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CASE STUDY

Management of Intracanal Separated Instrument Using Bypassing and Braiding Techniques: Case Reports

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ABSTRACT

The separation of an endodontic instrument during a root canal procedure is a complication that can significantly hinder successful treatment. Separated instruments blocked access to the apical portion of the root, impeding adequate apical canal debridement and potentially compromising disinfection efficacy, thereby jeopardizing the long-term success of the endodontic therapy. Recent advancements in endodontic technology and methodology have facilitated the management of separated instruments (SIs), potentially enhancing treatment prognosis This article presents a case series of the management of SI using bypassing and braiding techniques. Separated instruments were lodged at various levels in the middle and apical third of the maxillary and mandibular incisor and canine teeth. Today, the majority of broken instruments can potentially be removed safely and effectively. However, instrument removal techniques lead to significant loss of tooth substances, which increases the risk of tooth fracture. The choice of the most appropriate technique for removing the fractured fragment depends on several parameters. The two techniques used in these clinical cases are conservative, simple and less invasive for instrument removal.

Keywords: Braiding technique, bypassing technique, endodontics, Separated instrument.

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1. Introduction

Instrument fracture in endodontics is an uncommon complication. It is a mechanical failure that can occur due to a variety of factors, including the use of rotary instruments, canals with complex anatomy, canals with calcifications or debris and excessive force [1].

A variety of instruments, including files and reamers, ultrasonic tips, irrigation needles, and Lentulo spirals are used in endodontic treatment. However, Files and burs exhibit a significantly higher probability of breakage compared to other instruments [2].

Stainless steel instruments are more susceptible to breakage due to excessive torque, while NiTi rotary files typically fracture due to torsional stress and cyclic fatigue [3].

Instrument breakage may not be the cause of treatment failure, but it can compromise the proper shaping of the root canal.

Instrument separation can be managed with conservative or surgical treatment. The following options may be available for nonsurgical approaches:

- Bypassing of the fragment
- Fragment removal
- Instrumentation and obturation of coronal portion beyond the fragment [4].

This article presents clinical cases involving separation and removal of intracanal instruments using bypass and braiding techniques.

2. Case Reports

2.1. Case N1

Patient Information: A female patient aged 46, reported to the Conservative Dentistry and Endodontics Department, of the Dental Teaching Hospital affiliated to the Faculty of Dental Medicine of Casablanca, complaining

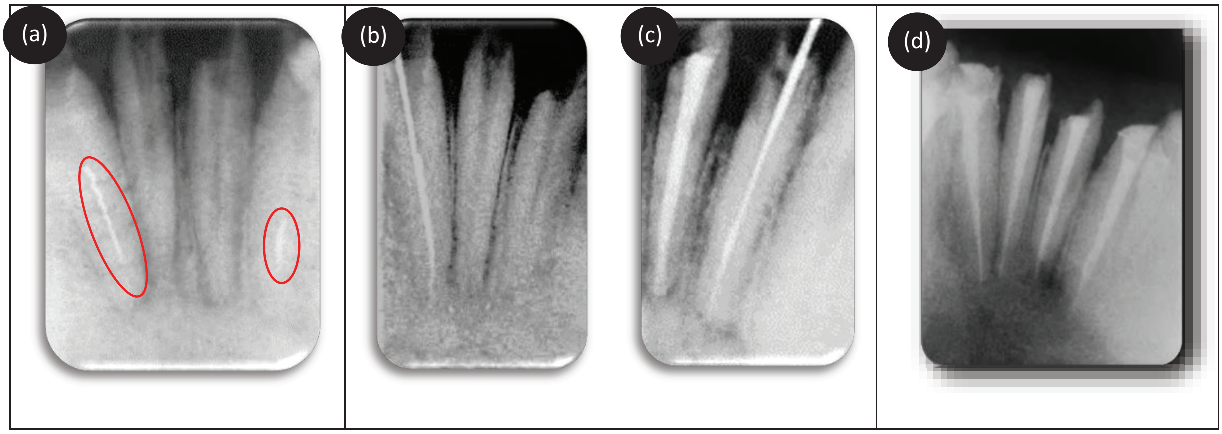

Fig. 1. (a) Intraoral periapical: separated instruments on the right mandibular canine and the left mandibular lateral incisor; (b) SI bypassed with size 8 K-in the left mandibular lateral incisor; (c) SI bypassed with size 8 K-in the on the right mandibular canine; (d) Root filling with gutta-percha.

of pain in mandibular anterior teeth, dating back two weeks. The patient's medical antecedents showed a previous endodontic treatment on the lower incisors and right canine. The patient was apparently healthy. Clinical examination revealed that the patient's oral hygiene was fair. There was no significant periodontal disease. The right mandibular canine and left mandibular lateral incisor were tender to percussion.

Radiographic examination revealed two endodontic instruments located in the middle third of the root canals of the left mandibular lateral incisor and the right mandibular canine. The root canal of the canine appeared narrow and calcified.

Treatment Plan: We received the patient's full consent for a bypass procedure, utilizing a specific technique, to effectively manage the separated instrument.

2.1.1. Clinical Protocol

a. First Visit

Preoperative radiographs: They revealed the presence of fractured steel files within the root canals. The position and direction of the file were determined (Fig. 1a).

Access preparation: The access cavity is prepared to expose the root canal. This is done using a drill and burs.

Direct access cavity: Coronal portions were prepared using Pro Taper instruments.

Bypassing: A small file (size 08 K-file), a flexible file is used to navigate around the fractured file. The file is inserted into the canal and advanced slowly and carefully. The file should be kept in contact with the dentinal wall to avoid damaging the canal wall (Figs. 1b and 1c).

Working length determination: The working length of the canal is determined using a radiograph following a successful bypass.

Irrigation and shaping: The canal is irrigated with sodium hypochlorite (2.5%) to remove debris and bacteria. It was prepared using a series of files (stainless steel K-Files and NiTi Pro taper) to enlarge and straighten it. This is done to create a space for the filling material.

Calcium hydroxide: It was placed as an intracanal medicament for two weeks, and cavities were subsequently sealed using a cotton pellet and a provisional restoration (Glass Ionomer Cement).

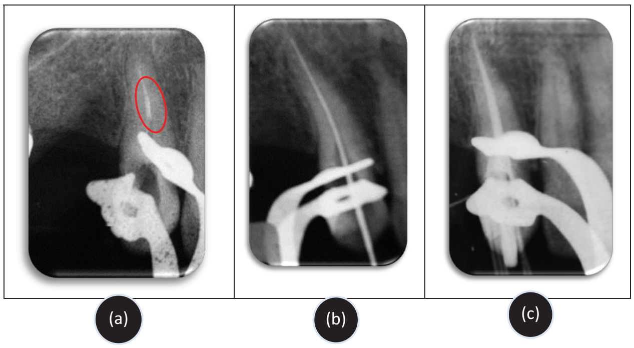

Fig. 2. (a) Pre-operative radiograph: Separated instrument located between the middle and apical thirds of the canal; (b) Working length radiograph after removal of the fragment using the braiding technique; (c) Control radiograph after root canal obturation.

b. Second Visit

The provisional restoration and calcium hydroxide were removed using 2.5% sodium hypochlorite irrigation. Irrigation is activated by a master cone by performing up-and-down, left-to-right, or rotational movements for approximately 30 seconds. The canal is then filled with gutta-percha. To achieve a dense and complete seal, the cold lateral condensation technique was meticulously employed. Finally, a temporary restoration composed of glass ionomer cement was placed (Fig. 1d).

2.2. Case N2

A 30-year-old male patient presented to the Department of Conservative Dentistry-Endodontics at the CCTD CHU Ibn Rochd Casablanca for the management of a separated endodontic instrument lodged in the right upper canine. His medical and dental history were unremarkable. Radiographical examination revealed the instrument fracture location between the middle and apical thirds of the root canal (Fig. 2a).

The treatment includes the following steps:

1. **Rubber dam isolation and coronal restoration removal:** The tooth was isolated with a rubber dam and the existing restoration was carefully removed to gain access to the canal.

2. **Softening of gutta-percha:** Gutta-percha solvent was flushed into the canal to soften and dissolve the sealer, making the fractured instrument easier to extract.
3. **Sealer removal with K-file:** A size 10 stainless steel K-file was used to carry the solvent down the canal and dissolve as much sealer as possible. This process was repeated to maximize sealer removal, as fresh solvent is more effective.
4. **Hedstrom file engagement:** Three size 10 Hedstrom files were inserted as far apically as possible in the mesial, distal, and labial aspects of the canal.
5. **SI extraction with braid technique and working length determination:** The Hedstrom files were twisted together, entangling the fractured instrument, and then withdrawn as a single unit. An X-ray confirmed the complete removal of the instrument and determined the working length (Fig. 2b).
6. **Canal shaping with irrigation:** Throughout canal shaping, 2.5% sodium hypochlorite was used for irrigation to clean and disinfect the canal.
7. **Final obturation:** The tooth was permanently filled with gutta-percha, completing the endodontic treatment (Fig. 2c).

3. Discussion

3.1. *Incidence of Endodontic Instrument Separation*

Fractured endodontic instruments, both rotary and hand files, present a challenge in root canal treatment. Studies report varying separation rates, ranging from 0.13% to 10% for rotary instruments and 0.25% to 6% for hand files [5]–[10]. Notably, continuous rotary devices seem more prone to fractures (2.43%) compared to reciprocating rotary (1.0%) [5], [6], [8], [11]. Further research reveals an overall separation frequency of 1.83% to 8.2% for all endodontic instruments [7], [8]. Material analysis revealed a near-equal split in fracture incidence, with 49.8% of broken instruments being nickel-titanium and 50.2% being stainless steel [8]. Notably, molars stood out as the culprit for the highest separation rates, ranging from a staggering 77% to 89% compared to other teeth [8], [10].

3.2. *Bypass Technique: A Non-Instrumental Approach to Instrument Separation*

The bypass technique stands as a valuable tool within the endodontic armamentarium for addressing instrument separation. It offers the distinct advantage of not requiring specialized instruments, utilizing instead readily available endodontic files commonly found in dental practices. This technique hinges on the fundamental principle that root canals lack perfect roundness. This inherent anatomical feature creates minute spaces between fractured fragments and canal walls, permitting the careful passage of a smaller file to circumvent the obstruction.

It requires a high degree of tactile sensitivity and perseverance from the operator. However, retaining the fragment within the canal and employing a thermoplastic obturation has demonstrated the potential to enhance the overall prognosis [12]–[14].

A thin file is meticulously introduced into the space between the fragment and the canal wall, enabling access to the full working length. This facilitates thorough root canal preparation and subsequent obturation. Achieving high-quality obturation is paramount to ensure the optimal flow of obturation material and sealer into the intricate spaces between the separated file's flutes and the canal walls, as emphasized in the literature [4], [12], [15], [16].

3.3. *Braiding Technique: A Tactile Approach to Instrument Fragment Retrieval*

The procedure aims to engage and remove a separated instrument fragment lodged deep within the canal, often beyond visual access. clinicians rely on tactile sensitivity to insert two or three Hedstrom files alongside the fragment within the canal. The first file engages the fragment by "screwing" it into its flutes, while the remaining files intertwine to form a braided structure [4], [13]. This braided construct enhances gripping force as all files are simultaneously withdrawn, aiming to extract the captured fragment. H-sections with their fluted design are preferred for optimal engagement [17], [18]. Despite the initial recommendation of ISO **size 15** files, current best practice emphasizes using the largest size suitable for the canal to minimize iatrogenic damage. This technique proves particularly valuable when fragments lie deep within the canal and are not readily visible, but success hinges on operator skill and careful assessment of canal anatomy to avoid complications [4], [13].

3.4. *Factors Influencing Intracanal Fracture*

Procedural errors during root canal treatment, leading to instrument fracture, can arise from diverse and interacting factors. While some are inherent to the anatomy or material properties, others stem from operator choices and technique execution. To systematically analyze their intricate interplay, we categorize these factors into four key domains: operator-related, anatomy-related, instrument-related, and technique/use-related [12].

3.4.1. *Tooth Anatomy*

Access Cavity: Traditional access cavities provide clear visual access to all root canal segments and serve as funnels to guide all instruments into the root canal, either directly to the apex or to the first bend. Minimally invasive access cavities often lead to increased canal curvature, which can hinder instrument navigation and increase the risk of fatigue fracture [13]. To evaluate the risk of instrument fracture in minimally invasive preparations, two studies compared the cyclic fatigue resistance of ConsAC and UltraAC reciprocating instruments against TradAC in mandibular molars, maxillary central incisors, and maxillary premolars [14], [15]. The studies found that the instruments used in minimally invasive cavities exhibited lower cyclic fatigue strength than those used in TradAC preparations [16], [17]. While reported fracture rates may be low, the potential consequences of instrument breakage are significant. Extraction of a broken fragment often requires additional dentin removal, which undermines the minimally invasive approach and weakens the tooth structure [19]–[21].

Root Canal Anatomy and Fracture Risk: The complexity of root canal anatomy seems to directly influence the risk of instrument fracture [22]. Studies have shown fractures to be more prevalent in molars compared to premolars or bicuspids [23], [24], with the mesiobuccal canal of upper and lower molars exhibiting the highest incidence [25]. This likely stems from the inherent intricate structure of molar root canal systems, often featuring multiple canals within each tooth. However, the primary culprit is likely the increased curvature of these canals [12]. Furthermore, studies indicate that curvatures located in the coronal or middle third of the root canal are more susceptible to fracture than those found in the apical region [26].

Instrument Design and Fracture: Endodontic instruments are typically made from metal alloys, such as nickel-titanium (NiTi). These alloys have high fatigue resistance, making them well-suited for endodontic applications. However, even NiTi instruments can fracture if the mechanical stresses are too great [27]. The design of endodontic instruments can help to reduce the risk of fracture. For example, instruments with a wider cross-section are generally stronger than those with a narrower cross-section REFR. Similarly, instruments with rounded edges are less likely to fracture than those with sharp edges. The manufacturing of endodontic instruments is also important for minimizing the risk of fracture. Instruments must be manufactured precisely and free of defects. Manufacturing defects, such as cracks or burrs, can weaken the instrument and make it more susceptible to fracture [12].

4. Conclusion

In conclusion, the best way to prevent instrument fracture is to use the instruments carefully and correctly. If a fracture does occur, the prognosis is generally good, unless there is pre-existing apical periodontitis. Treatment options include bypassing the fragment directly, bypassing it indirectly via another canal, or retrieving the fragment. The patient should always be informed of the fracture and the treatment plan.

Conflicts of Interest

Authors declare that they do not have any conflict of interest.

References

[1] Choksi D, Idnani B, Kalaria D, Patel RN. Management of an intracanal separated instrument: a case report. *Iran Endod J*. 2013;8(4):205.

[2] Lambrianidis T, Mazinis E. Parameters influencing the removal of fractured instruments. In *Management of Fractured Endodontic Instruments: A Clinical Guide*. Lambrianidis T, Ed. Cham: Springer International Publishing AG; 2018, pp. 197–206.

[3] Silva E, de Lima CO, Vieira V, Antunes H, Moreira EJL, Versiani M. Cyclic fatigue and torsional resistance of four martensite-based nickel titanium reciprocating instruments. *Eur Endod J*. 2020;5(3):231.

[4] Lambrianidis T. Therapeutic options for the management of fractured instruments. In *Management of Fractured Endodontic Instruments: A Clinical Guide*. Lambrianidis T, Ed. Cham: Springer International Publishing AG; 2018, pp. 75–195.

[5] Malarvizhi D, Shuruthi J, Anuradha B, Subbiya A. Etiology and management of separation of instruments in endodontics–An overview. *Eur J Mol Clin Med*. 2020;7:1229–34.

[6] Vouzara T, Lyroudia K. Separated instrument in endodontics: frequency, treatment and prognosis. *Balk J Dent Med*. 2018;22(3):123–32.

[7] Madarati AA, Hunter MJ, Dummer PMH. Management of intracanal separated instruments. *J Endod*. 2013;39:569–81.

[8] Lohar J, Sood H, Gosai P, Shekh TM. 3P's in retreatment endodontics—An often forgotten virtue. *J Pharm Bioallied Sci*. 2019;11(Suppl 1):S76.

[9] Babar M, Moiz A, Siddique S. Case report: retrieval of a separated endodontic instrument via braiding technique. *J Islam Int Med Coll (JIIMC)*. 2020;15(1):63–5.

[10] Spili P, Parashos P, Messer HH. The impact of instrument fracture on outcome of endodontic treatment. *J Endod*. 2005;31:845–50.

[11] Parashos P, Messer HH. Rotary NiTi instrument fracture and its consequences. *J Endodont*. 2006;32(11):1031–43.

[12] Tzanetakis GN, Kontakiotis EG, Maurikou DV, Marzelou MP. Prevalence and management of instrument fracture in the postgraduate endodontic program at the dental school of athens: a five-year retrospective clinical study. *J Endod*. 2008;34:675–8.

[13] Chandak M, Sarangi S, Dass A, Khubchandani M, Chandak R. Demystifying failures behind separated instruments: a review. *Cureus*. 2022 Sep;14(9):e29588.

[14] Ba-Hattab R, Rahman I, Elsayed LK, Alasmari WF, Abidia R, Abdelgaffar S, *et al.* Ethical aspects concerning instrument separation and perforations during endodontic treatment: a cross-sectional study. *Int J Dent*. 2020;2020:8849105. doi: 10.1155/2020/8849105. PMID: 33014062; PMCID: PMC7512109.

[15] Gomes MS, Vieira RM, Böttcher DE, Plotino G, Celeste RK, Rossi-Fedele G. Clinical fracture incidence of rotary and reciprocating NiTi files: a systematic review and meta-regression. *Aust Endod J*. 2021;47(2):372–85.

[16] Boutsioukis C, Lambrianidis T. Factors affecting intracanal instrument fracture. In *Management of Fractured Endodontic Instruments: A Clinical Guide*. Cham: Springer International Publishing AG; 2018, pp. 31–60.

[17] Roda SR, Gettleman BH. Nonsurgical retreatment. In *Cohen's Pathways of the Pulp*. Hargreaves K, Berman LH. 11th ed. St. Louis: Elsevier, 2016, pp. 324–86.

[18] Silva EJNL, Attademo RS, da Silva MCD, Pinto KP, Antunes HDS, Vieira VTL. Does the type of endodontic ac-cess influence in the cyclic fatigue resistance of reciprocating instruments? *Clin Oral Invest*. 2021a;25:3691–8.

[19] Spicciarelli V, Marruganti C, Marzocco D, Martignoni M, Ounsi H, Grandini S. Influence of endodontic access cavity design on fracture strength of maxillary incisors and pre-molars and on fatigue resistance of reciprocating instruments. *Front Dent Med*. 2020;1: 1–8.

[20] Pedullà E, La Rosa GRM, Boninelli S, Rinaldi OG, Rapisarda E, Kim HC. Influence of different angles of file ac-cess on cyclic fatigue resistance of reciproc and reciproc blue instruments. *J Endodont*. 2018;44:1849–55.

[21] Pedullà E, La Rosa GRM, Virgillito C, Rapisarda E, Kim HC, Generali L. Cyclic fatigue resistance of nickel-titanium rotary instruments according to the angle of file access and radius of root canal. *J Endodont*. 2020;46:431–6.

[22] Lopes HP, Vieira MV, Elias CN, Goncalves LS, Siqueira JF Jr, Moreira EJ, *et al.* Influence of the geometry of curved artificial canals on the fracture of rotary nickel-titanium instruments subjected to cyclic fatigue tests. *J Endodont*. 2013;39:704–7.

[23] Özyürek T, Yilmaz K, Uslu G. Shaping ability of reciproc, WaveOne GOLD, and HyFlex EDM single-file sys-tems in simulated Sshaped canals. *J Endodont*. 2017;43:805–9.

[24] Silva EJNL, Pinto KP, Ferreira CM, Belladonna FG, De- Deus G, Dummer PMH, *et al.* Current status on minimal access cavity preparations: a critical analysis and a proposal for a universal nomenclature. *Int Endod J*. 2020c;53:1618–35.

[25] Silva EJNL, De-Deus G, Souza EM, Belladonna FG, Cavalcante DM, Simões-Carvalho M, *et al.* Present status and future directions-minimal endodontic access cavities. *Int Endod J*. 2022;55:531–87.

[26] Peters OA. Current challenges and concepts in the preparation of root canal systems: a review. *J Endod*. 2004;30(8):559–65.

[27] Ungerechts C, Bårdsen A, Fristad I. Instrument fracture in root canals-where, why, when and what? A study from a student clinic. *Int Endod J*. 2014;47(2):183–90.