument from Coronal 3<sup>rd</sup> of Maxillary 1<sup>st</sup> Molar

#### Patient Information & Chief Complaint:

A 34-year-old female visited to the department of conservative dentistry and endodontics of HPGDC, Shimla with the chief complaint of pain in the upper left back tooth region for the past 1 month. She described the pain as sharp and shooting type which aggravated on eating cold food items. She also complained of increase in pain during night.

#### Clinical & Radiographic Findings:

Upon clinical examination, it was observed that access opening was already done with respect to tooth #26. A separated file head could also be seen in the distobuccal canal of the tooth. The tooth exhibited tenderness to percussion. Patient mentioned that root canal treatment had been started for that tooth, 3 months back.

Intraoral periapical radiograph of the tooth showed incomplete endodontic treatment of the tooth. A fractured k-file measuring approximately 4-5 mm was seen in the coronal third of the distobuccal canal of the tooth. (Figure 2a)

**Clinical procedure:**

Treatment was initiated after obtaining a written, informed consent from the patient. After administering appropriate local anaesthesia (Posterior superior alveolar nerve block), the tooth was isolated using rubber dam. Residual caries was removed and access was refined using a high-speed handpiece with Endo-Access diamond bur (Dentsply) and a safe-ended Endo-Z bur. The tooth was viewed under the dental operating microscope (Labomed Magna), for a better visualisation of the separated file fragment, the head of which was otherwise visible to the naked eye as well. (Figure 2b).

Sequential coronal flaring was performed using Gates-Glidden drills #2, #3 and then #4. The fractured segment was then bypassed using small number k files starting from #8, progressing sequentially upto #30. After completely bypassing the file, endodontic ultrasonic tips were employed to loosen the instrument fragment.

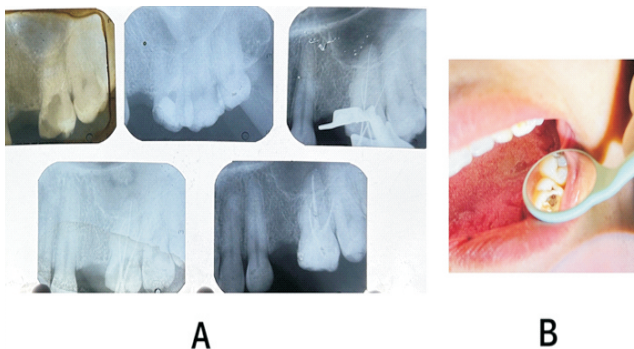


Figure 2

After achieving loosening of the fractured segment, “Braiding technique” was used to retrieve the file. Two H files (no. 10 and no. 15) were inserted in the space created in the canal by coronal flaring and twisted around the separated file and then pulled upwards towards the orifice. After several attempts, the file came out of the canal and was retrieved with the help of steiglitz forceps. The fragment was 4 mm in size.

Complete retrieval was confirmed by taking an intra oral periapical radiograph. Working length was taken using apex locator (J.MORITA DENTAPORT ZX) and confirmed on IOPAR. BMP was completed and intracanal calcium hydroxide dressing was placed. The patient was recalled after a week for obturation and post endodontic restoration. The symptoms were completely resolved.

**Case report 3 – Bypass of a separated instrument in middle apical 3<sup>rd</sup> of Mandibular 1<sup>st</sup> Molar**

**Patient Information & Chief Complaint:**

A 27 year old male was referred to the department of conservative dentistry and endodontics of HPGDC, Shimla with the chief complaint of a dull, aching pain in right lower back tooth region for the past 2 months, which was occasionally extreme and radiated to the upper jaw as well.

**Clinical & Radiographic Findings:**

Clinical examination revealed mesial proximal caries in mandibular right first molar. The tooth was tender on percussion. On radiograph, caries was seen to be extending upto the mesial pulp horn. No pdl widening or periapical lesion was apparent. Diagnosis of irreversible pulpitis with respect to #46 was made.

**Clinical procedure:**

The patient was explained about the diagnosis and the treatment plan and root canal therapy was initiated for the offending tooth. Access opening was done under Local anaesthesia and rubber dam isolation. Working length was determined using apex locator and verified radiographically. While performing cleaning and shaping using hand files, a # 30 stainless steel K-file was separated in the mesiobuccal canal of the tooth. A radiograph taken to judge the level of separation revealed the fractured segment at the junction of middle and apical third. Since the fragment was difficult to retrieve, it was decided to attempt a bypass instead.

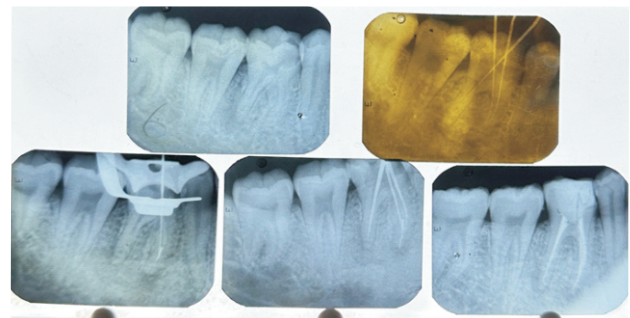


Figure 3

A #8 c plus (Dentsply) file was lubricated with EDTA gel and inserted carefully into the canal so as to avoid placing the file directly over the fractured segment. The file was walked around the separated instrument in order to find a catch where the file engaged between the dentinal wall and the broken instrument. Once a catch was felt, the file was progressed further in quarter turns followed by outward movement of the file. Small in and out movements along with copious irrigation of the root canal was done. The same sequence of quarter turn and then withdrawing the file was continued until

the file reached the full working length after which a radiograph was taken to confirm the bypass. Similarly, the full working length was bypassed upto #25 k file. Cleaning and shaping of the other 2 canals was done as usual and calcium hydroxide dressing was placed in the canals. In the next visit, after 1 week, the patient was completely asymptomatic and the canals were obturated followed by post endodontic restoration. (Figure 3)

#### **Case report 4 – Bypass of a separated instrument in apical 3<sup>rd</sup> of Mandibular 1<sup>st</sup> Molar**

##### **Patient Information & Chief Complaint:**

A 52 year old female came to the department of conservative dentistry and endodontics with the chief complaint of decayed tooth in lower right back jaw region. The tooth had been as such for the past one year. She had pain in the same tooth 3 months back for which she sought treatment elsewhere but did not complete the treatment.

##### **Clinical & Radiographic Findings:**

On examination, it was seen that the mandibular left first molar had distal proximal caries with temporary restoration placed in it.

Intraoral periapical radiograph showed incomplete root canal treatment in tooth #36 with a separated k file of about 4-5 mm lodged in the apical third of mesial root of the tooth.



##### **Clinical procedure:**

The patient was informed about the tooth's condition and the recommended treatment plan. Inferior alveolar nerve block was given and rubber dam was placed for isolation. The access refined and caries removal was completed. Three canals were visualised and while inserting the files into the canals, an obstruction was felt in the mesiobuccal canal, indicating that the broken file was in the mesiobuccal canal.

Bypass of the fractured segment was initiated using the same technique as in case 3, starting with #8 k file, progressing upto #20 k file. Bypass was confirmed radiographically. Then the working length radiograph was taken followed by cleaning and shaping of the canals and placement of intracanal medicament. In the next appointment, after 7 days, the patient was asymptomatic and the treatment was completed with obturation and post endodontic restoration.

##### **Discussion:**

File separation during root canal treatment remains one of the most challenging procedural issues clinicians can encounter. Despite their flexibility and widespread use, NiTi rotary instruments remain susceptible to both torsional overload—when the file tip locks but the motor continues—and cyclic fatigue—when the file bends repeatedly in curved canals, leading to microscopic cracks that eventually fracture. In particular, smaller instruments like ISO sizes 15 and 20 have thinner cross-sections, making them more prone to failure under stress or repeated reuse.

When a broken file occurs, clinicians face two main treatment options: removing the fragment surgically or non-surgically, including bypassing it or filling the canal only upto the obstruction. Even if a file fractures inside the canal, it doesn't necessarily spell doom for the tooth's long-term prognosis. With the advent of dental operating microscopes and precision ultrasonic tools, many of these separated fragments can now be safely removed. Under magnification, clinicians can clearly see the fragment and perform highly targeted ultrasonic manoeuvres. This precise approach allows for accurate loosening or retrieval of the fragment while preserving as much surrounding dentin as possible. The feasibility of instrument retrieval often hinges on factors like fragment location, canal anatomy, dentin thickness, and whether the canal curvature allows straight-line access. Fragments in straight, coronal portions are easier to remove safely; those lodged beyond curvature pose greater risk and may compromise canal integrity if aggressive retrieval is attempted.

Alternatively, bypassing the fragment can preserve tooth structure while re-establishing patency beyond the obstruction. This involves gently introducing a small, pre-curved stainless-steel hand file alongside the lodged fragment, under proper magnification and lubrication, avoiding unnecessary dentin removal. If bypass is successful, shaping may continue to a safe apical size (e.g. ISO #30) before obturation, provided the fragment has not compromised the canal integrity.

Modern ultrasonic systems—with specialized tips and piezoelectric operation—can facilitate safe instrument removal with success rates up to ~80–90% in some procedures. However, these methods still require staging platforms and can remove excessive dentin, increasing the potential for root weakness or perforation despite advances in magnification.

In our reported case, a size #8 pre-curved stainless-steel hand file was gently threaded alongside the #25 fragment, and sequential enlargement up to size #20 was performed. Calcium hydroxide was used as an interim dressing to support microbial control. Using magnification, generous irrigation, and a cautious step-by-step approach, canal patency was restored without aggressive retrieval—a strategy consistent with conservative management philosophies and backed by clinical case literature

### Conclusion:

With a sound understanding of root canal anatomy and instrumentation technique, various mishaps such as instrument fracture can be avoided but in case an accident occurs, it is possible to successfully remove instruments that have been lodged in the canal using magnification and ultrasonics. It is preferable to remove the fragment wherever possible. But in spite of the best existing techniques, the broken file segment sometimes may not be retrieved. In such cases, instrument bypass is also a viable option.

This case series reinforces that, when a file fragment is lodged in the curved apical third of a canal, bypassing the fragment can be a highly effective and more conservative approach than attempting retrieval. By maintaining minimal intervention—using small pre-curved hand files, diligent irrigation, and radiographic control—clinicians can regain canal patency, complete biomechanical preparation, and obturate effectively.

Reliable outcomes depend on informed patient discussion, adequate isolation, careful instrument selection, and radiographic verification throughout. The favorable healing observed at follow-up in this case underscores that, when performed meticulously, bypassing a lodged fragment can preserve tooth structure and offer a prognosis comparable to more invasive methods—often with fewer risks.

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