

ETIOLOGY AND MANAGEMENT OF SEPARATION OF INSTRUMENTS IN ENDODONTICS – AN OVERVIEW.

Running title: Separation of instruments- a review

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ABSTRACT

In recent years, as there is increased usage of rotary system, separated rotary nickel - titanium (NiTi) files in root canals is the most frequently reported mishap, causing lot of stress and anxiety among clinicians and patients. The prognosis of endodontic treatment is dependent on condition of the pulp, presence or absence of periapical lesion, operator knowledge and skill and many other factors. This review was attempted to help the general dentists and non - endodontists decide which strategy is best when faced with a broken file in root canal.

Keywords: Endodontic instruments, Separated instrument removal, Fractured endodontic instruments, Rotary Niti files.

INTRODUCTION

Endodontics has been revolutionized by the introduction of rotary instruments with super flexibility. This has improved the quality of canal preparation and decreased the operator fatigue time. But these instruments are not without its deficiencies. These deficiencies become a hindrance to glitch free instrumentation. The major hindrance for cleaning and shaping procedures within the root canal system, is the separation of the endodontic instruments which has potential impact on the outcome of treatment. Though endodontic treatment can result in various complications such as instrument breakage, perforation, ledge formation, postoperative pain, etc instrument breakage remains major concern. ^(1,2)Various steps have been taken to control instrument separation without compromising the basic advantage of the NiTi alloys. The aim of this review is to highlight the literature regarding the prevalence, factors leading to instrument separation and its treatment options.

PREVALANCE

Stainless steel (SS) instruments were prone to separation rate which ranges between 0.25% and 6 % and that of Nickel Titanium (NiTi) rotary instruments were reported to range

between 1.3% and 10.0%^(3,4,5). The increased range of separation rates reported in above studies might be because of fact that those studies were done with a fewer standardization in terms of techniques used and experience, position of tooth, operators skill and curvature of the root. A greater risk of file separation occurs during treatment of mandibular molars ranging from 50% - 55% and that of maxillary molars (25% - 33.3%).⁽⁶⁾ The separation of endodontic instruments in maxillary molars is three times more likely to occur in the mesio-buccal root canals than the disto-buccal ones, due to the distal curvature of the mesial root.^(3,6,7) In mandibular molars, the mesial root canals present a distal and a buccolingual curvature⁽⁸⁾. The lingual curvature of the mesio-buccal root canal is more severe than the buccal curvature of the mesio-lingual root canal in mandibular molars. Consequently as a result, the frequency of instrument separation in the mesio-buccal root canals is three times more common than in the mesio-lingual ones in mandibular molars⁽³⁾.

FACTORS LEADING TO INSTRUMENT BREAKAGE:-

a) Anatomic variations:

Studies have shown if canal anatomy is complicated more the chances of instrument separation. The frequency of instrument fracture is more in molars^(3,9) especially in mesial canals of mandibular molars^(10,11) also apical third is more subjected to instrument separation than coronal and middle third.⁽³⁾ When assessing the curvature of the root canal, separation frequency is directly proportional to curvature: 7% in straight root canals, 35% in averagely curved ones, and 58% in intensely curved ones^(3,12). An increased rate of separation is observed in the apical third (41% - 82.7%) then in the mesial third (14.8% - 32%), and finally in the coronal third (2.5% - 20%)^(3,6,12)

b) Frequency of usage :

Cyclic flexural fatigue resistance decreases with prolonged use^(13,14). A clinical study suggested that rotary instruments might be used to prepare four molar teeth, with no increase in the incidence of instrument fracture.^(15,16) Parashos *et al.*⁽¹⁷⁾ concluded that there is no correlation between fracture of instrument and frequency of use.

c) Speed:

There is a general consensus that in high speed of rotation, instrument fracture occurs as compared to low speed of rotation. A higher rate of instrument fracture was reported when high speed 300–350 rpm was used⁽¹⁸⁾. Other studies have demonstrated that there is no effect of rotational speed on file separation^(19,20)

d) Torque of rotation:

The torque generated in small canals is generally higher than canals with larger diameter⁽²¹⁾. The instrument becomes active and the chances of instrument locking increases if the high torque is used. This leads to deformation of the file and separation tends to increase⁽²²⁾. Small diameter files and files in acutely curved canals have more tendency to separate in the root canal⁽²³⁾. When practitioners use low torque (<1 N/cm), there is less chances of fracture than when used at high torque values (>3 N/cm)⁽²²⁾. When the diameter of file increases then respective torque required to unwind or to fracture also increases⁽²⁴⁾. Severe curvature is one of the main cause for instrument breakage because of cyclic fatigue.

OUTCOMES OF RETAINED INSTRUMENT REMOVAL:-

The following are treatment modality described in the literature for management of separated instruments in root canals

1. Retaining the separated instrument in the canal followed by management the remaining portion of canal.
2. Bypassing the separated fragment and managing the canal.
3. Retrieving separated fragment and cleaning and shaping of the canal.
4. Retrieving by surgery of separated fragment followed by management.

RETAINING THE SEPARATED INSTRUMENT IN THE CANAL FOLLOWED BY MANAGEMENT OF THE REMAINING PORTION OF CANAL:

Standard endodontic procedures must be performed when the separated fragment is decided to be left in canal ⁽²⁶⁾. The separated fragments if could not be retrieved then the separated fragment may be left over in the canal. If the fractured segment binds snugly in apical third, then this method of treating the canal can be considered. Removal or bypassing the separated fragment is considered if the file binds in coronal or middle third.

The techniques suggested in these cases is thermo plasticized obturation because of their excellent flow and they seal the gap between walls of the canal and fractured fragment better than other techniques like cold lateral compaction, single greater tapered cone obturation. ⁽²⁷⁾

BYPASSING THE INSTRUMENT AND MANAGING THE CANAL:

The separated fragment should be bypassed and that the canal should be treated according to standard endodontic procedures and the separated fragment should be incorporated into the root filling material. In case of incorporating this technique of bypassing the fractured segment then good quality of obturation is mandatory so that the obturating material or sealer flows and seals the spaces between the flutes of separated file and canal wall ⁽²⁸⁾

Bypassing technique is based on the fact that none of the root canals are perfectly round, and a small space exists between the wall of root canal and the fractured fragment, which permits a smaller file to bypass the separated fragment. The process of bypassing involves insertion of a fine file between the fracture fragment and the root canal wall, and thus negotiating the canal to full working length which enables the clinician a thorough instrumentation and root canal obturation with the separated fragment remaining in situ. The prognosis is improved by retaining the fragment in canal along with thermo plasticized obturation.

RETRIEVING THE SEPARATED FRAGMENT AND MANAGING THE CANAL:

Numerous instruments and equipments have been introduced to dentistry to remove these instruments from root canal. The silver points and separated instruments from coronal third can be removed by Stieglitz pliers, small mosquito haemostats, Masserann kit is used to remove the fractured files and posts, Micro tube removal systems like Lasso and Anchor, Tube and Glue, Tap and tread, Endo extractor removal system and Cavi-Endo ultrasonic instruments are few of the available systems for this purpose⁽²⁹⁾ These devices, techniques, and methods described here vary in their effectiveness as per the operators skill, magnification, illumination and other factors.

Endodontic treatment is complex issue which needs adequate training. The dentist should have extra knowledge, training, familiarity with techniques and instruments when it comes for retrieval, and needs utmost patience to deal with a frustrating incident like separated instrument.

RETRIEVAL OF SEPARATED FRAGMENT BY SURGERY FOLLOWED BY MANAGEMENT:

Loss of tooth structure and clinical complications such as perforation of root, weakening of root, unfavourable crown-root ratio and other surgical complications may be reported if there is orthograde or surgical retrieval, also long-term restorative success of tooth will be compromised⁽³⁰⁾. Unfortunately, file breakage occurs most commonly in molar; especially mesial roots of mandibular molars and mesiobuccal roots of maxillary molars, even for experienced clinicians because of their intimate anatomical relation with vital structures like mandibular nerve, mental nerve, lingual artery, maxillary sinus and maxillary artery. Good visibility is almost impossible without magnification with surgical microscope, ultrasonic equipments, and microsurgical instruments. Removal of separated fragment after the intentional extraction, and replantation should be considered as only last option after all other options fail or are likely to fail.

CONCLUSION:

Bypassing the fractured fragment is considered to be a conservative technique, in cases of instrument separation as it has low risk of clinical mishap. If bypassing the instrument seems to be impossible, the next treatment option is to attempt the removal of the separated fragment. Usage of dental operating microscope and ultrasonics is encouraged when the decision is made to remove the separated fragment. The higher chances of success is seen when the fragment is found in the coronal third, before the root canal curvature or when the root canal curvature is not severe, and when it is seen in maxillary or anterior teeth. The instrument removal is not recommended if the separated fragment is found either in the apical third or beyond the root canal curvature, or visibility and access are impossible, since there is a higher chance of perforating the concerned tooth. The other possible complications during the removal of separated fragments are weakening of the tooth structure, secondary separation of the instrument, extrusion of the separated fragment into periapical tissues, transformation of the root canal, and increased surface temperature sufficient to cause tissue damage. In case where the removal of the separated instrument seems to be impossible or dangerous, then the possibility of retaining the separated fragment in the root canal should be evaluated. Immediate surgical treatment is recommended if any clinical symptoms are encountered. If the patient is asymptomatic then, instrumentation and obturation of the root canal coronal to the separated fragment can be performed and then subsequent follow-up schedule is made. Future surgical treatment is considered in case of failure. Prognosis of the tooth is not affected by presence of the separated instrument but depends mainly on the presence of a lesion and infection of the root canal at the time of separation, and the quality of the remaining root canal obturation.

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