

Management of Broken Instrument

Abstract

Instrument fracture within the root canal during root canal treatment is an unwanted and frustrating complication. The fractured segment may hinder cleaning and shaping procedures with potential impact on prognosis of treatment. Fracture of endodontic instruments often results from incorrect use or overuse. If breakage occurs clinically, the patient should be informed of the incident and consideration should be given whether to remove the fragment or not. When managed properly, the presence of a broken fragment per se may not adversely affect the outcome of root canal treatment. This article reports management of an intracanal separated instrument. Masserann kit along with gate glidden drills were used to remove the intracanal broken instrument.

1. Introduction

Every clinician who has performed endodontics has experienced a variety of emotions ranging from the *thrill of the fill* to an upset, like the procedural accidents such as intra canal separation of an instrument. During root canal preparation procedures, the potential for instrument breakage is always present. When instrument breakage occurs, it immediately provokes despair, anxiety, and then the hope that nonsurgical retreatment techniques still exist to liberate the instrument from the canal [1].

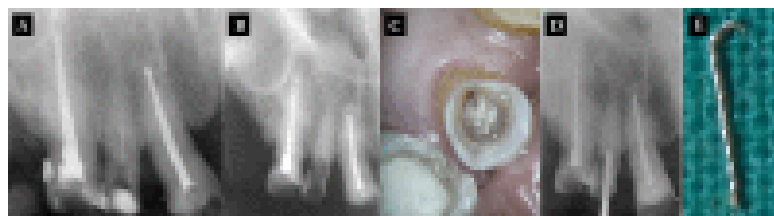
Most of the stainless steel instruments fail by excessive torque and NiTi rotary files usually fracture because of torsional stress and cyclic loading. Fractured instrument itself may not cause treatment failure. However, the remaining fragment in the root canal can hinder proper preparation of root canal space. Masserann kit is one of many devices that have been proposed for removal of the fractured fragment [2]. In the presence of a separated

instrument the outcome is affected. Fox et al. also concluded that failed cases were associated with intracanal broken instruments [3]. Broken separated instruments when retained might produce corrosion products in the canal and thereby lead to endodontic failure [4]. The following case describes the clinical scenario of a separated intracanal instrument removal by means of Masserann kit.

2. Case Report

A 45 year old female was referred to us with a separated endodontic instrument in the calcified root canal of maxillary right lateral incisor [3]. An intentional root canal therapy was advised as a part of a treatment plan for full mouth rehabilitation. During which the procedural accident had happened.

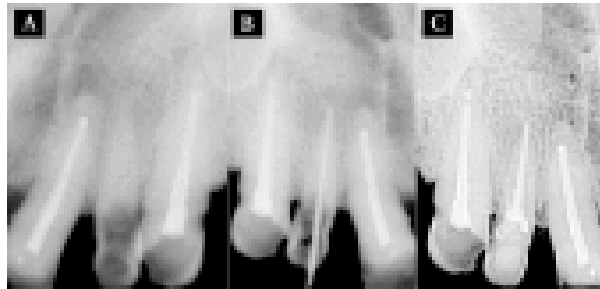
On clinical examination, generalised tooth abrasion was found. Vitality test of tooth #12 revealed no response. On radiographic examination, a separated endodontic instrument was found in the middle third of the root canal. The canal was also calcified and narrow (Figure 1A). Patient was informed about the instrument separation and removal of the fragment was chosen as the treatment plan.



A) Periapical radiograph: Separated instrument is visible in the middle 3rd of the calcified root canal in the maxillary right lateral incisor; B and C) Making a channel around the separated instrument to keep the broken instrument in the centre of the tube of Masserann ...

A Masserann micro kit (Micro-Mega, Besancon, France) was used to retrieve the instrument. Initially a gates glidden drill and ultrasonic Kerr K-file tips (#15-20) were used to keep the broken instrument in its centre and to cut a circumferential trough around the fragment The metal tube was then fitted over the 'freed' end of the fragment, to engage it by means of a central stylus that was screwed in position. The instrument was then removed from the canal

Root canal treatment was performed). Working length was established using a size 15 K-file (Mani, Huaxian, China). Root canal irrigation was done using a warm 3% NaOCl solution and then 17% EDTA was used to fully negotiate the narrow, calcified root canal. Canal was prepared using hand up to size 45. Obturation was done using 2% gutta-percha cones with lateral condensation technique. Access cavity was then sealed using hybrid composite (3M ESPE, St. Paul, USA). Early treatment goals were achieved without complication and the patient was referred to the prosthodontic department for final restoration.



A) After removal of separated instrument; B) Negotiation of full working length of calcified root canal, and C) Obturation

3. Discussion

Procedural errors in endodontics can occur during the process of root canal treatment that can be a result of factors over which the operator may or may not have control. Stainless steel instruments usually fail by excessive amounts of torque and NiTi instruments break due to combined action of torsional stress and cyclic loading. Factors affecting failures are instrumentation technique, use of torque controlled motor, core dimension and surface conditioning of the instrument, rotation rate, radius of canal curvature, presence of straight line access and glide path to apical portion of the canal. Root canal instruments are indispensable for root canal space preparation. An instrument can fracture if its ultimate strength is exceeded, or when a crack has propagated to such a degree that the remaining cross section of the instrument is unable to bear the operating load. Smaller endodontic instruments (size 15, 20) are more prone to distortion as a result of stressing on their small cross sections. Fractured fragment itself may not cause treatment failure but its being stored within the root canal can prevent improper preparation and disinfection resulting in a negative effect on the treatment outcome. Attempts to remove fractured instruments can lead to ledge formation, over enlargement and transportation of prepared root canal or can lead to perforation. Hence the clinician has to evaluate the options of attempting to remove the instrument, bypassing it or leave the fractured fragment in the canal. The decision making should be made with the consideration for pulp status, canal infection, canal

anatomy, position of the fragment and the type of fractured instrument. Most commonly used devices to remove the fractured instruments are: ultrasonic devices, extraction tubes (Masserann kit), Canal Finder system and manual instruments. The main determinant for removal of the fractured fragment is the location of the fragment in relation to the curvature of the root canal. If the fragment is situated coronal to the curve, removal of the fragment is possible; on the other hand if the separation occurs beyond the curvature the retrieval is deemed impossible. Removal of fractured fragments from the root canal requires manual skills, equipment, instruments and good knowledge of root canal anatomy. Recommended guidelines to retrieve the instruments are:

1. Obtain a visual access of the coronal end of the fragment;
2. Knowledge about the root canal anatomy;
3. Attempt to bypass the fragment at first stage;
4. Choosing the right armamentarium.

To prevent the unpleasant mishap of instrument separation from happening, proper measures have to be taken during the treatment, such as;

1. Whenever possible, straight-line access to the apical portion of the canal should be created;
2. Glide path to the working length has to be established using #10 and #15;
3. Recommended torque control motor has to be used for particular instruments;
4. The file has to be advanced slowly and gradually in the canal until the resistance is felt;
5. Use of rotary files in abruptly curved canals has to be avoided;
6. Greater safety margins have to be allowed for instruments used in conjunction with NaOCl due to detrimental effects of corrosion; and
7. Smaller instruments are prone to fracture hence they are recommended to be single used. Curved and narrow canals have a higher risk of instrument fracture than straight and wide canals.

Since most stainless steel instruments fracture with excessive amounts of torque, care has to be taken during negotiation and instrumentation of narrow, curved root canals. Various techniques and treatment modalities are available for instrument retrieval from the root canal. This article describes a case of management of instrument separation by the use of Masserann kit

AIM

In the event of endodontic instrument fracture the clinician has to be prepared to manage the situation both clinically and medico legally. The clinical decision should be based on a thorough knowl-edge of the success rates of each treatment option, balanced against potential risks of removal or file retention. A review of the available evidence for each treatment option and clinical decision-making is the subject of the third and final review in this series.

WHAT ARE THE OPTIONS?

When an instrument fractures in the root canal system a decision has to be made to leave, bypass or remove the fragment, the choice being based on an assessment of the potential benefit of removal compared with the risk of complication. The interests of the patient are paramount in this decision as they may opt to have the tooth extracted for reasons such as anxiety, time and finance.

LEAVE FRACTURED INSTRUMENT

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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 completed coronal to the fragment, before a period of review. It was proposed that the fractured instrument generally did not affect prognosis and could therefore be retained, as the risk of removal was high. It must be stressed, however, that these publications predate the use of the operating microscope and specialised ultrasonic tips, which would limit the risk of complication. Although it was suggested that the retention of the fractured instrument did not affect prognosis, it is logical to assume that the fragment will compromise chemo-mechanical cleansing, working length control and root canal filling.

From the patient's perspective, retaining the fractured instrument can be a source of anxiety as it can be viewed as a treatment failure or even clinical negligence and may be perceived as the source of any problem the patient may encounter in the future.

Furthermore, it is difficult for the patient to further invest in a 'compromised' tooth (eg coronal restoration) where the prognosis seems uncertain. Equally, for the clinician, it is often an unsatisfying conclusion to the treatment, which could result in a complaint or medico-legal proceeding and can become a source of contention between a referring dentist and specialist. Conversely, it can be argued that retaining the fragment where appropriate is a less destructive option, conserving tooth substance, time and money.

REMOVE FRACTURED INSTRUMENT

Recently, it has been suggested that removal should always be attempted, the fragment only being retained when

PRACTICE

nonsurgical removal has been unsuccessful. The rationale is (as previously stated) that unless the obstruction in the canal is removed – allowing complete chemo-mechanical disinfection of the root canal system – outcome will be significantly reduced.

Furthermore, it has been reported that in the presence of a periapical lesion, endodontic treatment which is compromised by procedural errors – such as a fractured instrument – demonstrated reduced healing.

Obviously, removal should improve working length control – assuming there is minimal canal aberration – and facilitate effective obturation of the root canal system. Successful removal of the fragment from the tooth also provides psychological benefits for the patient and avoids the risk of medico-legal action (Figs 1a and 1b). The recent literature does advocate retention of the fractured instrument in selected circumstances, such as file fracture of an instrument in a vital tooth or when chemo-mechanical disinfection is well advanced. The extent of canal disinfection correlates to the stage of instrumentation; logically if an instrument fractures early in the procedure, the canal is less likely to be clean than if a file fractures at the end of instrumentation, however, surprisingly it has not been convincingly demonstrated in the literature that this makes a difference to endodontic prognosis.

Ultimately, it is difficult to judge the level of infection in the root canal system before treatment or at a particular stage of cleaning, other than to comment that root canal infection is considered the essential cause of apical periodontitis.

Where conditions are favourable, removal of the retained fragment can be a conservative procedure, but in cases where access to the fragment is difficult and/or visibility limited, removal may lead to iatrogenic errors such as ledge formation, perforation or excessive enlargement of the canal; this results in a weakened root structure which predisposes to vertical fracture.

Additional complications of removal involve fracture of a second instrument or extrusion of the fractured segment. If non-surgical removal is not possible, surgical removal of the portion of the root containing the fractured fragment has also been advocated, however this procedure relies on considerable surgical skill and may reduce the crown-root ratio

BYPASS FRACTURED INSTRUMENT

Other authors suggest that it is more conservative to bypass the fractured instrument, particularly in cases where access to the fragment is restricted (apical one-third of canal or beyond the canal curvature)

and its removal may lead to excessive removal of dentine with associated sequelae. Interestingly, it has been reported that if the file is bypassed, the retained fragment does not compromise obturation quality;

However, this observation was made from a leakage study, the clinical relevance of which is questionable. Notably, it is generally reported if the instrument can be bypassed it can be removed.

HOW SUCCESSFUL ARE CLINICIANS AT REMOVING INSTRUMENTS AND WHAT INFLUENCES THAT SUCCESS?

CONCLUSIONS

- Fractured instruments can be removed by a variety of methods such as fine ultrasonic tips, micro-tubule devices and pliers/haemostatic forceps.

- Although many of these techniques have been described as successful, they require skilled use of the operating microscope and generally considered within the remit of the endodontic specialist
- As removal of a fractured file is associated with considerable risk, bypassing the fragment 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 the patient.
- Patients should be informed if an instrument fractures during treatment or if a fractured file is discovered during a routine radiographic examination. It is essential legally that the treatment details and the information given to the patient are recorded accurately in the patient's notes.