

Peri-apical microsurgery for removal of a fractured endodontic instrument

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Fig. 1

Fig. 1_Initial clinical aspect.

Fig. 2_Initial X-ray.

_During endodontic treatment, procedural errors may occur, such as the breakage of endodontic files. These accidents may compromise the treatment and prognosis of the clinical case. Frequently, it is necessary to perform additional procedures to resolve the problem.

With the development of cleaning and shaping endodontic systems, there is decreasing frequency of procedural problems in dental practice.¹ However, concern persists that rotary NiTi instruments are more susceptible to breakage. This has been the second most common reason for dentists not using rotary instruments.²

A recent study has shown that the incidence of broken instruments accounts for 11.7% of all endodontic malpractice cases.³ The incidence of NiTi file fractures has been shown to range from 0.4 to 5% and their use is considered safe.⁴⁻⁶ Fractures can occur through torsional failure or as a result of flexural fatigue.

_Minimising breakages

In order to minimise these incidents, care must be taken as follows: evaluate the tooth anatomy carefully before treatment; ensure a straight-line access; create a glide path with small hand files; use the crown-down technique; use a torque-controlled motor; keep files moving in and out of the canal; and control the number of times files are used, discarding files after a specified number and types of canals.

Fractures of endodontic instruments inside canals may be classified according to their intra-radicular position as occurring in the cervical, middle or apical thirds. The success rate for removing fractured instruments in the cervical and middle thirds is higher than it is in the apical third, and the incidence of iatrogenies during the attempt to remove them is lower.⁷⁻⁹

The prognosis of treatment can be altered as a result of the presence of endodontic infection. Cases



Fig. 2

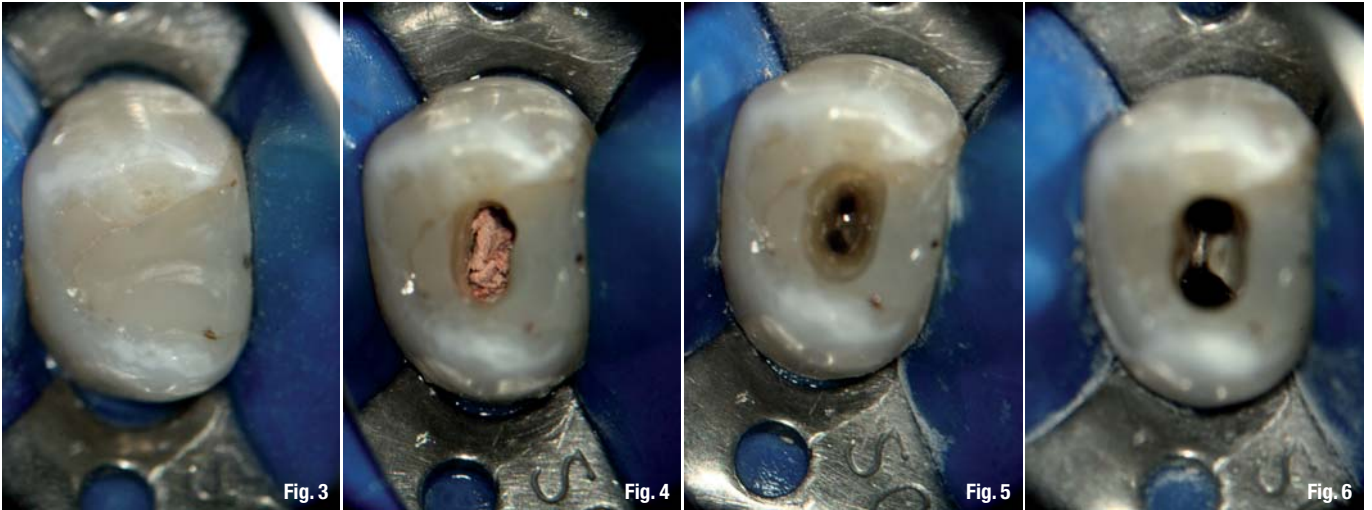


Fig. 3 _Initial occlusal clinical aspect.
Fig. 4 _Gutta-percha removal without solvents.
Fig. 5 _2.5% NaOCl.
Fig. 6 _After shaping.

of pulp necrosis have a worse prognosis than cases with live pulp, as the presence of a large quantity of bacteria and the limitation of correctly eliminating them may lead to treatment failure.

Failure to remove the fractured endodontic instrument results in deficient cleaning, shaping and filling of the root-canal system. Under these conditions, in addition to the endodontic diagnosis, the time during treatment when the instrument fracture occurs is of great importance in the prognosis of the case.¹⁰

When instrument fracture in a contaminated canal occurs at the beginning of treatment, the prognosis is worse because there is still a large quantity of bacteria, and the presence of the instrument may prevent adequate microbiological control. The presence of the instrument may also contribute to inadequate endodontic filling. The prognosis is better when the fracture occurs near the end of the canal-cleaning and shaping process, as it is at a more advanced stage of endodontic microbiological control.

In situations of instrument fractures associated with pulp vitality, the prognosis does not change significantly.¹⁰

_Removing broken instruments

When making the decision to remove the instrument, factors such as pulp diagnosis, location, root curvature and length, size and type of fractured instrument, remaining dentinal thickness, and risks of iatrogenies during the attempted removal must be taken into consideration.

A technique commonly used for removing fractured instruments is to achieve a bypass with a manual file, so that the fragment can be drawn to the pulp

chamber and removed. Another removal technique is by means of ultrasonic vibration of the fractured fragment, associated with the use of an operating microscope. The application of ultrasonic energy causes the fractured instrument to vibrate, causing it to detach from the canal wall, and it can then be drawn to the pulp chamber and finally removed.⁷

The application of these methods in atresic canals may result in excessive wear of the root walls. Therefore, their use associated with the operating microscope is safer, owing to the possibility of improving visualisation through the magnification and illumination provided by the microscope.

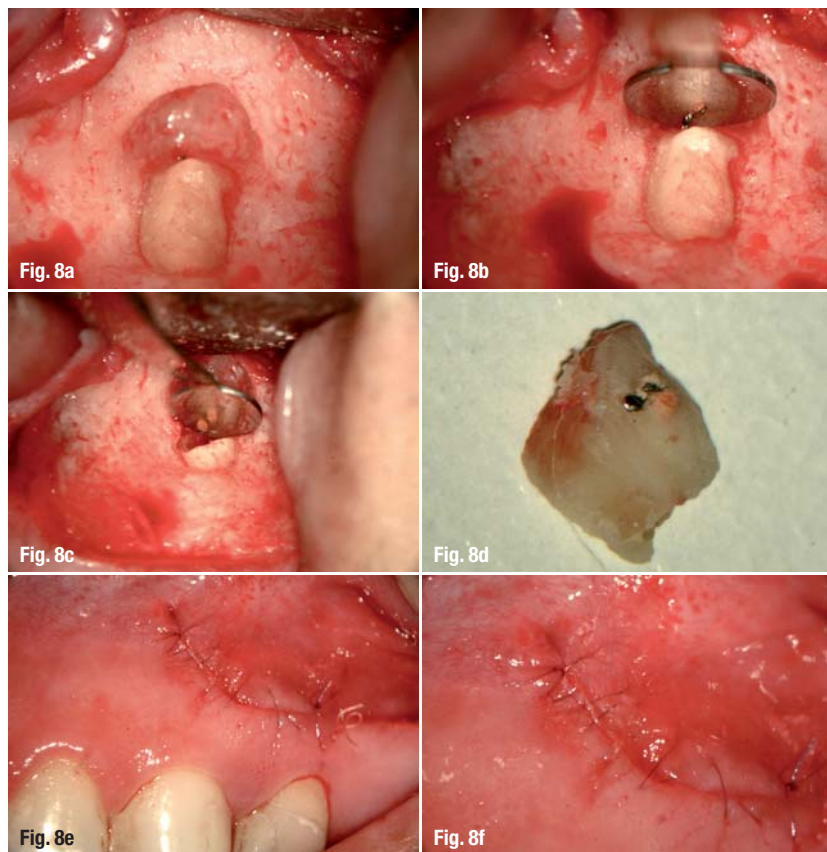
In cases of unsuccessful removal of the instrument and control of infection, with persistence of signs and symptoms of endodontic disease, surgical removal of the fragment may be indicated.



Fig. 7 _After filling, with broken file still in place, and before micro-surgery.

_A clinical example

This article demonstrates the resolution of a clinical case in which there was fracture of a K3 rotary instrument in the apical third, extending out of the root apex.



restoration, using ultrasonic diamond inserts (CR1, CVDentus; Fig. 3).¹¹ Filling was removed from the root canals with the use of ultrasound and type K hand files, without the use of solvents (Fig. 4). As auxiliary chemical substances, 2.5% NaOCl (Figs. 5 & 6), ENDO-PTC and 17% EDTA-T were used.

After removing the fillings from the canals and establishing the working length by means of the apical locator Elements Diagnostics (SybronEndo), root-canal preparation began with oscillating hand endodontic files in M4 handpiece up to type K #20 file.

After this, preparation of the canals continued with K3 SybronEndo VTVT Pack files, driven by an NSK electric motor with torque control adjusted to 1.2 N and a speed of 350 rpm.

At the time of using instrument K3 #30.04 in the apical region, there was no adequate control of the pre-established working length and the instrument overtook the root apex and fractured. The fractured fragment measured 3 mm, of which approximately 1 mm was outside of the apex.

_The bypass technique

Several attempts were made to remove the fragment using the bypass technique associated with the use of ultrasound and operating microscopy. In spite of making the bypass with a type K #08 file, and successively with type K #10, #15, #20 and #25 files, the fragment did not come out. The position of the instrument in the apical third, associated with the root curvature in the region, was responsible for the failed attempt to remove it.

At this stage of the treatment, disinfection of the root-canal system had not yet been concluded. The presence of the instrument, made it impossible to sanitise the canals correctly and the signs and symptoms of endodontic infection persisted.

In an endeavour to perform additional decontamination, calcium hydroxide was used as intra-canal medication for three weeks, but the signs and symptoms of endodontic infection did not yield.

As a result of the failure to control the infection in this case, complementary surgery was proposed to remove the apical root third, since it was not possible to shape and disinfect it because of the presence of the instrument.

For the complete resolution of infection, the root canals were filled (Fig. 7) and after this, piezoelectric peri-apical microsurgery was performed to resect the apical third of the root.

The patient, a healthy 44-year-old woman, came to the dental office complaining of constant, low intensity, spontaneous pain in the vestibular apical region of tooth #24, and presented intra-oral oedema, pain on chewing and vertical percussion.

She reported having undergone endodontic treatment in tooth #24 more than six years ago. In the peri-apical radiographic examination, it was possible to visualise deficient endodontic treatment and the presence of apical bone rarefaction (Figs. 1 & 2). An acute peri-apical abscess was diagnosed.

The proposed treatment was endodontic re-treatment because in the previously performed treatment there was inadequate canal cleaning and shaping, which had led to filling with empty spaces and prolonged the intra-canal endodontic infection. Peri-apical surgery was contra-indicated, owing to the presence of deficient endodontic treatment.

Endodontic re-treatment began with access to the pulp chamber, with removal of the occlusal resin

Fig. 8a _Broken file, surgical view.
Fig. 8b _Broken file, micro-mirror view.
Fig. 8c _Retro view of obturation.
Figs. 8d _Apical fragment.
Figs. 8e _Vicryl 8-0 sutures (operating microscope at 12.5x magnification).
Fig. 8f _Sutures (20x).

A full thickness flap was made with a semilunar incision. Selection of this type of incision was determined by the absence of a large, radiographically visible bone defect (Fig. 2) and for aesthetic reasons. This type of incision does not carry the risk of post-operative gingival recession.

After raising the surgical flap, it was possible to note the integrity of the cortical vestibular bone. The osteotomy was performed using surgical piezoelectric ultrasound and CVDentus W1-0 insert for more precise control of the cut, followed by apicectomy, also performed using ultrasound.

_The benefits of ultrasound

There are technical and biological advantages to osteotomy performed using ultrasound when compared to the use of high or low speed burs. Ultrasound has a highly selective tissue cutting ability. Its action occurs only on mineralised tissues such as bone and tooth, preserving soft tissues such as nerves, vessels and mucosae. During osteotomy, the amplitude of the micro-movements generated by the ultrasonic insert ranged between 60 and 210 µm, making the hard-tissue cut extremely precise. This is associated with the formation of acoustic micro-stream and cavitation in the operative field, which promote a clean field, as observed in Figures 8a to c.¹³⁻²⁰

The biological benefits of piezoelectric surgery particularly involve the maintenance of cellular viability in the operated region, so that the first post-operative stages of the bone repair process are better. It induces a faster increase in morphogenetic bone proteins and modulates the inflammatory reaction, in addition to stimulating healing.¹⁴

The fractured instrument was removed together with the apical root third in the apicectomy (Fig. 8d). The apical root cut was performed at an angle of 90° to the long axis of the root, in order to expose the smallest quantity of dentinal tubules and preserve the most root extension, favouring microbiological control and function of the dental remainder.²¹



Fig. 9 Post-op X-ray.

The quality of the remainder of the root filling was evaluated by introducing a micro-mirror into the apical bone recess and reviewing the remainder of the root filling, which was considered satisfactory because it filled the root canals uniformly (Fig. 8c).

This was the criterion that determined whether retro-preparation and retro-filling of the root canals should be performed, since this region of the canal had been adequately cleaned, shaped and filled.

The sutures were made with the aid of the operating microscope. Two simple stitches with Vicryl 6-0 thread were made to stabilise the flap, and another continuous stitch was made with Vicryl 9-0 thread to coapt the edges (Fig. 9).

Clinical control was performed after 7, 30 and 90 days. There was remission of all the clinical signs and symptoms of endodontic infection.

Editorial note: A list of references is available from the publisher.

_about the author

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