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Removal of fractured endodontic NiTi file in the apical third of the root canal using an alternative approach. A case report

Remoção de lima endodôntica de NiTi fraturada no terço apical do canal radicular usando uma abordagem alternativa. Um relato de caso

Extracción de una lima endodóntica de NiTi fracturada en el tercio apical del conducto radicular mediante un abordaje alternativo. Un reporte de caso

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Abstract
This case report presents an alternative approach for the removal of a fractured endodontic instrument from the apical third of the root canal. A 52-years-old female patient was referred for specialized endodontic treatment of the maxillary left first molar due to the presence of a periapical lesion and root canal calcification. After clinical and radiographic examination, the calcification was confirmed. During biomechanical preparation, the fracture of a size 25/.06 NiTi reciprocating file (ProDesign R) occurred in the apical third of the palatine canal. The patient was informed about the complication and agreed with the attempt to remove the fragment. Firstly, a slight wear of the dentinal walls around the fragment was made using ultrasonic inserts under magnification. Then, a customized extractor was made using a hypodermic needle and a handling file whose mechanism is similar to the removal method previously described by Masserann. For this, the hypodermic needle was inserted in the root canal and the handling file was adapted in the needle lumen, with the function of fixing the fragment and removing it from the canal through the opposite movement performed by the fractured file. After associating the technique with a hypodermic needle and using ultrasound and an operating microscope to perform the procedure, the fragment was successfully removed. The association of techniques to remove fragments using only items already present in the endodontic arsenal can eliminate the need for surgical treatment and improve the prognosis of endodontic treatment through a safe, simple and cost-effective method that can be performed in the endodontic clinical routine.
Keywords: Endodontics; Root canal therapy; Separated instrument; Instrument removal.

Resumo
Este relato de caso apresenta uma abordagem alternativa para a remoção de um instrumento endodôntico fraturado no terço apical do canal radicular. Paciente do sexo feminino, 52 anos, foi encaminhada para tratamento endodôntico especializado do primeiro molar superior esquerdo devido à presença de lesão periapical e calcificação do canal radicular. Após exame clínico e radiográfico, a calcificação foi confirmada. Durante o preparo biomecânico, ocorreu no terço apical do canal palatino, a fratura de uma lima reciprocante de NiTi 25/.06 (ProDesign R). A paciente foi informada sobre a intercorrência e concordou com a tentativa de retirada do fragmento. Primeiramente, um leve desgaste das paredes dentinárias ao redor do fragmento foi feito com insertos ultrassônicos sob magnificação. Em

seguida, foi confeccionado um extrator customizado utilizando uma agulha hipodérmica e uma lima manual cujo mecanismo é semelhante ao método de remoção descrito anteriormente por Masserann. Para isso, a agulha hipodérmica foi inserida no canal radicular e a lima manual foi adaptada no lúmen da agulha, com a função de fixar o fragmento e retirá-lo do canal por meio do movimento contrário realizado pela lima fraturada. Após associar a técnica da agulha hipodérmica e utilizar o ultrassom e o microscópio operatório para realização do procedimento, o fragmento foi removido com sucesso. A associação de técnicas de remoção de fragmentos utilizando apenas itens já presentes no arsenal endodôntico pode eliminar a necessidade de tratamento cirúrgico e melhorar o prognóstico do tratamento endodôntico por meio de um método seguro, simples e de baixo custo que pode ser realizado na rotina clínica endodôntica.
Palavras-chave: Endodontia; Tratamento do canal radicular; Instrumentos fraturados; Remoção de instrumentos.

Resumen
Este caso clínico presenta un enfoque alternativo para la extracción de un instrumento endodóntico fracturado en el tercio apical del conducto radicular. Paciente de sexo femenino de 52 años que fue remitida para tratamiento endodóntico especializado del primer molar superior izquierdo por presencia de lesión periapical y calcificación del conducto radicular. Tras el examen clínico y radiográfico, se confirmó la calcificación. Durante la preparación biomecánica, se produjo una fractura de una lima recíproca de NiTi 25/.06 (ProDesign R) en el tercio apical del canal palatino. Se informó al paciente sobre la complicación y se mostró de acuerdo con el intento de retirar el fragmento. Primero, se realizó un ligero desgaste en las paredes dentinarias alrededor del fragmento con inserciones ultrasónicas bajo aumento. Luego, se realizó un extractor personalizado utilizando una aguja hipodérmica y una lima manual cuyo mecanismo es similar al método de extracción descrito anteriormente por Masserann. Para ello, se insertó la aguja hipodérmica en el conducto radicular y se adaptó la lima manual en el lumen de la aguja, con la función de fijar el fragmento y sacarlo del conducto mediante el movimiento contrario que realiza la lima fracturada. Tras asociar la técnica de la aguja hipodérmica y utilizar ultrasonido y un microscopio quirúrgico para realizar el procedimiento, el fragmento fue retirado con éxito. La asociación de técnicas de remoción de fragmentos utilizando únicamente elementos ya presentes en el arsenal endodóntico puede eliminar la necesidad de tratamiento quirúrgico y mejorar el pronóstico del tratamiento endodóntico a través de un método seguro, simple y de bajo costo que se puede realizar en la rutina clínica endodóntica.
Palabras clave: Endodoncia; Tratamiento de conducto; Instrumentos fracturados; Extracción de instrumentos.

1. Introduction

Nickel-titanium (NiTi) rotary or reciprocating instruments have gained a prominent position in the optimization of endodontic treatment (Alapati et al., 2005), as they have several advantages in comparison to steel instruments: greater flexibility, easiness for preparation of curved root canals, maintenance of the original position of the apical foramen, higher resistance to torsion, larger instrument conicity, and above all, reduced operating time (Gambill et al., 1996; Thompson, 2000). Concomitant with the increase of NiTi instruments use, file fractures have gained importance since they represent an uncomfortable situation during endodontic therapy (Parashos & Messer, 2006).

The anatomical complexity of the root canal system represents one of the major challenges to be overcome during endodontic treatment and can be one of the most frequent causes related to instrument fracture (Sjogren et al., 1990; Wolf et al., 2016). In addition, the lack of professional mastery of the technique, excessive use of the instrument, inadequate use, and the amount of sterilization suffered by the instrument are also associated with these accidents (Lopes et al., 2012). Obstruction of the root canal by fragments of fractured instruments implies an unfavorable prognosis of the case since the cleaning and disinfection of the obstructed root canal may be compromised (Madarati et al., 2013).

The removal of fractured instruments requires professional knowledge and ability. Moreover, some aspects must be considered such as access to the fractured file, fragment size, instrument specification, prior diagnosis of the case, remaining dental structure, and the consent of the patient after guidance on risks and benefits related to the procedure (Shahabinejad et al., 2013; Shen et al., 2004). Several extracting techniques and devices have been created and described. Among them, manual instruments, extraction systems such as the Masserann kit and Canal Finder system, and alternative techniques such as the use of hypodermic needles (Brito-Junior et al., 2015; Chhina et al., 2015; Frota et al., 2016; Hulsmann, 1990; Monteiro et al., 2014). Regardless of the technique chosen, the use of ultrasonic tips and, mainly, the operating microscope is essential during

this procedure (Brito-Junior et al., 2015; Chhina et al., 2015; Shahabinejad et al., 2013).

Although several techniques aiming at removing fragments of the root canal have been described, standardized procedures do not exist to be followed in the literature. Thereby, this case report aims to present an alternative removal technique of a fractured instrument in the apical third of the root canal through a clinical case report using a hypodermic needle with ultrasound aid.

2. Methodology (Case Report)

Clinical and radiographic examination

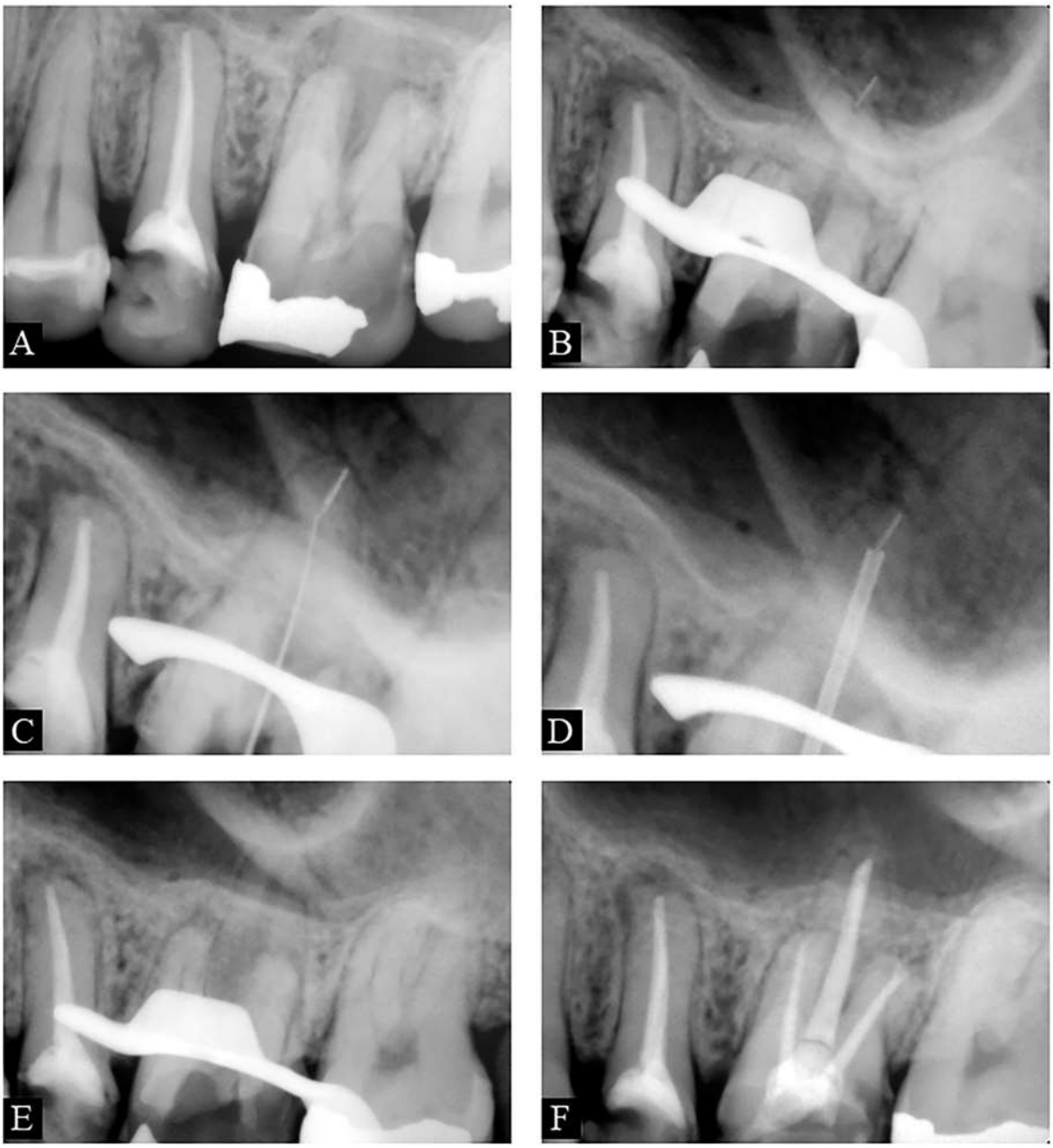
A 52-year-old female patient sought the Endodontics Clinic at the School of Dentistry, Araçatuba - UNESP, complaining of pain when chewing on the upper left side. The patient was referred for treatment of the maxillary left first molar presenting calcified canals, which was radiographically noted. Anamnesis and clinical examination were performed at the first visit as part of the care protocol. An informed consent form was signed before any procedure was carried out.

The anamnesis revealed the absence of systemic disease and/or allergies. During the clinical examination, an intraoral fistula near the periapical region of maxillary left second molar was observed. The maxillary left first molar presented unsatisfactory restoration and recurrence of caries. The periapical diagnostic radiograph showed a periapical lesion involving the buccal roots of the tooth (Figure 1A). According to the patient's report, the fistula had appeared about 6 months ago and disappeared every now and then. To confirm the origin of the fistula, mapping was done with a gutta-percha cone.

Clinical management

Local anesthesia using prilocaine 3% with felypressin was administered (Citocaína ®, Cristália, Itapira, Brazil), and the access cavity was prepared using a sterile diamond drill under rubber dam isolation. Biomechanical preparation of the cervical and middle thirds were performed by using a size 25/.06 reciprocating file (ProDesign R, Easy Odontological Equipment, Belo Horizonte, Brazil). Root canals were irrigated with 2.5% sodium hypochlorite (NaOCl) (Rioquímica, São José do Rio Preto, Brazil). The determination of working length (1 mm below the apex) was made using the apex locator (Root ZX, J Morita, Tokyo, Japan). Biomechanical preparation was finished with the size 25/.06 file (ProDesign R) in the buccal root canals. The glide path and enlargement of the calcified palatine canal were performed with size # 06 to #10 hand files (Dentsply Maillefer, Ballaigues, Switzerland) before the reciprocating instrumentation. A fracture of the reciprocating file occurred during instrumentation of the apical third of the palatine root canal (Figure 1B). Then, a decision was made to stop the procedures and use intracanal medication with calcium hydroxide paste, iodoform and, propylene glycol. The tooth was sealed with Coltosol® (Coltene, Altstatten, Switzerland) and glass ionomer (Maxxion R, FGM, Joinville, Brazil). The patient was oriented over the fracture of the instrument and agreed to the attempt of removing it.

Figure 1. Radiographic sequence of the endodontic techniques performed in this study.



A. Initial radiographic image; B. Presence of the fragment of a size 25/.06 NiTi reciprocating file (ProDesign R) in the apical third of the palatine canal from maxillary left first molar; C. Examination of the coronal end of the separated instrument to guide needle adaptation; D. Hypodermic needle adaptation around the separated instrument; E. Root canal after the instrument removal; F. Root canal obturation. Source: Authors.

Treatment planning

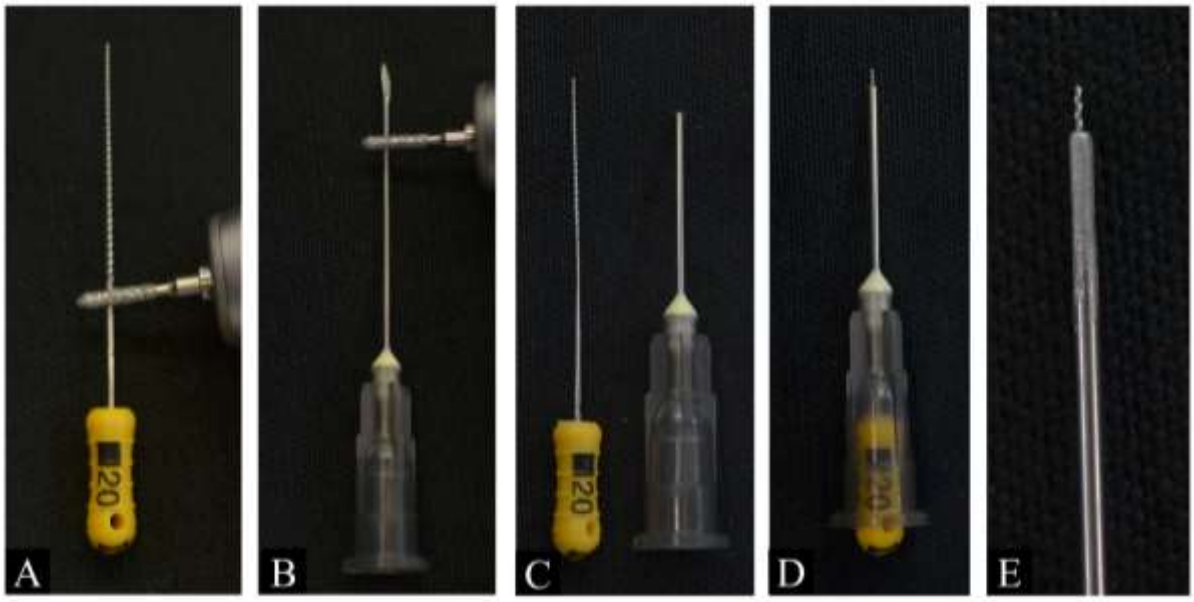
Non-surgical approaches for removing fragments are preferable and can prevent the patient from undergoing an invasive procedure. Conservative management includes removing, bypassing through the fragment, or filling the canal from the fragment limit. Among these possibilities of conduct, an attempt was made to remove the fragment. Three factors were decisive for the clinical management: the absence of symptoms, the patient collaboration, and the favorable anatomy of the palatine canal for the enlargement procedures.

Removal technique

The removal technique used followed the protocol described by Monteiro et al. (2014) that used a stainless-steel prepared needle associated with a K-file. On the patient's return after 21 days, the clinical examination showed no symptoms and the resolution of the fistula. Firstly, the enlargement of the root canal through slight wear of the dentin walls around the fragment using a Clearsonic ultrasonic insert (Helse, Santa Rosa de Viterbo, Brazil) under magnification was performed (Figure 1C).

Figure 2 shows the wear and adaptations made to the file and the needle for making the extractor. After creating a space in the instrument/tooth interface, a hypodermic needle with a 0.7 x 25mm caliber was used, suitable for the insertion of a file in its interior, whose function is to attach itself to the fragment and draw it out of them, as previously described as Masserann technique (Thirumalai et al., 2008). The root canal enlargement was performed in stages and radiographs were taken during the process to confirm the path and its proximity to the fragment (Figure 1D). After fixing the needle and insert the file into the needle lumen, the movement to remove the fragment might be in the opposite direction to the torque of the instrument system. The instrument presented resistance even after the use of ultrasound but then was successfully removed after the association of the techniques (Figure 1E).

Figure 2. Adaptations and wear on the file/needle for making the customized extractor.



A. Wear of the handling file to allow it to enter the needle; B. Removal of the hypodermic needle bevel; C. Instruments after all wear; D. Customized extractor used in the case; E. File tip that will be fixed to the fractured instrument during the removal. Source: Authors.

Obturation

After the removal, irrigation and final agitation with Irrisonic ultrasonic insert (Helse) were performed. After dried with paper points, the root canals were filled using standardized gutta-percha cones and MTA Fillapex cement (Angelus, Londrina, Brazil). Two obturation techniques were performed in the tooth: the lateral condensation technique in the palatine root canal due to its enlargement during the wearing procedures, and in the buccal root canals by the single cone technique (Figure 1F). The coronary sealing was done through temporary cement followed by a glass ionomer (Maxxion R). The patient was referred to perform the definitive restoration.

3. Results and Discussion

The fracture of an endodontic instrument in the root canal turns the treatment more complex to perform. The high incidence of this complication leads to an unfavorable prognosis due to the difficulty to clear and decontaminate the remaining obliterated root canal (Cheung, 2009). Instrument fracture occurs due to several factors, such as lack of knowledge about the root anatomy, unsatisfactory coronary access, anatomical complexities, reuse of the file, and inability of the operator (Shen et al., 2004). Some features of the fragment should be considered at the time of removal, such as type, size, location in the root canal, and anatomical particularities of the tooth. Some situations may increase the difficulty of removing the instrument, including the small length of the fragment, fragment location close to the apical third or beyond the foramen, associated anatomical complexities such as curvatures, calcifications, and flattening, and also the lack of an operative microscope (Madarati et al., 2013).

NiTi instruments fracture more frequently than stainless steel instruments, so the operator must follow the system instructions for use, especially the number of uses indicated by the manufacturer (Di Fiore et al., 2006; Drago et al., 2011). However, rotating files can suffer fractures on their first use if excessive forces are applied to the root canal allowing the metal composite to fail (Martin et al., 2003). The instrument fractured cause in this case report is related to possible cyclic fatigue originated by the canal calcification, even though file was on its first use. The most frequent causes related to fracture of NiTi instruments are torsion, fatigue, and speed of rotation used to prepare the root canal system (Martin et al., 2003). In this way, some precautions should be taken in order to avoid these fractures such as: staying as short as possible inside a curved root canal with the instrument; do not apply excessive force during biomechanical instrumentation, employ the lowest possible speed of rotation and perform preventive discarding of the instrument before it reaches the fatigue life limit (Lopes et al., 2012).

Clinical management may differ between fragment removal, overpassing, or apicoectomy (Bahcall et al., 2005). In this case, instrument removal was chosen because it is a conservative and cost-effective approach concerning the other procedures. Intracanal intervention is always the first alternative, and instrument removal is preferable before choosing to bury it inside the root canal. Apical surgery remains an option after intracanal removal resources are depleted. There are numerous procedures used for the removal of fractured instruments such as the conventional method with manual instruments, Masserann kit, Canal Finder, IRS (Instrument Removal System), ultrasound, and the association of methods (Chhina et al., 2015). The technique using the hypodermic needle associated with K-file has an affordable cost as already highlighted by Monteiro et al., (2014). This fact allows the operator to always consider trying to remove the fragment as a clinical option improving the prognosis of the patient.

Among the advantages of this reported technique is the simplicity of manufacturing the custom extractor, the small wear of dentin walls and, the reduced cost for its manufacture when compared to other commercialized extractors, such as the Masserann Kit. In addition, the technique is considered less invasive when compared to surgical approaches because all steps are done inside the root canal. Nevertheless, this technique presents difficulties related to any instrument removal intervention, such as the long operative time that requires patient compliance, the need to use the operating microscope, the operator's skill and knowledge about the required materials, and especially, about the internal anatomy of the root canals. Furthermore, considering the technique reported, there is difficult to fix the needle around the fragment which is determined through various radiographic sockets (Grossman, 1969).

Every effort should be made to avoid fracturing the instrument since the approach to removing it requires a greater number of interventions, clinical experience, and in-depth knowledge of the internal anatomy of the root canals (Terauchi et al., 2006). When the clinical decision is to remove the fractured instrument, patient compliance is necessary and conservative

interventions are the best accepted. The operator must combine the different techniques available in the literature, being able to use routine clinical materials such as hypodermic needles in an attempt to remove the instrument.

4. Conclusion

In conclusion, this clinical case report presented an alternative technique to remove fractured NiTi instruments in the apical third of the root canal using hypodermic needles associated with the use of ultrasound and operating microscope. The association of techniques to remove fragments using only items already present in the endodontic arsenal can eliminate the requirement for surgical treatment and improve the prognosis of endodontic treatment through a safe, simple, and cost-effective method that could be performed in the endodontic clinical routine.

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