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Case Report

Conservative Management of Broken Endodontic Instruments: Two Case Reports

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Abstract

In our daily dental practice, broken instruments are one of the most common accidents. Many factors can lead to these endodontic mishaps such as canal curvatures and instrumental fatigue. The prognosis depends on file location, presence or absence of periapical lesion and canal curvature. Removing these broken instruments appears to be the best option in terms of regaining the canal patency and cleaning and shaping it to its full length. However, in some cases this effort of retrieval can fail, for example, when the instrument is located beyond the canal curvature and can't be reached, and if so, it can lead to a poor prognosis or tooth fracture. In these situations, bypassing the broken file and being able to clean and shape the canal can be as good and effective. The aim of this paper is to describe the file bypass technique and a conservative removal method. Then, to discuss the outcomes through two clinical cases.

Keywords: Fractured Instrument; Bypassing; Broken Instrument Retrieval; Endodontic Treatment; Instrument Removal

Introduction

The success of endodontic treatment relies on the precise shaping, disinfection, andthree-dimensional obturation of the complex root canal system. The occurrence of instrument separation during treatment is a significant challenge in endodontics.

Dealing with broken files in endodontics demands a range of strategies, including retrieval, bypass, or even the option of leaving the fractured file and proceeding with canal obturation.

Among these approaches, bypassing the fractured instrument emerges as a notably conservative method for managing broken files. This technique preserves dental integrity while addressing the issue at hand.

Furthermore, after successfully executing the bypass technique, a subsequent retrievalmethod using the Xp Endo Shaper (FKG) can be employed, adding a layer of versatility to the management of these challenging cases.

The purpose of this paper is to describe the file bypass technique and a conservative removal method. Then, to discuss the outcomes in two clinical cases.

Case Report N°1

A 24-year-old female patient was referred to the Department of Conservative Dentistry and Endodontics after beginning endodontic treatment elsewhere. Thebuccal canal of the upper right second premolar had a broken file.

Upon clinical examination, the patient was asymptomatic, with no reported pain or discomfort. There were no evident signs of periapical pathology observed on the preoperative periapical radiograph (Figure 1).

The periapical radiograph confirmed the precise location of the separated file withinthe canal, situated in the apical third of the root (Figure 1).

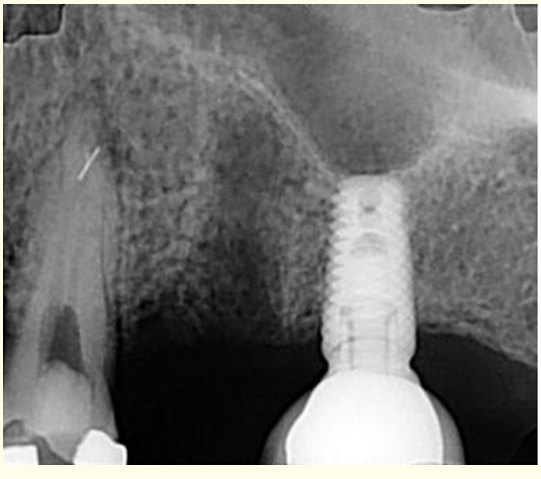

Figure 1: Periapical radiograph showing the preoperative status of the tooth 15.

During the initial preparation of the buccal canal, an obstruction was encountered at adepth of 18 mm. To address this challenge, the bypass technique was carefully employed as follows: An #8k file (Dentsply Maillefer) was pre-curved and carefully inserted into the canal in an attempt to navigate past the fragment between the dentinal wall and the broken instrument.

Prior to this, a preflaring of the canal was performed using an SX file (19,08) from E-flex Gold Eighteeth. It was crucial to make an effort to bypass the broken file in the narrow space between the inner wall and the file.

Upon achieving a sense of engagement, a radiograph was promptly taken to confirmthe establishment of a path along the inner wall (Figure 2).

Instead of immediate removal, a watch-winding motion combined with gentle in-and-out movements was employed, accompanied by thorough irrigation of the root canal. Subsequently, a #10k file (Dentsply Maillefer) was utilized to further enlarge the space created by the #8k file, using the same watch-winding technique until the apex was reached. At this point, a working length measurement radiograph was taken.

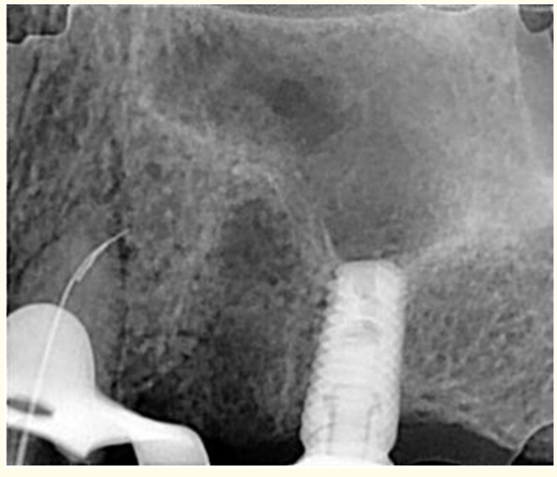

Figure 2: Periapical radiograph showing the broken file bypassed.

Chemo-mechanical preparation of the canals was performed using rotary files from E-flex Gold Eighteeth (19,02; 15,04; 20,04; and 25,04) at 350 RPM, with abundant irrigation using sodium hypochlorite 2.5% and EDTA 17%.

The canals were then filled using a Gutta percha cone and a resin-based sealer (Adsealfrom Metabiomed), employing the single cone technique.

A post-operative radiograph (Figure 3) was taken to verify the quality of the obturation,and a permanent coronal restoration was completed one week later.

The patient was advised to return for follow-up appointments at 6 and 12 months.

Figure 3: Post-operative periapical radiograph showing the filled root canals including the bypassed file.

Case Report N°2

A 56-year-old male patient was referred to the Department of Conservative Dentistryand Endodontics for management of a broken file.

The patient presented with a challenging scenario: A broken file was lodged in thesecond mesiobuccal canal of the upper right first molar.

The initial diagnosis was chronic apical periodontitis.

A periapical radiograph was taken to accurately assess the position of the separated filewithin the canal.

The radiograph confirmed the location of the file in the apical third of the canal,extending beyond the canal curvature (Figure 4).

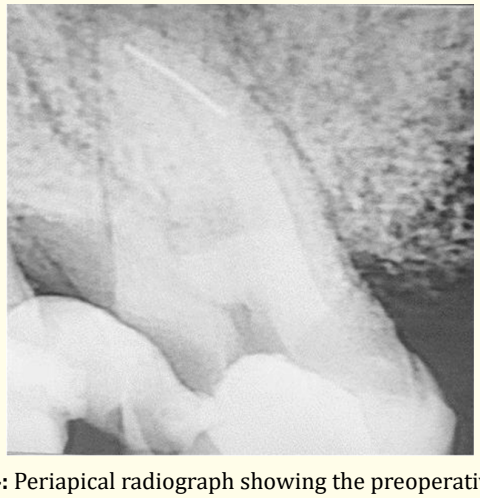

Figure 4: Periapical radiograph showing the preoperative status of tooth 16.

In an attempt to manage this complex case, a non-surgical file bypass technique was used with the aim of retrieving the fractured file using the XP Endo Shaper file (FKG).This particular technique was initially described by DDS Yoshi Terauchi from Japan [12].

During canal preparation, an obstruction was encountered in the second mesiobuccalcanal at a depth of 18 mm.

The bypass procedure was carried out under the guidance of an Operative Microscope(LEICA) to increase precision.

The bypass technique was performed. An #8k file (Dentsply Maillefer) was carefully inserted into the canal after being pre-curved to pass through the space between the dentinal wall and the broken instrument.

Prior to this, a pre-flaring of the canal was carried out using an SX file (19.08) of E-flex Gold Eighteeth.

In this particular case, the #8k file (Dentsply Maillefer) was used on the outer wall ofthe canal during the procedure.

However, careful execution ensured that potential complications, such as zipping,were avoided.

Radiographic verification confirmed that the #8k file reached the apical foramenwithout deviation (Figure 5).

A gentle watch-winding motion, followed by an in-and-out motion, accompanied bythorough root canal irrigation, was performed.

A #10k file (Dentsply Maillefer) was employed to enlarge the space created by the#8k file, using the same watch-winding motion until the apex was reached.

Subsequently, a #15k file (Dentsply Maillefer) was used with a similar motion tofurther enlarge the path created.

Following the bypass procedure, the working length was precisely determined andrecorded at 22 mm using a working length measuring radiograph.

An XP Endo Shaper (FKG) was employed at 1300 RPM, following recommendedguidelines, with an attempt to remove the broken instrument.

The XP Endo Shaper (FKG) was used in a brushing motion towards the broken instrument, and with the aid of copious and ac-

tive irrigation using EDTA 17%. Thebroken file was successfully removed from the canal (Figure 6).

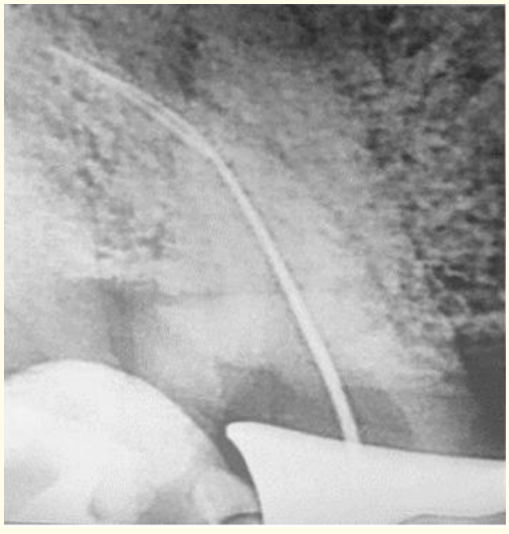

Figure 5: Periapical radiograph showing the broken file bypassed.

Figure 6: Periapical radiograph showing the broken file removed.

Following successful retrieval, the canals were further shaped using the XP Endo Shaper system (FKG) and then filled with a gutta-percha cone and resin-based sealer(Adseal from metabiomed) in a single visit using the single cone technique.

A post-operative radiograph was taken to document the quality of the endodonticobturation and treatment outcome (Figure 7).

Eight days after the procedure, a permanent coronal restoration was completed toensure the structural integrity of the tooth.

Figure 7: Post-operative periapical radiograph showing the filled root canals of the tooth 16.

The patient was advised to return for follow-up appointments at 6 and 12 months tomonitor the long-term success and stability of the endodontic treatment.

Discussion

The reported frequency of instrument separation varies, with manual stainless-steelfiles ranging from 2 to 6% and NiTi rotary files from 1.3 to 10% [1-3].

The causes of file separation in endodontics are diverse and include factors such as improper file use, limitations of file material properties, inadequate preparation of theaccess cavity, the complexity of the root canal anatomy and even potential manufacturing defects [4].

Instrument separation typically takes one of two forms: torsional fatigue or cyclicfatigue.

Torsional fracture occurs when the tip or another part of the instrument becomes locked in the canal while the remaining portions continue to rotate, ultimately leadingto the instrument tip's fracture when torque exceeds the metal's elastic limit.

In cases involving curved canals, compression forces and tensile stress are alternatelygenerated, subjecting the instrument to cyclic fatigue [5].

Instrument separation is often observed in the middle or apical third of the mesial canals of mandibular molars and the mesiobuccal roots of maxillary molars, mainlydue to their inherent root curvatures. These roots have pronounced curvatures, including a distal curvature on two-dimensional periapical radiographs.

Additionally, the mesiobuccal canal often presents a distal curvature, while themesiolingual canal may exhibit a slight buccal curvature [6,7].

In case of fractured instrument, a periapical radiograph is essential to determine theposition of the file relative to the root canal curvature.

Even in apparently straight canals, the potential for buccal or lingual curvature shouldnot be overlooked.

In general, a broken instrument closer to the apex in the later stages of endodontictreatment is associated with a more favorable prognosis compared to a short instrument in the early stages with an undebrided canal [6].

Ultrasonic file retrieval techniques and devices, and possibly file retrieval systems, can damage the dentinal structure, potentially leading to tooth fracture and loss [8,9]. While file retrieval is often considered the gold standard for restoring canal patency, itis important to be aware of the potential drawbacks, including ledge formation, over- enlargement, transportation and perforation [10-13].

In this context, the file bypass technique emerges as a conservative alternative. It hascertain advantages. It is relevant in cases where retrieval may compromise the structural integrity of the tooth, especially when the instrument is located near the apex [14].

Bypassing the fractured instrument allows proper instrumentation of the apical portionof the canal while preserving radicular dentin [15].

Small files are used to create a narrow path for shaping files and irrigation to reachthe apical third [10].

Adequate irrigation with EDTA (17%) is essential to lubricate the files and removedebris generated during the procedure [2].

It has been noted that when bypassing the file, the remaining fragment does notcompromise the quality of obturation [16].

The clinical decision to bypass or retrieve a broken file should be made judiciously,taking into account several factors [17].

The infectious status of the canal plays a crucial role in this, and the impact of an instrument fracture varies depending on whether the tooth is vital or non-vital and atwhat stage of canal cleaning and shaping the fracture occurred [6].

In addition, the type and location of the fractured instrument must be carefullyassessed.

Notably, it is generally reported if the broken file can be bypassed, it can beremoved [11,17,18].

Among the various methods and instruments discussed for managing broken endodontic instruments, the use of the XP-endo Shaper (FKG) after performing thebypass technique stands out as a promising solution for retrieving broken instruments.

This rotary system is composed of a novel heat-treated MaxWire alloy with a size 15booster tip. This system offers unique instrument retrieval capabilities and is remarkably conservative in its approach [19].

The XP-endo Shaper's design allows it to expand from a size 27/.01 to a larger taperof ≥ 30/.04 at body temperature, which is a distinctive feature that comes into play during instrument retrieval.

Its ability to rotate clockwise inside the canal while being straight in the martensiticphase at room temperature makes it particularly well-suited for engaging and disengaging fractured instruments within the root canal [19].

In practical terms, when the XP-endo Shaper is rotated clockwise in a swirling motionon the side of the disengaged fractured instrument, it induces a counterclockwise rotation of the instrument itself. This unscrewing motion helps remove the fractured instrument coronally, contributing to a successful outcome.

It should be noted that the use of lubricants such as EDTA or silicone oil not onlyfacilitates this movement but also prevents the XP-endo Shaper from breaking.

However, in order to optimise the use of the XP-endo Shaper in this context, certainfactors must be taken into account [19].

The use of an operating microscope provides good precision when inserting this file between the fractured instrument and the canal wall, rotating the instrument at a relatively high speed (>2000 rpm) and using short up and down strokes along the fractured instrument are crucial steps to mitigate torsional and cyclic fatigue.

Recent research has shown that higher speeds, particularly around 3000 rpm, increasethe efficiency and safety of the XP-endo Shaper when instrumenting in the confined root canal space [19].

Although the bypass technique is a conservative and effective approach to themanagement of fractured files in endodontics, it is important to recognise its limitations. In fact, bypass technique cannot always be performed.

Shen et al. reported an overall success rate of 53% for bypassing fracturedinstruments, of which 44% could be retrieved [20].

Bypass attempts can also lead to mistakes. These can include false canals or even rootperforation [21].

Subsequently, the retrieval method using the Xp Endo Shaper could not always be performed and, to date, no clinical study has been published on the clinical successrate of this method.

Conclusion

Broken instruments in endodontics are a challenge. It is important to emphasise the role of conservative treatment. File bypass is an effective and secure method. The XP-endo Shaper (FKG) stands out as a promising retrieval tool in this context. Further research is needed to validate these methods in different clinical scenarios and contribute to the advancement of endodontic practice.

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