

Separated instrument retrieval through ultrasonics - A case series

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INTRODUCTION

Instrument separation during root canal therapy is one of the most frustrating event to a clinician. A separated instrument can hinder thorough chemico-mechanical disinfection of the root canal system leading to failure. Prevalence of fractured instruments varies between 0.7 to 7.4% (mean 1.6%). The advent of nickel-titanium (NiTi) alloys has not resulted in a lower incidence of instrument separation. Whereas separation rates of stainless steel (SS) instruments have been reported to range between 0.25% and 6%, the separation rate of NiTi rotary instruments has been reported to range between 1.3% and 10.0%. Although stainless steel instruments shows signs of wear, nickel-titanium instruments breaks without any signs of fatigue. Many clinicians have addressed the problems which comes with instrument separation. As early as 1956 Strindberg reported reduced peri-apical healing in cases having a separated instrument in the canal. Some studies show no significant difference in healing in cases with separated instrument while others reported reduced success rate of root canal treatment. The prognosis is likely to depend on the stage and degree of canal preparation and disinfection at the time of instrument fracture and, therefore, on the extent to which microbial control is compromised. The main prognostic factor in such cases has been reported to be the existence or nonexistence of a pre-operative peri-radicular pathosis.

During the past several decades many devices, techniques, and methods have been described for removal of separated instruments. Although some are still widely used, others are only of historical interest. In addition, several new promising techniques and devices, have emerged.

It is essential that a clinician effectively and safely handles the devices and instruments used for removing the separated fragment to avoid further complications. Where confidence and/or competence are in doubt, referral to a more experienced clinician or specialist is the preferred approach.

MATERIALS AND METHODS

2 Cases were selected from the OPD pool Dept of conservative dentistry and Endodontics. All patients had persisting pain after root canal treatment from a private practitioner. In this case series, we did not use any proprietary instrument retrieval system and used stainless-steel ED14 Ultrasonics tips connected to an ultrasonic device. The whole procedure was done under dental operating microscope (DOM). Pre-operative X-rays were taken at different angulations to pinpoint the separated instrument in and its angulation to the root canal. All cases were done under complete rubber dam isolation. Initially a NiTi orifice opener was used to enlarge the orifice. No 1 and No 2 Gates were modified by trimming the flame shaped tip until its maximum diameter and were used sequentially at 800 RPM to drill the canal until the separated instrument to create a staging platform.



ED 14 ultrasonic tips



Modified Gates-Glidden drill

Then at a power setting of 1 in the piezoelectric ultrasonic device(Cavitron, Acteon Satellec, France) the ultrasonic tip was introduced between the separated instrument and the inner dentin wall.

To avoid perforation, dentinal troughing was done only in the inner wall. During this process a repeated alternative irrigation using a 26 gauge needle was done inside the canal using 5.5% sodium hypochlorite and 17% EDTA solution to remove the debris and root canals were dried using paper points. Once inserted the ultrasonic tip is inserted between the separated instrument and inner wall dentin and activated with short pulses. Once the instrument started to vibrate loosely in the root canal, 17% EDTA solution was introduced in the canal and activated. The acoustic streaming and cavitation produced facilitated the removal of separated instrument.

Then a No 8 K-file was introduced inside the canal to negotiate till the working length. Further treatment protocol was completed with Neo-Endo flex files rotary instruments(Orikam, India) and obturated accordingly.



Pre-operative radiograph



Separated Instrument as seen under microscope



Separated instrument removed



Post-obturation and bonded composite build-up radiograph



Pre-operative radiograph



Separated Instrument as seen under microscope



Post-obturation and bonded composite build-up radiograph

Many different attempts at instrument removal have been described, and a number of experimental studies have compared the success rates of different removal techniques, mainly the use of ultrasonics. According to the review article by Madarati et al several factors affecting success rates of instrument retrieval can be classified broadly into

- **Tooth factors** include maxillary teeth, anterior teeth, presence of separated instrument before the curvature of root canal and availability of straight line access into the canal.
- **Instrument factors** include shape, size, material the instrument made of.
- **Operator factors** include experience successful removal is a challenge that relies on knowledge, training, familiarity with techniques and instruments, perseverance, and creativity. It is important to stress that an experienced operator not only can remove the separated instrument(s) but also does not sacrifice tooth tissue unnecessarily. If a clinician believes that he/she does not have the competence for successful management, referring the patient to a specialist would be the preferred approach.
- **Patient factors** such as the extent of mouth opening, limitations in accessing the tooth, time constraints, anxiety level, and motivation to retain teeth are important. By explaining and discussing the complexity of the procedures and their potential complications with the patient before treatment, it may be possible to alleviate many of the patient's fears while earning "good will support" from the patient, allowing the operator time to enable successful accomplishment of the task

Ultrasonics and dental operating microscope have been proven to be an indispensable in retrieval of separated instruments. To reduce the amount of dentin removed during instrument retrieval, along with staging platform, a funnel shaped access to the instrument is recommended to improve visualisation of the separated instrument under the microscope.

Hashem examined the temperature rise in the root canal during activation of ultrasonics in retrieval of separated instrument and recommended the use of 1-4 power setting in the piezoelectric unit and showed that the power of 5 and above would cause damage to PDL. The ultrasonic tip should always be activated in a pulsing motion with 2 second interval to prevent rise in temperature inside the root canal. The force that is required to fracture roots vertically after the removal of broken instruments using ultrasonic tips has been investigated in many studies. Madarati et al.(2009) reported that there was no significant difference in relation to the changes in either canal volume or mass between a group in which the canals were only instrumented and a group in which a broken instrument was removed from the coronal part of the canal.

In the same study, it was also reported that the removal of fractured instruments from the apical third of the root canal caused the greatest loss of root dentine, followed by the middle and coronal areas. In another study, Madarati et al. (2010) reported that leaving instruments that had broken in the apical one third of the root canal did not affect the force required to fracture the root.

Souter & Messer (2005) stated that the removal of fractured instruments from the middle or apical one-third significantly affected the force required to fracture the roots vertically. Gerek et al showed that there was no significant difference between the force required to fracture the roots in which ultrasonic tips and Masseran kits was used.

Other Techniques

- Masseran kit
- Extractors
- Post removal system
- Canal finder system
- Chemical solvents
- Braiding techniques
- Cotton and broach
- Mini-forceps
- Wire-loops
- Hypodermic surgical needle

The Masserann kit (Micro-Mega, Besancon, France) consists of 14 hollow cutting-end trephine burs (sizes 11–24) ranging in diameter from 1.1–2.4 mm and 2 extractors (tubes into which a plunger can be advanced). The trephines (burs) are used in a counterclockwise fashion to prepare a groove (trough) around the coronal portion of the fragment. When inserted into the groove and tightening the screw, the free part of the fragment is locked between the plunger and the internal embossment. The relatively large diameters of extractors (1.2 and 1.5 mm) require removal of a considerable amount of dentin, which may weaken the root and lead to perforation or postoperative root fracture. This largely restricts the use of Masserann instruments to anterior teeth.

However, by creating a wider space between the tube and plunger inside the tubular extractor, it can be used in the straight portion of canals of posterior teeth. This also increases retention while gripping the firmly wedged separated instrument.

To some extent, this fulfills the objective of root canal treatment: proper cleaning and shaping of the root canal system followed by good filling. Thus, bypassing the separated instrument has been categorized as a successful approach especially because there have been no clinical studies comparing the treatment outcome of bypassing fragments and removing them. However, it is possible that a false channel parallel to the original root canal can be created when a clinician attempts to bypass the fragment which in turn can lead to a root perforation.

CONCLUSION

The decision on management should consider the following 1) Anatomy of the root canal accommodating the fragment, 2) the stage of root canal instrumentation at which the instrument separated, 3) the expertise of the clinician, 4) armamentaria available, 5) possible associated complications, 6) the strategic importance of the tooth involved, 7) and the presence or absence of periapical pathosis. Clinical experience and understanding of these influencing factors as well as the ability to make a balanced decision are essential.