# Broken file retrieval in the age of minimally invasive endodontics

## Drs. L. Stephen Buchanan and Christophe Verbanck discuss a new technique to retrieve a broken fragment with a loop

*If it can be broke, then it can be fixed — Bloc Party, The Pioneers.*

Although files and instruments nowadays are meticulously well-designed and have an unmatched metallurgy in comparison to a decade ago, instrument separation still occurs during root canal shaping and hinders completion of treatment.

Reasons for instrument separation are: improper use, limited flexibility and strength in a certain curvature, excessive force, and overuse.[1]

Torsional stress (55.7%) and cyclic fatigue (44.3%) are the main causes for fracture during these events.[2] Prevention is better than cure, and the best clinical advice to avert instrument separation is to change the instrument the moment the thought crosses your mind that the file in use might come apart.

With the advent of MIE-oriented treatments, the size and location of the broken fragment will dictate the choice for removal, bypass, or leaving it untouched and entombed. Careful bypassing should be a first choice, if feasible, but in the unlikely event a broken fragment blocks the entire canal lumen, removal is the only way forward.

Removal can be done solely by dislodging it with the aid of various instruments and raising it to the surface or by looping it and pulling out, especially in cases where the file fragments exceed a length of 4.5 millimeters.

**L. Stephen Buchanan, DDS, FICD, FACD, Dipl. ABE,** has been lecturing and teaching hands-on endodontic continuing education courses for over 30 years, both in his state-of-the-art training facility in Santa Barbara, California, as well as in dental schools and at meetings around the world. He currently serves as a part-time faculty member in the endodontic departments at the University of the Pacific's Arthur Dugoni School of Dentistry and the University of California at Los Angeles as well as being the Endodontic Advisory Board Member to the Academy of General Dentistry. Dr. Buchanan is nationally and internationally known for his 50-plus endodontic procedural articles as well as his expertise in the research and development of new endodontic technology, instruments, and techniques. He is a Diplomate of the American Board of Endodontists and a Fellow of the International and American College of Dentists. Dr. Buchanan also maintains a private practice limited to Endodontics in Santa Barbara, California.

**Christophe L.M. Verbanck, DDS, MSc,** obtained his Master of Dentistry at Gent University in 2009. He specialized in endodontics, graduating after a 3-year postgraduate training program from the same university. Since 2010 he has worked in several multi-disciplinary and endodontic referral practices all over Flanders. In January 2016, together with his wife, he started his own referral practice for endodontics, Lovendo, in Lovendegem (Belgium). He regularly teaches endodontics to general dentists and holds workshops on the application of endodontic techniques.

Disclosures: Dr. L. Stephen Buchanan is a co-founder of PlanB Dental.

This article will go more in depth on how to retrieve a broken fragment with a loop.

Older systems, like various ultrasonic tips, are used in a counter-clockwise movement around the separated instrument after the creation of a staging platform with modified Gates Glidden burs. The ultrasonic energy of the tips is used first to create space between dentin and the file fragment and then to vibrate the file to displace it from the canal. The CCW-movement is intended to get the file rotating in a way that would unscrew it from its entrapment.This time-consuming therapy usually leads to the removal of the instrument but could easily create a new problem — perforation or a future root fracture.

Extractors can also be used to grasp a loose or loosened fragment. But since they are stiff in nature, a straight line path with unhindered sight is necessary to get to the fragment. Another

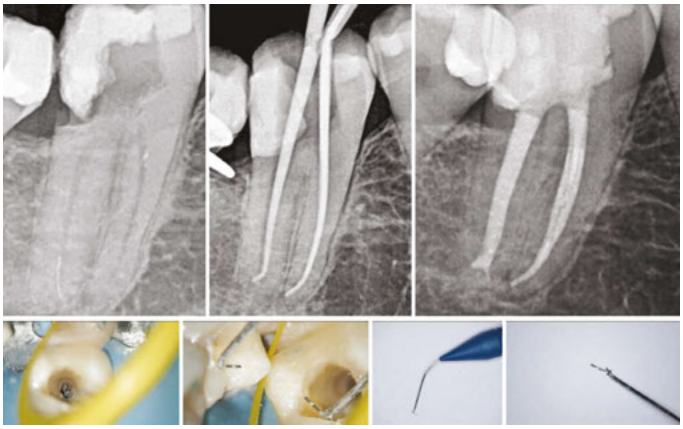

*Figure 1: Severely decayed lower first molar with broken fragment in the distal root canal.The fragment was blocking further apical preparation so retrieval was chosen instead of bypassing. (Case by Dr. Christophe Verbanck, 2023)*

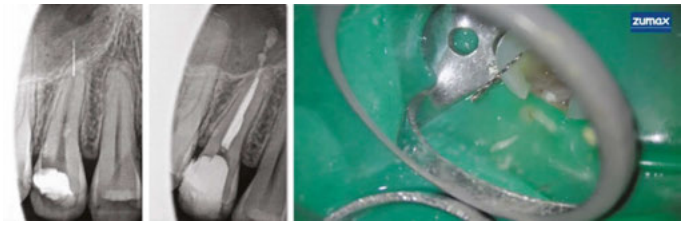


*Figure 2: Tooth referred for emergency retrieval since the patient did not want a surgical intervention for personal reasons. The accessible portion of the broken fragment was 2 mm, and only with the aid of the U/S- tips and EDTA, the fragment was out in only seconds. (Case by Dr. Benjamin Boublil)*

drawback of these systems was that the rubber handle came loose, making the device unworkable.

## If it can be lost, then it can be won

The TFRK-kit contains a box loaded with all the tools needed for a smooth (and almost pleasant) file removal treatment. The instruments are based on the previously described principles of older systems but without its weaknesses or the risk of over-enlarging the root canal space to get the job done.

A modified Gates Glidden and micro-trephine bur are used to create sufficient space around the coronal part of the broken instrument, and together with the newly designed 6 and 12 o'clock U/S micro-spoons, it is now possible to work further on the inside of the curve and gently create space only where it's needed. In this way, a trough can be made next to the instrument to free it from its engagement in dentin.

Both the 6 and 12 o'clock tips make it possible to angulate the tip to the correct side of the root canal of different root canals.

If no movement can be obtained, the Straight tip (S-tip) can always be used for troughing deeper apically and laterally to loosen it.

Working on the inside curvature of the root canal has two major benefits:

- It can shift the fragment coronally or can even completely free the instrument.
- In this way, the dentinal wall on the outside of the curve is retained to support the fragment and eliminates the likelihood of fracture along the length of the separated fragment due to excessive ultrasonic forces.[3]

Letting the U/S-tips work on the outside of the curvature increases the curvature on that side of the canal and can also drive the fragment deeper into the canal, making the situation more precarious than it already was.

An important clinical tip is that all of the U/S-tips should be used in bursts, by tapping the foot pedal repeatedly, and not in a constant way to avoid breakage by heat build-up and cyclic fatigue since they are used dry. The straight tip should also be used in a pecking/push-pull motion to avoid breaking of the fine ultrasonic tip.

Once the file fragment is loose, EDTA is added, and the Spear tip is used to vibrate and potentially displace the broken file segment. File fragments longer than 4.5 mm typically require the use of a loop. In this case, an extra space of 0.4 mm-plus the diameter of the broken file segment is required to complete staging. A simple way to measure the diameter of the broken file segment is the use of vertical condensation pluggers as a gauging device.

## All you need is time?

The "Loop +"[4] is an instrument made out of a 0.005 mm SS wire secured in the form of a micro-lasso so it can be placed around the coronal part of the broken instrument. The 0.005 wire is an update of the older 0.003 wire and tends to be 148% tougher than the 0.003 wire.

The extra space created around the instrument is necessary to have sufficient room for the TFRK-L+ cannula because it's not only the wire but also the flexible cannula holding the wire that needs to be positioned next to the fragment.

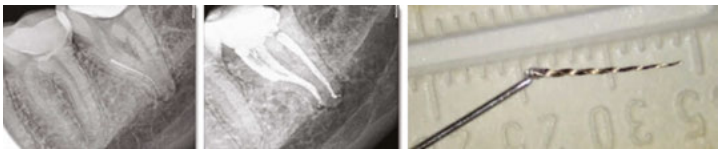

*Figure 3: A 9-mm fragment blocking an S-shaped mesial canal in lower second molar. Straight-line access was created with a modified GG drill followed by troughing a third of file length with a 6 o'clock U/S micro-spoon. Once moving, the Loop + was used to remove it. (Case by Dr. Benjamin Boublil)*

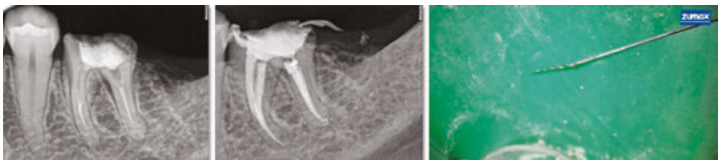

*Figure 4: Lower molar with broken indirect restoration. During initial attempt by GP, an instrument broke in the ML canal. A .45 rotary instrument was used to reach the coronal part of the instrument followed with a semi-circular preparation on the inside of the curve upon removal with the loop. (Case by Dr. Benjamin Boublil)*

A witty design in the tip of the cannula makes it impossible to "pull in" the wire and make the device unusable but also makes it safe to put a bend of 45° in the loop with the tip of an explorer in relation to the long axis of the cannula. The 45° angle will easily drive the loop over the fragment.

The loop should be facing towards the outside of the curve, making the cannula almost wedge between the instrument and the canal wall. Once the coronal part is "looped," the lasso can be tightened by pulling the tensioning button. While maintaining this tension, the fragment can be pulled out of the canal sometimes with a gentle push-pull and CCW-movement to get it completely loose.

The intention of the loop is to gain time during a challenging job. In the past, ultrasound was our only option to remove broken file segments — often a very time-consuming procedure especially for file fragments longer than 4.5 mm. The micro-lasso offers an elegant and efficient solution to that problem.

## It's all under control

Once you get the hang of it, the Loop + can be used at all depths in the root canal. For instance, a silver point at or beyond the apex of a root canal, Thermafil® carriers that have broken mid-root, etc.

It is obvious that the use of the ultrasonic tips, together with the aid of the TFRK-Loop+, make it possible to safely stage adequate space without over-enlarging and weakening root structure.

***Acknowledgement:*** *Authors wish to thank Dr. Benjamin Boublil, Endodontist (Paris, France) for his case work.* EP

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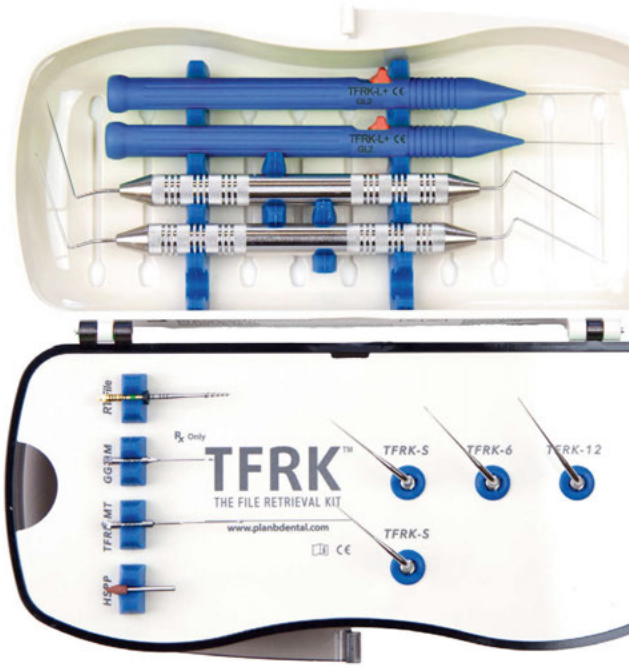


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