



Research Article

FRACTURED ENDODONTIC INSTRUMENT: CLINICAL DECISION MAKING, AND ITS INFLUENCE ON SUCCESS RATE OF ENDODONTIC TREATMENT

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ABSTRACT

The fracture of an endodontic instrument is a recognized complication in endodontics. The immediate response to a fractured instrument is frequently regarded as the treatment failure. Several factors must be taken into account to evaluate the prognosis of the tooth. Although integration of modern technique into endodontic practice has improved the clinician's ability to remove fractured files, removal may not always be possible or even desirable. Analysis of the literature shows that the presence of a fractured instrument need not reduce the prognosis if the case is well-treated and there is no evidence of apical disease. Given the variants of anatomy that Mother Nature may have placed in the canals, roots and /or jaw of that particular patient, we now have added an iatrogenic factor. In a quest to develop better instruments and techniques to improve our quality of care, we have developed a double-edged sword, an instrument that can cut and shape the dentin wall efficiently, and in the blink of an eye, cut into the peace of the mind of the operator when it separates. The aim of the paper is an attempt to place fractured instrument in context, and to manage the situation both clinically and medico-legally.

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INTRODUCTION

The separation of an endodontic instrument instantly transforms a case, from whatever level of difficulty it was preoperatively, to a new level of severity. The success of endodontic treatment is affected negatively by inappropriate shaping, disinfection and obturation of the root canal system. It may take several months, or years, for the objective evidence of failure to appear radiographically as patients rarely experience pain. This leads to confusion in regard to the relationship between failure and treatment carried out several years ago.(1) This paper explores whether a fragment of instrument left in the canal during root canal treatment should be considered a factor in failure and, if it is, how does it influence the prognosis?

The effect of instrument fracture on prognosis had been reported prior to the introduction of nickel titanium rotary instruments.

All these studies with the exception of Grossman showed that the presence of a fractured instrument had little influence on success rates. It was also demonstrated that the failure rate increased when a periapical lesion was present. This suggests that the nature of the problem lies with the presence of infection rather than the fractured instrument.

A fractured instrument limits access to the apical part of the canal, compromising shaping and disinfection. The fragment of instrument behaves as an additional complication alongside those already existing naturally, such as the size of the canal, its curvature etc.

Whenever an instrument fractures in the root canal, a decision has to be taken

- 1. Leave the fractured instrument in situ.
2. Bypass the instrument.
3. Remove the instrument with instrument retrieval kit
4. Surgery

Leave Fractured Instrument in situ

Historically it was recommended that regardless of the preoperative status of the pulp, the fractured instrument should be left in situ and root canal treatment to be completed coronal to the fragment, before the period of review.(2,3) It was believed that fractured instrument has hardly any effect on the prognosis of the tooth and therefore should be retained, as the risk of removal was high. However these publications predate the use of surgical microscope, and specialized ultrasonic tips. It is true that the fractured instrument results in a compromised

Table with 3 columns: Author, Success rate, Influence of fractured files on outcome of endodontic treatment. Rows include Strindberg, Engstrom et al, Engstrom and Lundberg, Grossman, Crump and Natkin, Fox et al, Kerkes and Transtad, Molydas et al.

Fig1 Studies on effect of instrument fracture

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chemico-mechanical preparation, but it is always a source of anxiety to the patient. At the same time it is unsatisfying for the clinician, as it can result in a complaint or medicolegal case.

The choice being based on an assessment of potential benefits of removal compared with the risk of complication. The interest of the patient is of paramount in this decision as they may opt for extraction for reasons such as anxiety, time and finance

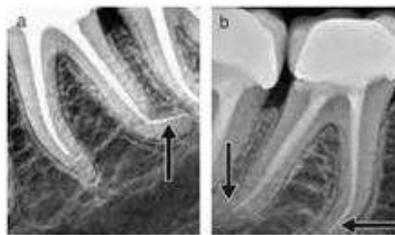


Fig 2 Fractured instrument in apical 1/3rd of root

Remove fractured instrument

Success of retrieval depends on the anatomy of root canal, metal of which the instrument is made, location of the instrument in the canal, the plane in which the canal curves, amount of dentin and diameter of the canal.

In today's time, with the invention of better equipments like surgical microscope and advanced ultrasonic tips it is suggested that removal of the fractured instrument should always be attempted. The rationale is that until the obstruction is completely removed, proper cleaning and shaping is difficult, and this can lead to failure of the treatment. Secondly, successful removal of the fragment from the tooth also provides psychological relief to the patient and avoids the risk of medico-legal action.

Certain situations must be kept in mind before attempting to remove the instrument. In case of vital pulpectomy the canal is virtually sterile and the objective is to remove the pulp tissue, shape, disinfect and obturate the canal. But if the instrument fractures during the shaping process, then a radiograph should be taken to see the position of the instrument. If the location precludes easy removal or bypass, then treatment should be completed in the same visit. If the canal system has never been contaminated, the presence of a fractured instrument should have no influence on the prognosis.

In case of infected canals the main objective is to obtain complete disinfection and prevent reinfection with appropriate endodontic and coronal seal. If fracture occurs at the end of instrumentation, and disinfection is already obtained, then canals should be sealed conventionally, by embedding the fragment in the filling material. But if the fracture occurs early in the treatment, the area beyond the fractured instrument will be inaccessible for cleaning and shaping and infection in this portion will remain as it is and will be directly responsible for failure. (4)

In short, where conditions are favourable, removal of a retained fragment can be a conservative approach, but where access to the fragment is difficult or visibility limited, then removal can lead to iatrogenic errors such as ledge formation, perforation or excessive enlargement of the canal.

If the clinician opts for removal of the instrument, then there are various devices available such as ultrasonics, microtube

devices, pliers/forceps. All the techniques share similar problems of excessive dentine removal, weakening of root extrusion of the fragment through the canal.



Fig 3 (L-R) Fractured instrument in canal, canal after instrument retrieval. Tool used for instrument retrieval

By Pass Fractured instrument: It is suggested that it is more conservative to bypass the fractured instrument, particularly in cases where access to the fragment is restricted and its removal may lead to excessive removal of dentine with associated sequelae (5,6,7). Interestingly, it has been reported that if the file is bypassed, the retained fragment does not compromise obturation quality. (8) But it is also reported that if an instrument can be bypassed it can be removed. (9,10) Finally, if it is not possible to bypass the fragment, then the canal should be shaped, disinfected and filled to the accessible length and restored. The success rate will depend upon canal contamination and fragment position (apical, middle or coronal third) as this influences the amount of root canal system that has not been disinfected.

Surgical removal: If non-surgical removal is not possible, then surgical removal of the portion of the root containing the fractured fragment has also been advocated, however this relies on surgical skill and may reduce the crown-root ratio. (11)

Factors to be considered before taking clinical decision

Periodontal condition and restorative status of tooth

Patients with good periodontal condition are considered good candidates for instrument removal. In cases where teeth are unrestorable subsequent to instrument removal, extraction should be considered.

Location of the instrument: Instruments in the straight portion of the canal can generally be easily removed, while those apical to canal curvature, removal is compromised, often impossible and ill-advised. (12,13,14,15) It has been reported that chances of perforation were higher when removal was attempted in apical third of the root.

Length: Hulsmann and Schinkel (12) concluded that longer instruments >5mm were easier to remove than shorter instrument. However other studies showed there is no correlation between fragment length and success of removal of fragment.

Type: Removal of reamers and lentulospirals have proved to be more successful than Hedstrom files. (12). Stainless steel files are easier to remove than nickel-titanium files which have a higher chance to fracture during the removal process, perhaps due to heat from direct ultrasonic vibration. It is very logical that increase taper of NiTi compared with stainless steel instrument would make access and trephining around the coronal aspect of NiTi fragment more difficult and therefore harder to remove.

Tooth/Canal: Root canal anatomy, diameter, root curvature and thickness of root dentine have an effect on the removal of the fractured instrument. Buccal canals of maxillary molars and mesial canals of mandibular molars present a high risk of removal when compared with straight canals (12). It has been reported that as the angle of the root curve increases, it becomes technically difficult to create staging platform and trephine around the coronal aspect of the fragment. With regards to single rooted teeth with uncomplicated root canal anatomy (e.g. incisors, canines, and palatal root of maxillary molars) success rate of removal is high.

Skill of the operator: Clinicians experience, competence and attitude are important factors in removal of fractured instrument. Selecting new technologies, and operating them efficiently requires experience and judgement. In modern technology use of dental operating microscope, ultrasonics and microtube extraction device require skill. Studies have shown a lower success rate and an increase prevalence of complication when operator time exceeded 45 -60 minutes. (13)

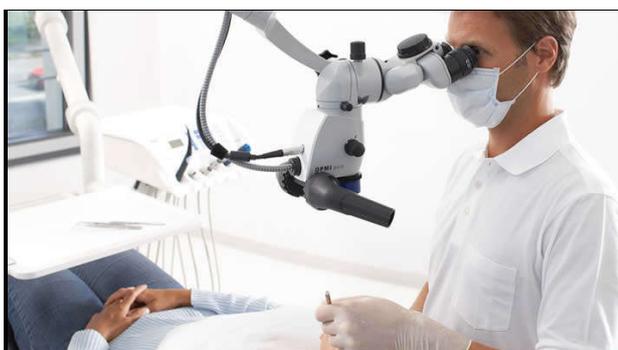


Fig 4 Dental operating microscope

Medico-legal Considerations: Instrument fracture is a significant frustration for the practitioner, however, another problem that arises is informing the patient of the event. Legally, it is necessary to inform the patient and the focus should be on the consequences of this event on the success rate, the complications that might occur, and any treatment that may be required. Theoretically, every patient undergoing endodontic treatment or retreatment should be warned of possibility of file fracture.

Various methods of removal of fractured instrument: If the clinician decides to remove the fractured instrument then there are various options available to him. He can use ultrasonics, instrument retrieval kit, microtube devices and Steiglitz forceps.

Ultrasonics in conjunction with a microscope is considered the most conservative method and is universally used technique. The commonly used technique involves creation of a staging platform, which creates sufficient space to allow the specialised ultrasonic tips to trephine around the coronal aspect of the fragment and in so doing agitating, loosening and unwinding the fractured instrument. Piezoelectric ultrasonic devices are recommended so that a dry field can be maintained to ensure optimal vision, however frequent irrigation is essential to dissipate heat, remove debris and promote chemico-mechanical cleansing of root canal system. (16)



Fig 5 Ultrasonic tips

Forceps/pliers: Steiglitz forceps or plier type instruments are suitable only in cases where the fragment extends into the pulp chamber and instrument can grab the coronal aspect of the instrument. (12) However the instrument is within the root canal, it is generally impossible for pliers to grab the instrument satisfactorily, without destroying any remaining residual coronal tissue in the process.



Fig 6 Steiglitz forceps

Microtube extraction: It generally involves positioning the end of a narrow metal tube over exposed tip of the fractured instrument, a circumferential trough around the head of the fragment having previously been created by specialised

trephine drills supplied with the system. The tube then engages the fragment mechanically or retains with the aid of cyanoacrylate glue. The application of such device is limited to straight or coronal section of the canal, with these systems generally being criticised for requiring excessive canal enlargement(14)



Fig 7 Microtubes

Other methods: Use of EDTA in combination with stainless hand files have also been used.

Lasers: With regards to development in future, laser (pulsed Nd:YAG) has been described as a possible technique for removing/melting the fractured fragment while causing minimal removal of surrounding root dentin. However research is required into the effect of this technique on adjacent periodontal tissue and to establish adequate parameters, before clinical use can be advocated.

SUMMARY AND CONCLUSION

The success rate of an endodontic treatment is related to disinfection of the canal, even in the presence of a fractured instrument. An instrument fragment is rarely the direct cause of the problem and when the obstacle can be bypassed and disinfection obtained, the prognosis is hardly affected. Fractured instruments can be removed by various methods such as ultrasonics, microtubule devices and pliers. Although many of these devices have been described as successful, they require skilled use of the operating microscope. If the removal is associated with risk then bypassing of instrument should be considered. The removal of files can be expensive in terms of time and equipment and therefore a cost benefit analysis of the treatment should be considered before selecting a definitive treatment for patient. Patient should be informed about the fractured instrument and it is essential legally that the treatment details and the information given to the patient are recorded in the patient's notes.

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