

## **Clinical Challenges and Success Strategies in Bypassing separated Endodontic files: two case reports**

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**Abstract:**

## Introduction:

Broken instruments within the root canal system is a frequent and challenging complication in endodontic treatment, which can compromise the continuation of therapy and potentially affecting the prognosis of the tooth. The bypass technique offers a conservative approach that aims to preserve the root structure while allowing effective canal debridement.

This article presents two clinical cases highlighting the challenges encountered during the bypass of separated endodontic files, as well as the key strategies and precautions required to optimize treatment success. We will discuss also the selection of appropriate instruments, and meticulous technique to negotiate broken fragments without compromising canal integrity.

## Observation:

Each case report details a unique clinical scenario, including the location and characteristics of the separated file, root canal anatomy, and the instruments and methods used to achieve the bypass. In all cases, the bypass technique successfully allowed the clinician to negotiate around the fractured instrument, facilitating adequate canal cleaning and optimal obturation.

## Discussion:

When an instrument is broken in the root canal system a decision has to be made whether to leave, bypass, remove the file or even performing an apicoectomy. Our choice is based on an assessment of the potential benefit of removal compared with the risk of complication. The patient's preferences is an important factor in this decision, as they may choose to have the tooth extracted for reasons such as anxiety, time and finance. Evidence shows that deeper fragments are associated with significantly greater dentin removal during retrieval attempts, which consequently reduces the fracture resistance of the root.

Given the risks of retrieval, bypassing a separated instrument represents a conservative strategy that maintains dentin and canal integrity. This technique uses the slight gap between the fragment and the inner wall of the canal to negotiate a pathway with small precurved files, preserving tooth structure and enabling effective cleaning and obturation when patency is reestablished.

## Conclusion:

Ultrasonic retrieval can be useful but includes significant risks such as dentin loss, thermal damage, and reduced root strength. Studies indicate that the bypass technique is a conservative approach, not demanding in terms of equipment yet able to ensure therapeutic success.

**Keywords:** broken file, separated instrument, by-pass, retrieval, tooth structure preservation, prevention.

## Introduction

The success of endodontic treatment relies on the precise shaping, thorough disinfection, and three-dimensional obturation of the complex root canal system (3,4). Unfortunately, during root canal therapy, instrument broken is a common complication and represents a significant clinical challenge (2,4). Files separation cannot be completely avoided because of the complex morphology of root canals (2). In addition, the confined surgical field and narrow operating space pose significant challenges to the clinician's visibility and instrument manipulation (3). Separated files, especially those separated in the apical third of the root, makes it difficult to eliminate infection from the root canal system due to absence of patency (5, 7).

To manage such situations, several therapeutic options are available, including instrument retrieval, bypassing the fractured segment, or leaving the fragment in place followed by canal obturation if cleaning and disinfection can still be achieved (3,6). Among these approaches, bypassing the fractured instrument is considered a conservative and effective method that allows the clinician to maintain tooth integrity while ensuring adequate canal debridement (1, 3, 6).

## Observations:

### Case 1:

The present case involved a 27-year-old female patient in good general health, with no relevant medical history. She was referred by a colleague due to persistent pain associated with the mandibular right first molar (tooth no. 36).

Clinical examination revealed tenderness to percussion, while the tooth showed non-response to cold test, no swelling or sinus tract. Radiographic examination (fig 1) demonstrated the presence of a fractured endodontic instrument located in the middle third of the mesio-lingual canal, suggesting the possibility of performing a bypass technique.

During the initial preparation of the mesio-lingual canal, an obstruction was encountered at a depth of 18 mm. To address this challenge, the bypass technique was carefully employed as follows:

Initially, coronal preflaring of the canal was performed using an opener file (diameter #019, conicity 8%) from E-Flex Gold (Eighteeth). It was crucial to create sufficient coronal space to facilitate the bypass attempt within the narrow gap between the canal wall and the fragment.

A #08 stainless steel K-file was pre-curved and gently inserted into the canal in an attempt to search a catch and navigate past the fragment between the dentinal wall and the broken instrument.

Once a tactile sense of engagement is achieved, a radiograph was taken to confirm the establishment of a path along the inner wall (Figure 2).

Instead of attempting immediate removal of the #08 file, a watch-winding motion combined with gentle in-and-out movements was performed, accompanied by thorough irrigation of the canal with sodium hypochlorite 2.5%. Subsequently, a #10 stainless steel K-file (DENTSPLY Maillefer) was used to further enlarge the pathway created by the #08 K-file, using the same technique until working length was achieved and verified radiographically (fig 2).

After that, a smooth canal pathway was performed beyond the fractured segment using rotary glide path files #13, #16 and #19 with 2% taper from Eighteeth. Canal shaping was completed using the TCA technique to ensure adequate cleaning and enlargement of the root canal system.

We have used shaping files up to #25 with 4% taper in mesial canal and 6% taper for the distal canal. A master cone fit X-ray was taken (fig 3). Irrigation with sodium hypochlorite 2.5%, activation with ultrasonic tips (UltraX - Eighteeth) and a definitive obturation using cold lateral condensation and a resin-based sealer was then performed, followed by radiographic and clinical evaluation, which confirmed a satisfactory filling and absence of postoperative symptoms (fig 4).



Fig 1: Pre-operative X-ray



Fig 2: (a) first working length radiograph along with partially by-passed broken file. (b) second working length radiograph along with completely by-passed broken file.



Fig 3: Radiograph showing the master cone fit with the bypassed instrument.



Fig 4: post-operative X-ray.

**Case 2:**

A 56-year-old female patient with no medical history was referred from her general dentist to the Department of Conservative Dentistry and Endodontics for management of a broken file on tooth number 17.

The patient presented with a challenging scenario: A broken file was lodged in the disto-buccal canal of the upper right second molar, at the apical third beyond the canal curvature.

The initial diagnosis was apical periodontitis. A periapical radiograph was taken to assess accurately the position of the separated file within the canal. (Fig 5)

Coronal access was refined to achieve a straight-line access toward the fragment, using ultrasonic tips before attempting bypassing maneuvers.

We have used 2.5% NaOCl as the primary irrigant to remove debris and disinfect the canal. Working length was established using an electronic apex locator for the mesio-buccal and palatal canals, which were prepared using the E-flex blue rotary files up to #25 4%. After instrumentation, irrigation using NaOCl 2.5% was performed, and both canal orifices were temporarily sealed with paper points and cotton to prevent the entry of additional debris or file fragments.

In the disto-buccal canal, management of the broken file began by creating a staging platform using a Satelec ET20 ultrasonic tip (Satelec Acteon, France), removing dentin around the coronal portion of the fragment in order to expose it. This step allows improved space creation around the fragment without attempting to completely loosen or unscrew it. Once adequate amount of dentin was removed and a catch point was obtained, bypassing was initiated. A #06 pre-curved Stainless-steel C-file was gently used alongside the fragment, allowing progression past the obstruction and re-establishment of canal patency.

Patency was ensured afterwards with a size 08 and 10 stainless steel K-file and glide path file #15 taper 3% (Magic Path Rainbow). A radiograph was taken to confirm the bypass (fig 6).

During the shaping of this disto-buccal canal, irrigation was carried out with 2.5% NaOCl and 17% EDTA separated by saline, followed by ultrasonic activation (UltraX Eighteenth).

Root canal obturation was performed using a bioceramic sealer (BioRoot) with a warm hydraulic condensation technique to ensure a three-dimensional seal of the root canal system (fig 7).



Fig 5: Periapical radiograph showing the preoperative status of tooth 16.

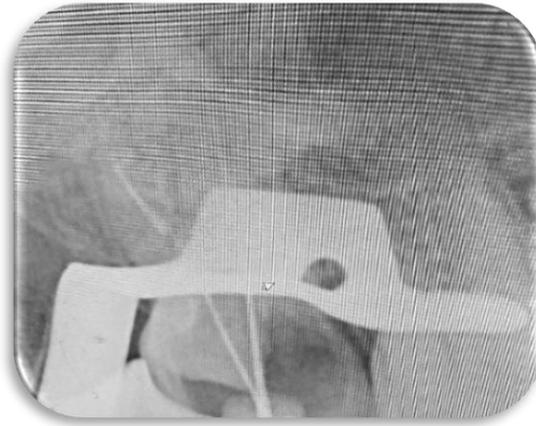


Fig 6: Periapical radiograph showing the broken fil bypassed.



Fig 7: Post-operative periapical radiograph showing the filled root canals of the tooth 17.

### Discussion:

#### Decision-making: retrieval, bypass, or retention:

When an instrument is broken in the root canal system a decision has to be made whether to leave, bypass, remove the file or even performing an apicoectomy. Our choice is based on an assessment of the potential benefit of removal compared with the risk of complication. The patient's preferences is an important factor in this decision, as they may choose to have the tooth extracted for reasons such as anxiety, time and finance (3,6).

The management of separated endodontic instruments remains a major clinical challenge, especially when the fragment is located in the middle or apical third of the canal. The clinician must balance the biological objective (effective canal disinfection) with biomechanical concerns (preservation of dentin and root integrity). Evidence shows that deeper fragments are associated with significantly greater dentin removal during retrieval attempts, which consequently reduces the fracture resistance of the root (5). Studies demonstrate a clear trend: the deeper the fragment, the greater the root-mass loss and the lower the force required to fracture the root vertically, indicating a measurable weakening of radicular structure during ultrasonic-assisted removal (6).

The presence of a fractured instrument does not necessarily compromise prognosis on its own (4,7) especially when no periapical disease is present. In such cases, bypassing or retaining the fragment may be sufficient, whereas in cases with apical pathology, the risk of persistent

infection may justify retrieval or bypass (3). Decision-making must consider pulp status, periapical condition, fragment location, canal anatomy, and the risks associated with retrieval. And not to forget practitioner ability and experience (3,2). Removal of fractured instrument from deeper locations within the root canal compromise root resistance to vertical fracture; the importance of the need for careful case selection (5).

#### **Role and Risks of ultrasonic assisted retrieval:**

Modern retrieval techniques often rely on microsurgical tools and ultrasonic tips (6). Although effective, these procedures lead to dentin removal, weakening of the root, or even vertical root fracture (5). Ultrasonic energy may also generate heat, risking periodontal injury, and may cause secondary separation or deeper displacement of the fragment (6). Even successful removal may compromise long-term structural integrity (5). For deeply located fragments, bypass as a minimally invasive and structure protective option often provides the best balance between effective treatment and long-term tooth preservation (1,3,6).

#### **Bypass as a conservative alternative:**

Given the risks of retrieval, bypassing a separated instrument represents a conservative strategy that maintains dentin and canal integrity (3). This technique uses the slight gap between the fragment and the inner wall of the canal to negotiate a pathway with small precurved files, preserving tooth structure and enabling effective cleaning and obturation when patency is reestablished (1,6).

There are many factors when present may facilitate the bypass procedure, first when the canal is pre-enlarged or when it has an oval section, we can find the gap between the file and the inner wall easier compared to a round sectioned canal (2). In addition, the hand files are easier to bypass than the rotary files due to their minimal taper (2,6). Also, in presence of small fragments, retrieval can cause more harm than benefit, so in this case, bypass is an option that is more suitable (3,5).

The bypass technique is based on tactile sensation and using hand files with small diameters, with or without EDTA gel, which can facilitate the procedure but must be used carefully to not cause misdirection and root perforation (6). Then a hermetic obturation allow the sealing of the separated file (7).

When bypass maneuver succeed, healing of the tooth is guaranteed with a very good prognosis.

#### **Limitations and considerations:**

Bypassing may not always be feasible in severely curved, calcified, or narrow canals (2). Fragment size, type, and engagement also influence success (2). In case of long separated file, the risk to cause a secondary fracture is considerable, so here retrieval is indicated. Operator skills, magnification, and cautious tactile control remain essential factors (3).

#### **Prevention of Instrument Fracture in Endodontics**

Instrument fracture is one of the most common iatrogenic complications in endodontics, influenced by canal anatomy, instrument design, operator experience, and clinical technique (8). Complex root canal curvatures, excessive torsional stress, and repeated use of NiTi instruments significantly increase the risk of separation (8). Preventive strategies should therefore focus on careful preoperative assessment, creating straight-line access, adhering to manufacturer-recommended torque and speed settings, using adequate irrigation and lubrication, and limiting the reuse of instruments (8). By minimizing these risk factors, the likelihood of instrument fracture can be reduced, thus preserving the structural integrity of the tooth (8). Nevertheless,

when a fracture occurs despite preventive measures, conservative management options such as bypassing the fragment provide a viable approach to continue canal disinfection and obturation while maintaining tooth strength (6,1). Integrating prevention with conservative management strategies ensures optimal clinical outcomes and reduces the risk of further complications (6,8).

### **Conclusion:**

Bypass of separated instruments provides a conservative and effective option in many clinical situations. Careful assessment of canal anatomy, fragment characteristics, and operator skill remains essential to optimize outcomes. When retrieval is attempted, risks to tooth structure must be weighed against potential benefits. In the end, individualized clinical judgment is essential to select the most appropriate management strategy for each case.

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