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Management Of Separated Endodontic Instruments: A Case Series

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Abstract

The separation of an endodontic instrument during a root canal procedure is a frequent mishap in endodontics. The separation of endodontic instruments can obstruct access to the apical portion of the root and impede the disinfection process. It hinders the proper cleaning of the canal located apical to the broken instrument, which can impact the treatment's success. However, improvements in techniques and tools, effectively retrieving separated instruments (SI) from the root canal is now achievable. This paper presents a series of cases that illustrate the management of separated instruments, in which the SI was successfully extracted in three instances. The instruments were fractured at different levels within the coronal and middle thirds of both maxillary and mandibular teeth. The location of the separation was identified, and the SI was removed utilizing an ultrasonic device under magnification. Following the removal of the SI, obturation was completed up to the full working length, along with subsequent post-endodontic restoration. The patients expressed satisfaction with the treatment outcomes in all cases. Evaluation of the cases, along with robust tools, sufficient knowledge, and proficient clinical skills and experience, contributes to the successful retrieval of separated instruments. It is crucial to remove the instrument without causing additional damage to the radicular dentin to preserve the tooth's integrity.

Keywords: Ultrasonics, separated instrument, instrument retrieval

Introduction

The occurrence of instrument separation during endodontic therapy poses a challenging situation, with reported incidences ranging from 2% to 6% in investigated cases. The presence of a distinct instrument within the root canal obstructs access to the root apex during nonsurgical root canal therapy. These instruments commonly encompass a variety of types, including files, reamers, peeso-reamers, Gates-Glidden drills, thermomechanical compactors for gutta-percha compaction, lentulo-spirals, or the tips of specific hand instruments such as gutta-percha spreaders or explorers. Common aetiologies of file separation include incorrect use, restrictions in its physical properties, insufficient access, aberrant anatomy of the root canal, and possible manufacturing flaws. Although these iatrogenic errors can often be prevented with thorough preoperative assessment, once they occur, managing them without causing further damage to the tooth structure becomes difficult. The site, size, and time to seal, the length of the separated fragment, and proximity to vital structures are the crucial factors that influence treatment success. This case series describes the successful extraction of a separated file firmly lodged in the root canal dentin of various teeth.

Case Report 1

A 25-year-old female patient reported to the Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, Chh. Sambhajinagar, with the chief complaint of pain in the upper right molar tooth. She gave a history of initiation of root canal treatment with the same tooth at a private clinic, 6 months back, and has been having pain since then. Clinical examination showed temporary restoration of the right maxillary first molar. The tooth was tender on percussion. Intraoral periapical (IOPA) radiograph revealed a fractured instrument at the coronal third of the palatal root canal of 16, and the canals were not obturated. There was no periapical radiolucency associated with the tooth.

Retreatment aiming to retrieve the separated instrument was planned, and the patient was informed about the treatment plan, and consent was obtained. After the removal of the temporary restoration access opening was enlarged. Gates Glidden (GG) drills no. 2 and 3 (Dentsply Maillefer, Ballaigues, Switzerland) were modified by cutting the drill perpendicular to the long axis at the greatest cross-sectional diameter. Modified GG drills were used to prepare a staging platform, and the coronal part of the broken instrument was exposed by removing the surrounding dentine. An ultrasonic with tips was used to trephine around the fragment. The procedure was carried out under magnifying loupes (×5 magnification). The ultrasonic tip was activated to trephine dentin around the broken fragment.

The canal was irrigated with normal saline intermittently to flush out the debris from the canal and act as a coolant. After about 15 minutes, the fragment loosened and popped out of the canal. IOPA was taken to confirm the removal of the separated instrument. The working length was then determined, and the root canal system was cleaned and shaped using the Protaper Gold rotary file system. Obturation of the pulp space was done with thermoplastic gutta-percha. After obturation, the tooth was restored with a composite restoration (Filtek Z350 XT Universal Restorative, 3 M India) followed by a porcelain-fused-to-metal crown.

Pre-operative radiograph with 16

Radiograph after instrument retrieval with 16

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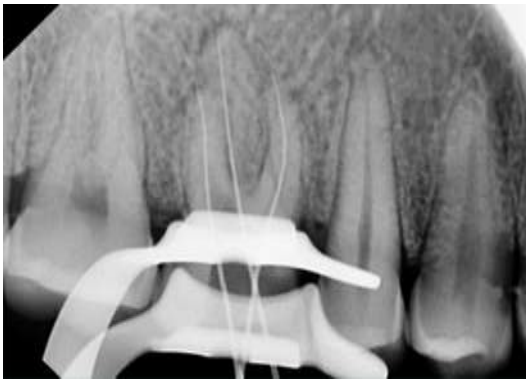
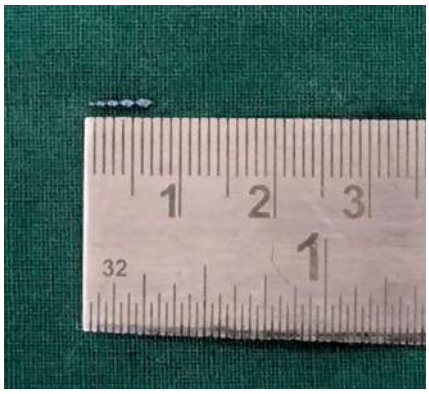
Working length determination with 16



6mm instrument retrieved



Master cone radiograph with 16

Post-operative radiograph with 16

Case Report 2

A 42-year-old female patient was referred to the Department of Conservative Dentistry and Endodontics, Government Dental College and Hospital, Chh. Sambhajinagar, with the chief complaint of pain in the upper right front tooth region for the past 1 month, gave a history of incomplete root canal treatment of the same tooth. A diagnostic radiograph revealed the presence of a separated instrument in the coronal third of the left mandibular first molar. Retrieval of the instrument was planned, and radicular access to the coronal end of the separated instrument was straightened by sequential use of modified GG drills. An ultrasonic tip was used to retrieve the broken instrument as described in case 1. During this procedure, the canal was irrigated intermittently with normal saline to decrease the heat generated within the root canal and hence prevent the adverse effects on periodontal tissues. The instrument was retrieved successfully from the canal in approximately 10 minutes, and a radiograph was taken to confirm the same. Canal was then prepared till F3 using ProTaper Universal rotary file system (Dentsply Maillefer, Ballaigues, Switzerland), followed by obturation using bioceramic sealer. In the subsequent appointment, the patient was asymptomatic, and post-obturation restoration was done with composite.

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Pre-operative radiograph

Post-operative radiograph

Case report 3

A 19-year-old male patient, referred by a general dentist, complained of mild, intermittent pain for two weeks, which aggravated on mastication. The patient reported a history of dental treatment initiated one month earlier. On intraoral examination, a temporary restoration was seen in the right maxillary lateral incisor (12), which was tender on percussion. An Intraoral Periapical (IOPA) radiograph of the tooth revealed a separated instrument in the coronal to middle third of the root and substantial periapical pathosis. Retreatment was initiated under rubber dam isolation. An ultrasonic tip was used to loosen the SI that could be visualized through a dental loupes. After retrieving the SI, the canals were thoroughly debrided, and an intracanal calcium hydroxide paste was placed. Once the tooth was asymptomatic and obturation was completed, followed by a post-endodontic restoration.

Post-operative radiograph

Post-operative radiograph

Discussion

Improper handling, like inserting an instrument too forcefully into the canal or navigating it around a tight curve, as well as excessive use of an endodontic instrument, can result in its fracture. The outcome of root canal treatment following instrument separation is influenced by the level of biomechanical preparation and cleaning that was done at the moment the instrument broke. Various techniques have been proposed for extracting separated instruments from the root canal, including the Masserann kit, Endo Extractor, wire loop method, and ultrasonic devices. Nonetheless, the successful retrieval of a broken instrument depends on factors like its length, type, and its location concerning the curvature of the canal.

The safe retrieval of a retained instrument is impacted by the anatomical structure, curvature of the canal, and is constrained by the morphology of the roots and the depth of any external concavities. An instrument is more likely to be successfully retrieved if it is located in the straight part of the canal and if at least one-third of its total length is visible. Stainless steel files are generally easier to extract compared to NiTi files, as NiTi files are prone to further breakage during extraction due to the heat generated. The probability of successfully retrieving stainless steel instruments ranges from 55% to 70%. While various retrieval methods have been developed, challenges arise due to limited visibility or cramped conditions, making it difficult to remove the instrument. Additionally, excessive widening of the canal during the removal of instruments may result in the weakness and eventual fracture of the tooth or lead to the creation of unintended ledges and perforations in the root. If it

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appears impossible to retrieve a broken instrument, it may be advisable to consider bypassing it with a smaller file. Nevertheless, caution is essential when attempting to bypass a fractured instrument to minimize the risk of additional errors, such as root perforation or the breakage of the bypass file.

Prevention is preferable to treatment; therefore, during root canal procedures, aspects like proper access cavity design, straight-line access, and glide path preparation must be taken into account. Innovations in technology and magnification tools have enabled the successful retrieval of instruments in most cases. Utilizing a microscope or magnifying loupes facilitates instrument retrieval and reduces damage to the canal dentine. According to Nevares et al., when the separated fragment was visible with a dental microscope, the retrieval success rate was 85.5%, compared to a 47.7% success rate when the fragment was not visible. The concept of using ultrasonics in endodontics was first introduced by Richman in 1957. Ultrasonics provides a reliable method for retrieving separated instruments from the root canal. In the current case, the piece of the instrument was extracted using the ULTRAX ultrasonic, which is a piezoelectric ultrasonic generator. The tips of these devices operate in a linear, back-and-forth "piston-like" motion, which is particularly effective for endodontic procedures.

Heat is produced due to the friction between ultrasonic tips and the canal wall dentine or a fractured instrument, which can result in quicker instrument wear and potential secondary fractures. Therefore, ultrasonic tips are used at lower power settings on the ultrasonic unit and for shorter durations. If retrieval is not feasible, the instrument may be bypassed, allowing for the integration of a retained, separated instrument into the obturation. Preventing file separation can be achieved by following established principles of biomechanical preparation and discarding endodontic instruments after each use. The best approach to avoid a fractured instrument in the root canal is through prevention. In the aforementioned case series, the separated instruments were successfully retrieved using the ultrasonic technique, which is both safe and conservative. The use of magnification also played a role in the success of the procedure. The separated fragments were extracted in a brief period with minimal removal of dentine. Ultrasonics provides a reliable method for retrieving separated instruments from the root canal.

Conclusion

Technological advancements, sophisticated devices, and experience enable the effective handling of broken instruments. With the least amount of dentine damage, the ultrasonic procedure provides a reliable way to remove detached instruments from root canals.

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