Methods and devices that assist the removal of fractured file: Literature review.

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ABSTRACT

Instrument fracture during endodontic therapy is an undesirable complication, which can lead to treatment failure. When this happens, it requires further planning of the case, aiming at a change of conduct in order to remove or surpass the instrument. It is important at this time the professional's knowledge of numerous techniques and mastery of instruments to execute them. In this study, a literature review was carried out in which it was concluded that the removal of fractured instruments in straight root canals is more easily solved than in curved root canals, that the use of ultrasonics associated with the operating microscope significantly increases the success of the removal, and if the fractured instrument removal from the canal is not possible, the overpass of the fragment has the best prognosis for the treatment.

Keywords: Endodontics. Ultrasonics. Microscopy. Dental instruments.

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Introduction

Endodontic treatment consists of the cleaning, disinfection, modeling and obturation of the root canal system seeking the periapical tissue repair. Several techniques and instruments have been developed with the aim of achieving a correct, safe and reasonably short biomechanical preparation.[1]

Among the various stages of the treatment, during chemical-mechanical preparation the endodontic instruments undergo strains and/or adverse deformations by the variations of the anatomy of the root canal.[2] In this step many accidents and complications may occur, such as instrumentation deviation, ledge, apical deviation, foramen deformation, canal obstruction and instrument fracture.[1] The factors that determine an instrument fracture are excessive force, operator inability, and instrument wear.

Nickel-titanium (NiTi) files are used in chemical-mechanical preparation (CMP) due to their special properties such as: super-elasticity, biocompatibility, high corrosion resistance and memory effect. NiTi rotating instruments have been applied in endodontic practice by these characteristics when compared to traditional stainless steel instruments.

Fracture can occur by two mechanisms, cyclic fracture (caused by compression and tensional stress in rotating instruments in curved root canals) or torsional (caused by friction between walls and instrument).[4] However the cyclic fatigue fracture of NiTi instruments occur unexpectedly, with no previous permanent deformation of the instrument, unlike the distortion in stainless steel instruments, which serves as a preventive fracture alert.[4]

The instrument fracture inside the root canal constitutes a serious risk to the continuity of endodontic treatment.[1] This situation is at least problematic and requires changes in the scheduled routine treatment, where the first objective would be to remove it or at least bypass it.[5,10]

Techniques for the fragment removal from a canal are many, such as methods using manual files, ultrasonics, canal finder system, cyanoacrylate gluing technique, seizure and traction with hemostatic clamps, or combination of these techniques.[6]

The aim of this literature review is to survey the clinically used methods to aid in the separated instruments removal or unblocking during endodontic treatment.

Literature review

Hartmann and Barletta[6] reported the removal of a broken file from a tooth #22 root canal which was filled. After desobturation, a path was created between the wall of the canal and the fractured instrument with fine-caliber files. The technique consisted in using two Hedstroen files (Dentsply-Maillefer, Ballaigues, Switzerland) of 15 and 20 gauges placed on the working length (WL) making a twisting motion of the cables and then traversing them in coronal direction until complete removal. Two sessions were performed for complete instrument removal, re-preparation and obturation. The tooth was prepared to make an intrarradicular retainer and provisional fixed prosthesis and guided radiographic control in 6 months. After 1 year and 3 months of follow-up, the healing of the lesion could be observed. It was possible to observe that the employed method is accessible and efficient.

Américo[7] reported a case of a tooth #27 with a broken file in the mesio-vestibular canal (MV) in the middle third of the canal. The removal attempt was first performed with a pre-bent manual # 10 K file at 14 mm from the canal reference, with scanning motion, attempting to bypass the fragment. There was no success on the first attempt. In the second session, the clinical microscope was used and the bypass was performed. The WL was established in 16 mm, but the instrument was not removed and the root canals were instrumented up to the WL and medicated with calcium hydroxide and paramonoclorophenol. The obturation was performed in the following session, and after 90 days, new clinical and radiographic exams were performed where a treatment success could be confirmed with absence of painful symptomatology and no apical resorption and no thickening of the lamina dura.

Chhina et al[8] reported a case of fractured endodontic instrument removal with the help of ultrasonics, and discussed the factors that influence its removal. The removal of broken file in a distobuccal canal was carried out with the help of an ultrasonics insert (ET25, Satelec Acteone, France) and then the canals were filled and the tooth restored with composite resin. The author discusses the existing types of ultrasonics: one which converts electromagnetic energy into mechanical through a pile of strips of

metal subjected to a magnetic field that results in vibration, and another one based on the piezoelectric principle, where a crystal that changes in dimension when an electric charge is applied where this deformation produces a mechanical oscillation without producing heat and with more cycles per second, 40 against 24Khz; and its oscillation with piston movements are ideal for endodontics. The case follow-up was carried out after six months. This article concluded that the clinician should have mastery of the anatomy of the canal as well as knowledge of several instruments and techniques for the treatment, and that the use of ultrasonics is a safe and conservative technique for the removal of separated instruments.

Dallagnol et al[2] reported a case of a #36 tooth with a broken file in the mesio-buccal canal in the apical third. In this case, the removal attempt was discarded due to the location of the fragment. Some attempts were made to bypass it with files of smaller diameter, but without success. The root canals were then filled and the mesio-buccal one was filled at the separation limit. After 2 months the tooth was definitively restored with composite resin and the patient was without pain and swelling. The author considered that in cases of separated files in the apical third of the tooth, it can work as a filiing material and a favorable diagnosis depending on the quality of the final obturation.

Cujé et al[9] investigated the success rate of endodontic technique using electron microscope and ultrasonic inserts. The study was performed with 170 cases of instruments fracture inside the root canal in different positions. Divided into groups according to the location of the fractured fragment (cervical, middle and apical). There was a success rate of 95% of the cases, with 5% of failure occurring in the apical third of the roots. The position of the instrument within the root canal, the angle of curvature of the root canal and the location of the fractured instrument in relation to the curvature of the root canal were the decisive factors that had a negative influence on the treatment result. The authors concluded that the tested removal method represents a highly effective technique.

Gencoglu and Helvacioglu[10] study aimed at evaluating the success of certain methods that can be used in the removal of broken instruments in different types of root canals, straight or curved, and even different fracture locations towards the type of canal. A total of 93 root canals (63 straight and 30 curved) were evaluated. In all cases, the microscope was used for magnification. Conventional techniques, ultrasonics and Masseran kit were used for straight root canals, and conventional technique and ultrasonics for the removal attempt in curved root canals. The success rate was 82.2% considering total removal or bypassing the fragment. The location of the fragment and the root canal anatomy influence the success of fractured instrument removal. The authors concluded that the use of ultrasonics under the view of an operating microscope is an effective removal method.

Linhares[11] reviewed the literature discussing causes and prognosis of fractured instruments presenting a clinical case. The presented case was of a #23 tooth in which the separated file was in all extension of the root, and the ultrasonics method of removal was used to wear around the instrument with the aid of the operative microscope. Based on the literature review and in the clinical case, this study concluded that the removal of the separated instrument within the canal can safely be performed using ultrasonics and operating microscope.

Terauchi et al[12] presented four clinical cases of separated instrument removal at the apex of curved root canals, using a technique which consists of three steps: Step 1 – Establish a straight access with minimal removal of dentin using Gates-Glidden drills counterclockwise in order to unscrew the separated fragment; Step 2 – use of ultrasonic insert in dentin removal around the tip and posterior vibration of it; Step 3 – use of a device to wrap the fragment through a NiTi loop. With the use of the surgical microscope, the cases were successful. In summary, the system presented a safe and effective method for the removal of separate instruments with minimal removal of dentin and foreseeable removal of the fragment.

Al-Dameh[13] summarized in his article the current understanding of the impact that a broken file in the canal can cause and the management of this situation, as well as treatment options. The article discusses the importance of using the surgical microscope in almost all removal techniques. It also presents the use of ultrasonics as a technique to

create a path between the file and the wall of the canal, and with the vibration of the fragment, the same can end up being released from the walls; but this will depend on the position of the fragment — if it is in the curvature, or after it, the attempt is not advised because a perforation may occur. If the canal was instrumented and decontaminated, that is, an advanced instrumentation stage of the canal and the tooth did not present apical periodontitis, the prognosis is good; but if there was no possibility of removal of the instrument and the tooth presents apical periodontitis, the prognosis is bad.

In the study of Navarro et al[14] two cases are shown in which the bypass of the fractured instrument fragment was performed. In case 1 (#26 tooth) a cervical widening of the MV canal was performed with Gates-Glidden up to # 5, bypass of the separated file first with K #08 file and posteriorly maintained the patency with K #10, the canal was instrumented up to the WL and filled with the separated file. In the second case (#36 tooth) there was no success of bypassing the instrument, and the canal was instrumented and filled to the limit of the separation. In view of the above, bypassing the fractured instrument is a safe technique that avoids the wear of the canal walls, and as observed in most cases, the instrument that remains in the obturator mass is not a reason for failure.

The case described by Pereira et al[15] showed a variation of Endo Extractor device, which employs metal pipes associated with a cyanoacrylate adhesive, for removing a broken file in the #22 tooth, the instrument was approximately 12mm long. A canal dilation was then performed, causing the fragment to be trapped only in the apical portion and to have visualization, a needle tip for drying the root canals was tested for the adapted portion of the cervical part of the fragment, then a drop of cyanoacrylate was placed on the tip of the needle and adjusted to the instrument inside the canal and kept the assembly immobile for five minutes. Then, for the removal an anticlockwise movement was carried out by pulling out the instrument firmly adhered to the needle. From the success of the case, he emphasizes the importance of clinical articles, which aggregate knowledge and can combine simple and low cost techniques that achieve the expected objectives.

Discussion

The greatest microbial reduction of the root canal system is during chemical mechanical preparation. In this preparation, manual and/or mechanically driven files are used for the removal of contaminated dentin. These instruments, manufactured with several types of metal alloys, may fracture at some point during preparation, complicating the completion of the endodontic treatment, acting as an obstacle towards the real length of the canal.[1]

NiTi files may suffer fracture due to cyclic fatigue and occur in curvatures of root canals.[4] The location of the fracture is directly related to the success of fragment removal. In cases of instrument fracture in the apical third, in curvatures and apex of curved canals, the removal becomes more difficult, reducing the success rates.[9,10,11,12]

The position of the instrument within the root canal, the angle of curvature of the root canal and the location of the separated instrument in relation to the curvature of the root canal were the decisive factors. The authors concluded that the tested removal method represents a highly effective technique.[9]

The magnification in the endodontic treatment provides significant improvement in the quality of the final result due to the better visualization and illumination of the operative field, showing an increase of details that can not be observed with the naked eye, allowing an excellent precision.[13,16] For other authors[9-12] the ultrasonics in conjunction with surgical microscope associated with removal techniques, achieved greater success in the removal. However Hartmann and Barleta[6] and Pereira et al[15] were successful in their attempts to remove broken instruments without the use of magnification of the surgical field. In both cases, the tooth in question was the #22, with a single canal and with no sharp curvature, the fragment had more than 10 mm in length, which facilitated its visualization and removal.

Ultrasonics based on the piezoelectric principle is better for endodontics due to the linear motion of the tips, working as a "piston" and a larger number of cycles per second, compared to the magnetostrictive ultrasonics.[8,17] Chhina et al[8] were successful without the aid of surgical microscope but with the use of ultrasonics because the fragment was visible in the cervical third of the root with about 10mm long.

Although authors argue that the best option in fracture cases is the fragment removal, in situations where this is not possible, as observed in most cases, the fractured instrument remains in the obturating mass and it is not a reason for postoperative pain or treatment failure.[14] For Fachin,[18] fractured instrument in the canal acts as a barrier that prevents the disinfection of the apical third, and for the appropriate obturation, the operator should try to pass another instrument by the side of the fractured instrument and under heavy irrigation, remove it or expand its side, corroborating the results of Navarro et al[14] and Dallagnol et al,[2] which could laterally fill one case and the other case was filled.

If the biopulpectomy is the case, the pulp tissue that remains in the unattached portion of the canal is not infected but inflamed, the prognosis of these cases is favorable, and the best course is the proservation; if there is no success, then surgical complementation is recommended.[2]

Conclusion

• Separated instruments at straight root canals are more easily removed compared to the curved root canals.

• For any removal technique in any type of tooth, the use of microscopy associated with ultrasonics significantly increases the success of the operation.

• If removal of the separated instrument from the canal is not possible, the fragment bypass has the best treatment prognosis.

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