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Challenging Management of Two Broken Instrument in a Severely Curved Canal: A Case Report

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Abstract

Instrument breakage is a common mishap where management options are reduced especially in a curved canal with restricted visual access. Bypassing the fractured instrument represents the most conservative way to deal with this obstacle without compromising the disinfection of the root canal. The aim of this article was to report a case of management of an acute curvature with two broken files with one of them partially extruded beyond the apex. bypassing of the broken files and negotiating the severe curvature was done after a meticulous study of the pre-operative radiography that assessed the case difficulties and helped us strategize the use of adequate instruments and techniques. Afterwards we will describe the instrumental management protocol to bypass the two broken files prior to the filling of root canals.

Keywords: ***Broken instruments; Bypass; Canal curvature.***

1. Introduction

Separation of root canal instruments is a common incident during root canal treatments' procedures. Fracture often results from incorrect use or overuse of endodontic instruments [1] and seems to occur mostly in the apical third of the canal [2]. The complex configuration of root canal systems is one of the most influencing factors, not only in the occurrence of instrument separation but also during the management of such unpleasant incidents. In curved canals, the ability to reach the separated instrument without weakening and/or perforating the root is the main challenge for the endodontist.

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In most of the cases instrument separation happens, retrieval of the separated file is advocated. If it cannot be retrieved, an attempt is made to bypass it. When the broken file is situated in the apical third of the canal, the attempt to bypass the file can cause other collateral damages like ledges formation, perforations, over-extruding the broken instrument apically beyond the apex and also secondary file fractures [3]. These risks get increased with the accentuation of the degree of canal curvature.

The aim of the article is to describe the instrumental management protocol of the bypass of two fractured endodontic instruments, one of them partially extruded beyond the apical foramen in a severely curved canal.

2. Case Report

A 35-year-oldfemale patient was referred to the dental department of Sahloul hospital to pursue her endodontic treatment on tooth 15. The patient had asymptomatic periodontitis on this tooth. The referring dentist had attempted a root canal treatment but he was not able to negotiate the curvature and broke 2 files instead. Before starting the treatment, a new diagnostic radiograph was taken and revealed 2 broken instruments in the apical third of the canal beyond the curvature.

The curvature was considered severe as the angle of curvature was about 80° according to schneider's method.

Fig. 1. Preoperative radiography.

Fig. 2. Estimation of angle curvature by schneider's method.

The position of the apical broken file was not clear in the periapical radiograph, so a CBCT was performed to determine its exact position with the apex. It revealed later that this one is extruded 2 mm from the apex and it also revealeda periapical lesion (PAI= 3) close to the maxillary sinus. CBCT also showed that the canal configuration was type 6 of Vertucci's classification.

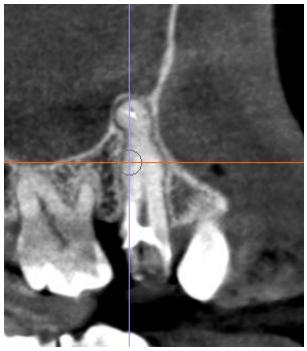

Fig. 3. Sagittal Section.

Fig. 4. Coronal section.

[The coronal section (Fig. 4) showing the extruded file not visible in its correspondent sagittal section (Fig. 3)]

Table 1: Prognostic Factors.

-Pulpal diagnosis -Peri-apical diagnosis	Necrotic pulp Asymptomatic periodontitis (PAI=3)
Anatomic factors: -Curvature assessment -Surrounding anatomic structures	 Severe curvature: 80° (Shneider's method) Very close to the maxillary sinus
Broken instrument related factors: -number of broken files -Stage of treatment -Size -length	 -2 -in the beginning of the endodontic treatment -low tapered instruments -short

-positioncurvature	⟹	-both beyond the curvature/ one of them extruded 2mm from the apex

The tooth was isolated with a rubber dam and coronal temporary filling was removed. In this case, the coronal end of both instruments could not be visualized even with a straight-line access, so retrieval was impossible.

The decision was made to bypass both of the instruments or to perform an endodontic surgery in case of failure. Bypassing was started by establishing a straight-line access to the curvature and the broken files using stainless steelK-files number 8, 10, and 15 until where it stopped without forcing on the files. After that, shaping with thermally treated shaping files Endostar AZUR 20/04 then 20/06 was performed to enlarge the portion of the canal coronal to the obstacles.

Afterwards, k-file number 8 was sharply pre-curved similarly to the canal's curve then gently introduced with withdrew motion until a catch was felt. A tactile feeling confirmed the engagement of the file between the broken files and the root canal. This process was repeated with SS k-file number 10 then a customized 12 K-file made by cutting 1 mm from the tip of a K10 file. Working length has been determined with an apex locator and confirmed radiographically. K-file 15 and a customized k-file 17 were consecutively used. The intermediate size made the negotiation of the apical third of the canal smooth and more secure until full glidepath was done with a mix of K-files and Niti glidepath files (19/0.2). Finally, the apical third was prepared with thermally treated Endostar Azur 20/0,4.

Fig. 5. X-ray file in place.

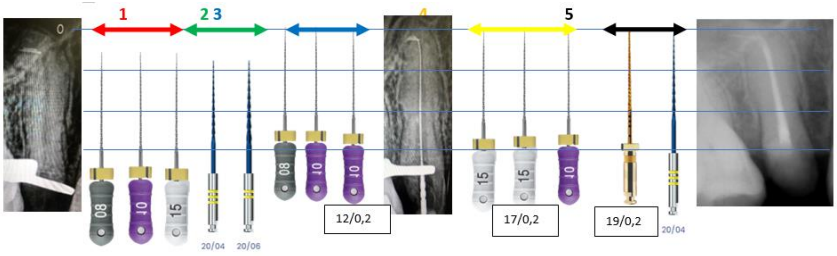

Fig. 6. Instrumental sequence adopted.

1/ establishing a straight-line access**2/** shapingto enlarge the portion of the canal coronal to the obstacles**3/**the engagement of the file between the broken files and the root canal**4/**negotiation of the apical third with a mix of K-files and Niti glidepath files**5/**preparation of the apical third endodontic irrigation needle as well as patency was maintained with k-file 10 between every instrument.

Calcium hydroxide was placed in the canal as an inter-appointment medication sealed with Cavit as a temporary restoration.

The patient returned after two weeks for the second appointment. Calcium hydroxide was removed with passive irrigation with 3% sodium hypochlorite. then the canal was washed with saline solution followed by 17% EDTA to remove the smear layer, after that the canal was neutralized with saline solution before the final irrigation with sodium hypochlorite activated with an ultrasonic activator Ultra-X (Eighteeth).

Canals were dried with paper cones, and 4% tapered ISO gutta percha cone were fitted in the canal to check the cone fit. The hydraulic obturation were performed with bio ceramic sealer Bioroot (RCS septodont). The patient was then referred for a temporary prosthetic rehabilitation.

3. Discussion

Case difficulty appreciation, planning and strategizing is of a critical importance while dealing with the root canal curvature and the broken instruments. CBCT represents one of the most valuable tools to fill the gap in the information provided by the 2-dimensional periapical radiography. This 3-dimensional data acquisition enables the visualisation and the quantification of the extruded file only visible in a coronal section due to the distobuccal direction of the apical curve. Moreover, CBCT allows the evaluation of the extent of periapical lesion and its spatial relationship with anatomical landmarks [4], [5].

Separated endodontic files can be managed conservatively via non-surgical methods or via surgical methods. The non-surgical methods are usually the first line of management and consist of removal of the broken instrument, bypassing it or cleaning and filling to the level of the broken file [6].

Several factors influence this decision such as anatomical tooth related factors. In our case, the apical localization of the broken file beyond such a severe curvature will not allow a visual access. Even though retrieval has gained in popularity among clinicians due to advancements in magnification with the operative microscope, innovative retrieval systems and improvement in ultrasonic tip designs, attempt to remove the broken instrument still imprudent.

Reports has demonstrated low success rate in removing fragments located in the apical third, especially inside and beyond the curvature (58% and 52%, respectively), when compared to those that reported regarding the middle and coronal thirds (68% and 100%, respectively) [7].

Furthermore, the localization of the broken files suggested that the fracture was caused by cyclic fatigue, the instruments were not locked in the dentinal walls so it would allow bypassing the broken instruments and complete instrumentation and disinfection to the apex. The latter was crucial for the healing of the periapical lesion.

Endodontic instruments rarely separate beyond the apical foramen. The fractured segment, always accompanied with bacteria and dentine debris, is a foreign object and might cause inflammation [8], [9]. It can also compromise the disinfection of the apical portion of the canal especially that the breakage of the instruments occurred in the early stages of the root canal therapy. Thus, an attempt to remove the segment from such cases with a surgical approach is often recommended by authors. Removal of the extruded instrument showed the lowest success rate (50%) [7]. Terauchi reported that when the separated instrument extruded apically, the first ultrasonic attempt may result in pushing the fragment further apically and sometimes out of the canal. He described the loop technique for removing along-separated instrument from the apical third of the mesial root of a mandibular first molar, that extended about 2 mm beyond the apical foramen. The fragment was visible and could be grasped by special removal kits [10]. By contrast, in the current case, both of the fragments were invisible and the tooth itself had complicated anatomy.
The surgical approaches for the extruded file include apicoectomy, root amputation or intentional replantation [11]. However, these kinds of approaches may not be applicable because of the difficulty of access to the surgical site and its proximity to important anatomical regions to the maxillary sinus in our case.

In addition, a systematic review and meta-analysis on the impact of a retained instrument on treatment outcome has shown that when an endodontic treatment is performed to a high technical standard, the influence of periapical lesion is slight. The outcome of endodontic treatment is mainly related to effective disinfection of the root canal system and prevention of recontamination. The instrument fragment in itself is rarely the cause of the complication mainly when it doesn't limit the access to the apical portion of the root canal [12]. The extruded instrument being bypassed to the apex and the tooth being properly restored, the surgical approaches were neglected or at least delayed.

In the above case presentation, the curvature of the root canal was considered "severe", this assessment will help picking the right instruments and techniques to deal with both of the obstacles.

Stainless steel as well as austenitic Niti files have the tendency to straighten up the canal and it is difficult for the clinician to control the amount of dentine removal through the push and pull motion. This could lead to other iatrogenic mishaps like ledges, perforation and another instrument separation [13].

This risk could be limited by two ways. The first one, is by shortening the active length of the file by gaining a straight-line access to the beginning of the curvature and the broken files with coronal flaring. The latter will limit the bending of the file against the dentinal walls with undesirable cutting and also prevent file failure under torsion by taper lock.
The second is by reducing the inherent force in a straight file by pre-curving the file according to the curving pattern of the canal for a better negotiation of the curve. The small ISO tip size can follow canal curvatures owing to their flexibility.

They should be used until they are made “super loose” in the canal before introducing a larger file tip. Customizing the small file by cutting 1mm from the tip will allow smoother transition for smoother cutting in a curved canal instead of the heavy shift from a SS K-file 10 to a SS k-file 15 which will increase the feel of increased stiffness [14].

During the negotiation of the curvature and the bypass attempt, manual files are used for better control with tactile feel and also to prevent the breakage of rotary files. Radiographs are necessary to detect any possible erroneous route of the file in time and risk of a perforation avoided.

It is wise to widen the glidepath until 20/0,2 ISO file before proceeding with rotary file for a safe shaping procedure. For the apical preparation, low tapered martensitic Niti files (20/0,4) are preferred for severely or double curved canals due to their increased flexibility and high cyclic fatigue resistance which is known to occur in curved canal. Moreover, martensitic files are prebendal which can be useful when trying to bypass a broken instrument.

Finally, it is necessary to organize appropriate follow-up of the patient in the event of any clinical complication. This allows periodic review and radiographic assessment. If deterioration of periapical health is detected, advanced apical surgery should be considered

4. Conclusion

Obstacles like fractured instruments or curvature may discourage some practitioners to initiate an endodontic therapy, but experience and knowledge of the endodontic armamentarium can allow a rational management of the case.

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