Management of separated instrument with file bypass method: acquainting two case reports.

ABSTRACT: One of the most frequently seen incidents during a root canal procedure is the separation of an endodontic file. The occurrence of file separation in endodontics might impede access to the apical region of the root and hinder the effectiveness of the disinfecting procedure. The presence of the fragment hinders the proper debridement of the apical canal, hence compromising the potential success of the treatment. Nevertheless, as a result of recent improvements in techniques and tools, the successful implementation of bypass or retrieval procedures has become feasible. This paper presents a case reports where the instruments were separated at various levels in the middle and apical third of maxillary and mandibular molar teeth. Successful bypass was achieved, enabling appropriate biomechanical preparation and effective debridement followed by obturation till the entire working length. The successful bypass of a separated instrument within the root canal can be achieved through a case review, utilising a well-equipped armamentarium, possessing appropriate knowledge, and demonstrating good clinical skills and expertise. This approach can be regarded as a straightforward and efficient way for managing separated instruments.

KEYWORDS: Instrument separation; File bypass; Endodontic therapy; Effective debridement

INTRODUCTION: In endodontic therapy, instrument separation in the root canal is a common procedural mistake that is encountered. It can occur frequently, not just with students and general practitioners, but also with professionals and experienced clinicians [1]. This can be very troublesome and frustrating for most of the clinicians. Access to the apical terminus may be blocked by a separated instrument within the root canal, which could be caused by a file or reamer, gates glidden or peaso-drills. However, improper use is one of the most frequently considered causes for file separation [2]. The most popular tools for removing diseased and damaged dentin and straightening the canal walls are endodontic hand and rotary files [3]. According to several studies, rotational NiTi can create well-centered, smooth, minimally transported canals with the least number of procedural mistakes [4]. The NI-TI rotary files can be effectively used in the root canal system, but there are drawbacks as well. Despite their greater flexibility, separation is the major issue with these instruments [5].

The prognosis may be impacted if the fractured file prevents the canal from being cleaned properly after the obstruction. Repeated cycle fatigue is a condition that may play a significant role in instrument separation. Instruments distort and experience stress when they are inserted into curved canals. The instrument shaft's inside and exterior halves are in tension and compression, respectively. As a result, each turn sends the instrument through a full cycle of tension and compression. Numerous factors determine how to handle an instrument that has separated. Even if file removal is effective, difficulties with the process could lower the long-term outlook and lead to clinical failure [4-5]. In several research, it was hypothesised that the prognosis in a separated instrument case with an existing periapical lesion would be poor. Fox et al.'s analysis of 304 instances with an average follow-up length of 7 years came to the suggestion that separated instruments will work well as filler materials [6].

During the initial stages of treatment, it is imperative to make diligent efforts to recover separated instruments in each case. In cases where retrieval is not feasible, alternative methods such as bypass should be considered. According to the findings of Ungerechts et al, the efficacy of broken instrument removal varied across different conditions, with success rates of 72.7% observed for vital teeth, 58.3% for primary infected teeth, and 42.9% for retreatment instances [7]. This article presents management of separated instruments where we initially tried to retrieve the separated instrument first but considering the fact that risk of transportation during excessive troughing might weaken the tooth structure and successful bypass can effectively allow proper biomechanical preparation and can further improve the prognosis of the case. Consequently, we proceeded to advance with the file bypass technique and obturation.

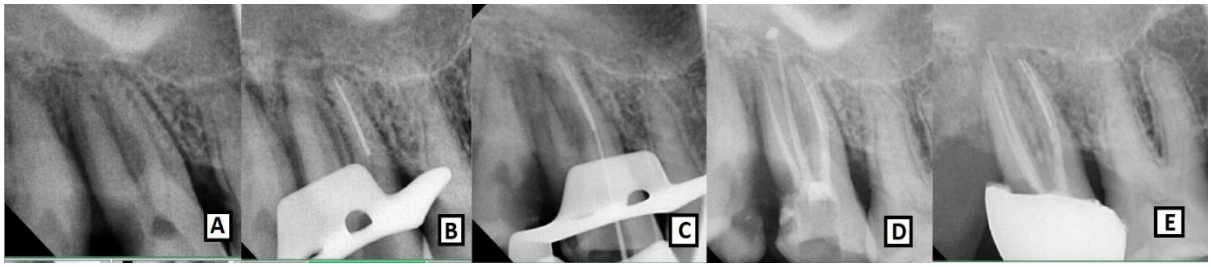
CASE REPORT:

Case 1: 40-year-old female was referred to our practice with symptomatic apical periodontitis with tooth #17. Medical history was non-contributory. Radiographic examination revealed deep proximal caries associated with tooth no. #17 along with apical radiolucency on the mesial and distal roots (Figure 1A). Following a thorough assessment of symptoms, clinical and radiographic examination, and obtaining informed consent from the patient, the initiation of endodontic treatment commenced. This involved the administration of 1 ml of local anaesthesia containing 40 mg of articaine hydrochloride and 0.005 mg of epinephrine (Septanest, Septodont), as well as the implementation of a rubber dam for

isolation purpose. Access opening was done and working length was established with the use of an apex locator (Root ZX, J. Mortina Inc, USA). During cleaning and shaping approximately 5 mm of a size #0.04/25 NiTi file was separated in mesiobuccal canal. A radiograph was taken to confirm the level of separation of the instrument (Figure 1B). The instrument was found to be separated at the apical 3rd of the mesial canal. As the broken file was remained within the canal a nonsurgical file bypass technique was selected for this case. The bypass technique was executed in the following manner: Initially, a glide path was established by attempting to loosen the fragment using a #8 file. Subsequently, the file was cautiously and gradually inserted into the canal, with the intention of navigating it past the fragment, situated between the dentinal wall and the broken instrument. This approach aimed to prevent direct contact between the instrument and the broken file. In a particular instance, a catch felt occurred, and it is worth noting that the file in question was not afterwards erased. A minor reciprocating motion, accompanied by abundant irrigation of the root canal, was performed. The patency of the canal was determined using a #10 file at a depth of 20 mm. Subsequently, a radiograph was performed to measure the working length of the canal. (Figure 1C). The canal underwent chemomechanical preparation using a standardised technique. In the mesiobuccal canal, a technique including a combination of pulling, rotating, and withdrawing movements were employed, as opposed to a straightforward filling motion. After bypassing a separated instrument in the mesiobuccal canal, the file braiding technique was employed in an effort to retrieve the instrument. Unfortunately, the instrument could not be successfully loosened and thus could not be extracted. An intracanal dressing of calcium hydroxide (CH) paste was then applied and patient was recalled after two weeks.

During the subsequent visit, no indications of discomfort, tenderness, mobility or swelling were observed. A substantial quantity of 2.5% sodium hypochlorite ultrasound-activated irrigation, along with negative apical pressure through the use of the EndoVac system, was employed to eliminate the CH paste from the root canal. The canal was dried with a paper point and thereafter sealed with suitable Gutta-percha mastercones and DIA-ROOT BIO (DiaDent) bioceramic sealer (Figure 1D). The patient was subsequently scheduled for a follow-up appointment one week later to undergo comprehensive coverage restoration. Six months follow up radiograph was taken which shows sufficient healing (Figure 1E).

Figure 1. Case 1- (A) Pre-operative radiograph of tooth 17. (B) Radiograph showing fractured 0.04/25 rotary NiTi file (C) bypassing the separated instrument (D) Radiograph after immediate obturation. (E) Follow up radiograph of 6 months after fixed prosthesis



Case 2: A female patient, aged 47, with no relevant medical history presented with a chief complaint of severe discomfort in the lower left region of her jaw persisting for a duration of 10 days. Upon examination, it was seen that tooth #36 exhibited extensive proximal caries and elicited tenderness upon percussion. A comprehensive radiographic assessment disclosed a substantial periapical lesion linked to tooth no. #36 (Figure 2A). Following the provision of comprehensive information and getting informed consent from the patient, the commencement of nonsurgical root canal therapy was initiated. After administration of anaesthesia and access cavity preparation four canals were negotiated with size 6, 8, 10 and 15 stainless steel hand files to their apices. The preparation of all four canals involved the utilization of rotary NiTi RaCe files (FKG, LaChaux De Fonds, Switzerland) in conjunction with Flexmaster files (Gunz Dental, VDW, Munich, Germany). During the process of preparing the mesiobuccal canal, approximately 4mm of size 0.02/20 taper RaCe rotary instrument separated (Figure 2B). Subsequent to this occurrence, the patient was duly apprised, and the primary author proceeded with the requisite preparations for the remaining canals. Mesiolingual canal prepared till the size 0.06/20 taper and distal canals prepared till the size of 0.06/25. The preliminary utilization of stainless steel Hedstrom files of sizes 8, 10,

and 15 shown that the instrument has the potential to be partially circumvented. The successful bypass of the separated instrument was conducted, reaching the full operating length (Figure 2C). The study revealed that the instrument was securely lodged within the canal. Taking into consideration the fact that the tooth exhibited a significant periapical lesion, many attempts were undertaken to extract the separated instrument, employing abundant irrigation with a 1% sodium hypochlorite solution. Regrettably, these attempts proved to be ineffective. The canal was then prepared using a standardised technique. CH paste was given as intracanal dressing and patient was recalled after 1 week. In the subsequent visit after evaluating all symptoms, CH paste was removed from all canals followed by utilisation of a 3% solution of sodium hypochlorite (Hyposol®) in conjunction with a 27-gauge endo safety needle. Canals were dried with paper points and filled with lateral compaction of gutta-percha and bioceramic sealer (DIA-ROOT BIO, DiaDent) (Figure 2D). A portion of the sealer material was observed to extend beyond the apex of the tooth, which exhibited signs of resorption over time. 1 year Follow up radiograph shows satisfactory healing of periapical tissue (Figure 2E).

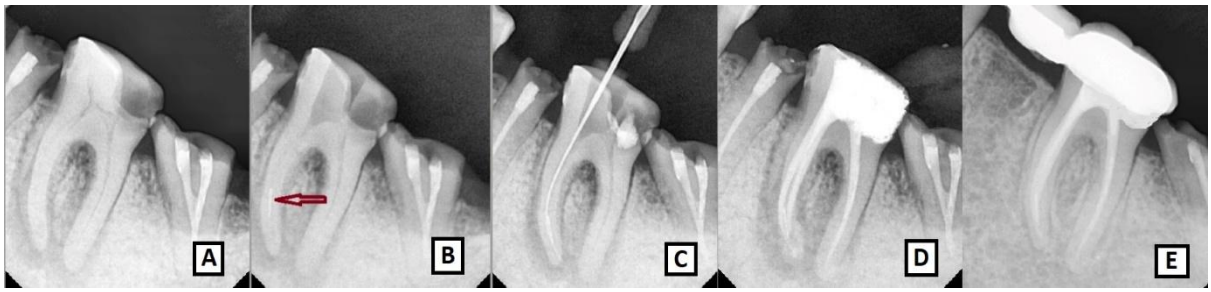


Figure 2. Case 2- (A) Pre-operative radiograph of tooth 36. (B) Radiograph showing separated 0.02/20 taper RaCe rotary file (C) Radiograph showing successful bypass of the separated instrument. (D) Radiograph after obturation and restoration. (E) 1 year follow up radiograph showing healing of periapical tissue

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DISCUSSION: The anatomical variability of the root canal system presents a significant obstacle that must be overcome in the context of endodontic treatment. Additionally, it is a prevalent factor contributing to instrument fracture. Moreover, these incidents might be attributed to a deficiency in professional expertise about the technique, excessive use of instruments, inadequate utilisation, and insufficient sterilisation procedures performed on the instruments. The most commonly observed cause of instrument separation or breakage is

overuse, which occurs when instruments are subjected to the highest levels of cycle fatigue and torsional stress that they can withstand [1]. However, Shen et al. conducted a study which revealed that a majority (two-thirds) of the separations observed in the ProTaper instruments they evaluated were attributed to cyclic fatigue rather than torsional strain. Walcott et al. conducted an analysis to investigate the potential impact of usage frequency on the performance of ProTaper rotary files, specifically focusing on separation incidents. The findings of their research revealed that the highest occurrence of instrument failures was observed when employing the bigger diameter file during the fifth use [5]. There is a prevailing belief that NiTi rotary instruments pose greater challenges in terms of removal compared to stainless steel (ss) rotary files. This belief is based on the following reasons:1. The rotating action of these instruments causes them to thread into the walls of root canals. 2.There is a higher likelihood of recurring fractures occurring during removal procedures, especially when ultrasonics are employed. 3.The inclination is for them to be situated adjacent to the exterior wall of the root canal rather than in the central region [6]. Various rotating movements of endodontic instruments have been found to yield varying levels of cyclic fatigue survival. Notably, reciprocating movements have demonstrated the ability to enhance the cyclic fatigue resistance of NiTi instruments. When employing reciprocating motion for all file types examined, there was a higher likelihood of extended instrument survival in comparison to continuous rotation [7]. In specific clinical scenarios, it may be more advantageous to retain the fragmented file within the root canal. The presence of broken instruments in the apical one-third of the canal did not seem to have a negative impact on the root's resistance to vertical fracture. The extraction of broken instruments might provide challenges in terms of difficulty and time consumption, with varied success rates [7-8]. Souter et al. conducted a study to assess the complications related to fractured file removal using an ultrasonic technique, both in vitro and in vivo. The results demonstrated a significant reduction in root strength when the file was located in the middle or apical third of the root. Additionally, the removal procedure led to a decrease in root strength by 30% and 40%, which may potentially contribute to the occurrence of vertical root fractures [9]. The majority of instrument removal methods, including the Masserann-kit, ultrasonics, the use of adhesives like cyanoacrylate, the Canal-Finder system, the tube and Hedstrom technique, and the use of chemical agents like iodine trichloride, are not conservative or safe alternatives for removing fractured instruments, especially in areas where access is difficult. They often pose a high risk of excessive dentin removal and file fracture in severely curved canals [10]. The perforation that results from attempting to remove the file may have a greater influence on

treatment outcomes than a retained fractured instrument [11]. Also, sometimes it's impossible or undesirable to remove an instrument that has been separated [12]. As a result, treating such a tooth requires caution and excellent judgement, and the choice was shifted towards bypassing the separated instrument, which can be effectively considered as a valid alternative in such instances.

CONCLUSION: The best way to handle a separated instrument relies on a number of variables. Even if file removal is effective, difficulties with the process could lower the long-term outlook and lead to clinical failure. In these circumstances, bypassing the broken file worked better than retrieving. In order to preserve the root structure and increase the likelihood that the tooth will have longer survival rate, it can be determined that bypassing the separated instrument may be a creative and superior strategy.

Ethical Approval:

As per international standard or university standards written ethical approval has been collected and preserved by the author(s).

Consent

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

Conflict of interest

We know of no conflict of interest associated with this publication and there has been no significant financial support for this work.

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