



Precision Beyond Limits: Successful Instrument Retrieval from a Maxillary Bicuspid

Dr.Remya Varghese¹, Dr.Nikitha Babu²

***Corresponding Author:**
Dr. Nikitha Babu

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Abstract

Background: Instrument separation during endodontic treatment is one of the common complications that may make the outcome of root canal therapy more difficult. The retrieval of such instruments requires precision, advanced technology, and skilful technique. This case report discusses the retrieval of a separated instrument from the buccal canal of an upper premolar in a female patient using a dental operating microscope (DOM), ultrasonics, and the final obturation with Bio-ceramic sealer.

Keywords: Instrument retrieval, Dental Operating microscope (DOM), Ultrasonic tips.

Introduction

Instrument separation during endodontic treatment is a recognized challenge, often introducing additional procedural difficulties and increasing the risk of compromised outcomes. Broken instruments may include files, lentulo-spirals, silver points, or even portions of obturators that inadvertently become lodged within the canal system. Studies indicate that the incidence of instrument separation varies, with reported prevalence rates ranging between 0.5% and 6%⁽¹⁾. In fact, NiTi instruments used in rotary motion have separation rates ranging from approximately 1.3% to 10% due to factors like excessive torque and repeated use^[1,2].

Instrument separation poses a significant clinical obstacle, often impeding thorough disinfection and optimal shaping of the root canal system, which may, in turn, impact the prognosis of the treated tooth. Consequently, non-surgical retrieval methods have been developed to address this complication and improve treatment outcomes. The use of ultrasonic devices under magnification has proven especially beneficial in enhancing visibility and delivering controlled vibrations directly to the broken fragment, facilitating its dislodgment while minimizing additional dentin removal^[3].

The success of instrument retrieval procedures is highly dependent on several factors, including the root canal's anatomy, the location of the fractured segment, and the clinician's skill and experience. Studies estimate the success rates for non-surgical retrieval techniques to range from approximately 55% to 79%, depending on the specific technique used^[3]. Ultrasonic tips combined with DOM magnification have demonstrated a notable increase in retrieval success, providing clinicians with greater control over this delicate procedure.

This case report presents the successful retrieval of a separated NiTi file fragment from the middle third of palatal canal of a maxillary premolar, utilizing an ultrasonic tip and DOM. This case highlights the practical advantages of these techniques in managing complex endodontic complications with minimal impact on remaining tooth structure.

Case Report:

This case report has been written according to Preferred Reporting Items for Case Reports in Endodontics (PRICE) 2020 guidelines.^[4]

Patient History and Examination:

A 36-year-old female patient presented with a chief complaint of persistent pain in the upper right back

tooth region for past 3 weeks. Past dental history revealed history of restoration on the teeth for past 1 year. Systemic history was non-contributory. Intraoral examination revealed a deep restoration on the maxillary first premolar, which exhibited a hyper-responsive reaction to cold testing with lingering pain and a positive percussion response. A diagnostic radiograph confirmed the restoration's proximity to the pulp chamber, consistent with the clinical signs of symptomatic irreversible pulpitis. Based on the clinical and radiographic findings, a diagnosis of irreversible pulpitis with acute apical periodontitis was established, and non-surgical endodontic therapy was planned.

Treatment Protocol and Complication:

After obtaining informed consent, rubber dam isolation was achieved to maintain an aseptic field. The old restoration was removed, and access cavity preparation was performed. The working length was determined using an electronic apex locator and confirmed radiographically. Root canal instrumentation was initiated with the ProTaper file system (Dentsply Sirona), progressing in sequence. However, during the cleaning and shaping phase, an S2 ProTaper file separated within the buccal canal at the apical third.(Fig 1)

Instrument Retrieval Technique:

The decision was made to attempt retrieval of the separated instrument to improve the treatment outcome. Under magnification using a dental operating microscope (DOM) (Zeiss OPMI Pico) at 12.5 x magnification, the radicular access was carefully widened, and a staging platform was created using modified Gates-Glidden (GG) drills to provide better access to the coronal portion of the separated file. The Satelec P5 ultrasonic generator (Acteon, France) was utilized with ultrasonic tips ET18 and ET25 in sequential order to trephine dentin around the fragment with intermittent stroke in anticlockwise direction (Fig 2). The power setting was adjusted to level 4-6 for optimal efficiency without excessive heating.

Throughout the procedure, the canal was intermittently irrigated with 17% EDTA to remove debris and serve as a lubricant and coolant. After approximately 12 minutes of ultrasonic activation, the fragment loosened and was successfully removed

from the canal using a micro- tweeze (Hu Freidy)(Fig 3). A follow-up radiograph confirmed complete removal of the separated instrument. (Fig 4)

Completion of Root Canal Therapy:

With the instrument removed, the working length was re-established, and biomechanical preparation of the canal was completed with rotary ProTaper files to ensure thorough debridement. Following shaping and irrigation, the canal was dried, and obturation was performed using a Thermoplasticized GP obturation technique (Gutta flow, Dentsply) to ensure a well-adapted three-dimensional obturation without voids. The root canal space was sealed with gutta-percha in conjunction with a bio-ceramic sealer (BioActive RCS, Safe Endo to achieve a homogenous fill.(Fig 5)

Final Restoration and Outcome:

A postoperative radiograph verified a satisfactory obturation with no voids or overextension. The tooth was subsequently restored with a resin composite (Tetric N Ceram Bulkfill Composite) to ensure optimal coronal seal and restoration of function. The patient was advised to return for follow-up visits at three and six months to monitor periapical healing. At the three-month follow-up, the patient remained asymptomatic, and radiographs showed favourable periapical healing.

Discussion:

Instrument separation within the root canal system is one of the more challenging complications encountered during endodontic therapy, with implications for both the prognosis and the approach to treatment. This report discusses a case in which an S2 ProTaper instrument separated in the apical third of the buccal canal of a maxillary premolar, a location for its limited access and difficulty in manoeuvring retrieval instruments. Maxillary premolars, with their delicate root morphology and narrow canals, pose additional retrieval challenges when compared to molars, where instrument fractures are more common, often in the mesio-buccal root.

The incidence of instrument separation varies across studies, with a range from 2% to 6% in routine endodontic cases, largely due to the inherent fatigue and torsional failure of nickel-titanium (NiTi) instruments, while offering enhanced flexibility and canal adaptation compared to stainless steel files, are

still prone to separation due to cyclic fatigue, particularly in curved canals where repeated stress occurs. In this, the separated instrument was localized in the apical third, presenting a challenge due to the limited accessibility and potential risk of further weakening the canal walls during retrieval.^[5]

Management strategies for separated instruments vary depending on the clinical circumstances and location within the canal. Options range from bypassing the fragment to reaching the working length of the canal, to attempting retrieval when feasible. With recent advancements, retrieval procedures have become more predictable and successful. For instrument retrieval, methods including the Masserann kit, Endo Extractor, wire loop technique, and ultrasonics have been commonly used, with ultrasonic methods proving advantageous due to their minimally invasive nature, provide controlled and precise vibrations, allowing selective dentin removal around the fragment while minimizing damage to the canal walls. This approach is best facilitated under magnification provided by a dental operating microscope (DOM), which significantly improves visibility and precision, reducing the risk of iatrogenic errors. The success rate for retrieval of separated instruments is known to be markedly higher when the fragment is visible under a microscope, with *Nevaris et al.* reporting an 85.5% success rate compared to 47.7% when fragments were not visible.^[6]

The use of a dental operating microscope (DOM) in this case allowed for a controlled and minimally invasive retrieval process. DOMs enhance visibility, especially in cases with challenging anatomy, and have proven invaluable in instrument retrieval due to their magnification and illumination capabilities. They aid in precise localization and positioning of ultrasonic tips, which is critical for minimizing dentin removal and preserving root structure. Furthermore, using ultrasonic tips at low power and in a dry field prevents heat buildup, reducing the risk of further instrument fracture or dentin damage. In this case, the Aceton Satelec P5 Neutron was utilized, a piezoelectric ultrasonic device with linear, piston-like tip movement ideal for endodontic retrieval applications. The intermittent activation of the tip at medium power, without coolant, allowed for adequate visualization of the retrieval process, reducing thermal stress and enhancing safety.

After successful retrieval, the canal was obturated using thermoplasticized gutta-percha (GP). Thermoplasticized GP techniques, known for superior adaptation to canal walls and minimal voids, were particularly advantageous in this case, where complex canal anatomy required precise sealing. By utilizing thermoplasticized obturation, a three-dimensional fill was achieved, promoting long-term success by preventing microleakage and potential reinfection.^[7] Compared to lateral compaction methods, thermoplasticized techniques such as continuous wave condensation have shown better adaptation in the literature, with reduced voids and improved sealing in irregular canal morphologies.^[8]

The retrieval of separated instruments is influenced by various factors, including the location, length, and diameter of the fragment, as well as root canal morphology and curvature. NiTi instruments, like the ProTaper file used in this case, are particularly challenging due to their propensity to fracture under heat stress during ultrasonic removal, unlike stainless steel instruments, which absorb ultrasonic energy more evenly.⁽²⁾ The success in this case was also attributed to careful procedural planning and adherence to minimally invasive principles, ensuring preservation of dentin integrity and preventing complications such as ledges or perforations. When removal is not feasible or presents high risk, other approaches, including obturation to the level of the fractured fragment or even surgical intervention, may be considered, though these options may carry a lower success rate and increase patient morbidity.

Conclusion

This case demonstrates the successful retrieval of a fractured instrument in a maxillary premolar using ultrasonics under a dental operating microscope, followed by thermoplasticized obturation. The combined use of magnification and precise retrieval techniques preserved the root canal anatomy, contributing to a favourable prognosis and emphasizing the importance of advanced technology in managing complex endodontic cases.

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Fig.1- ProTaper file separated within the buccal canal at the apical third



Fig 2- Satellac Ultrasonic tips



Fig 3 A- retrieval of separated instrument under microscope

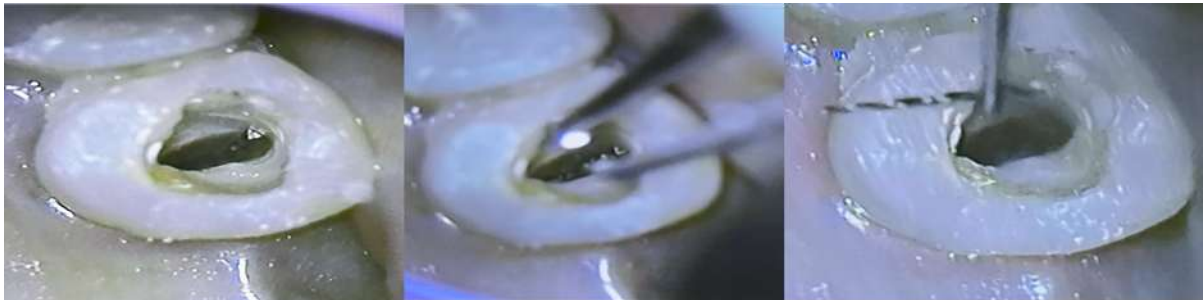


Fig 3 B- Separated instrument



Fig 4 - Confirmation radiograph after instrument retrieval



Fig 5- Completion of Root Canal treatment

