TITLE: "Use of Cone beam computed tomography (CBCT) for the management of Endodontic mishaps using Terauchi File Retrieval Kit: A Case Report"

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ABSTRACT:

Endodontic mishaps or procedural accidents are unfortunate occurrences that can occur during treatment. The fracture of endodontic instruments and iatrogenic furcal root perforations within the root canal during root canal treatment is a procedural problem creating a difficulty in normal endodontic therapy. The fractured segment may obstruct cleaning and shaping procedures with impending impact on prognosis of treatment. The separated instrument, predominantly a broken file, leads to metallic obstruction in the root canal and impedes efficient cleaning and shaping. When an Effort to bypass such a fragment becomes challenging, it should be retrieved by using a novel mechanical devices such as file- removal system (FRS). Furcal perforations might compromise the treatment outcome and continue as a significant complication if not repaired. The present case report demonstrates the procedure of novel file-removal system (FRS) technique using Terauchi File Retrieval Kit (TFRK) in removal of separated instruments and perforation repair by using Biodentine in the posteriorteeth.

Keywords: Biodentine, Cone beam computed tomography (CBCT), Instrument retrieval, Instrument separation, Perforation Repair, Retreatment, Terauchi File Retrieval Kit (TFRK).

INTRODUCTION:

In endodontic practice, while performing the root canal treatment, procedural accidents such as

separation of instruments and furcal perforation may occur and that can affect the prognosis of root canal treatment. Ingle in his analytical study he reported that perforations were the second greatest cause of endodontic failure.[1]

The separation of instruments during endodontic therapy is a troublesome incident, and its incidence ranges from 2% to 6% of the cases investigated. The most common causes for file separation are improper use, limitations in physical properties, inadequate access, root canal anatomy, and possibly manufacturing defects. Infrequently during nonsurgical root canal therapy, a separated instrument in a root canal system may block access to thorough root canal cleaning and shaping procedure apical to the level of separation. This is important for a tooth, as it affects the final outcome of the endodontic treatment.[2] This type of instrument includes Gates-Glidden or Peeso drills; lentulo spiral paste fillers; thermomechanical gutta-percha compactors; endodontic file, reamer or the tips of hand instruments such as explorers or gutta-perchaspreaders.[3]

Hence an attempt to bypass or retrieve the instrument should be made before leaving it and obturating to the level of separation. Fox *et al*. concluded that failed cases were associated with intracanal broken instruments.[4] Broken separated instrument when retained might produce corrosion products in the canal and thereby leads to the endodontic failure.[2]

To overcome of this problem Terauchi et al in 2006 developed a new file removal system (FRS) with the intended goal of minimizing both the dentin removal rate and the time required to remove the separated instruments. This new file removal system (FRS) available as Terauchi File Retrieval Kit (TFRK) which consists of Modified GG#3 bur, Microtrephine bur, Microexplorer instrument, Yoshi loops, Gutta-percha removal (GPR) instrument and Customized ultrasonictips.[5]

Perforations are unfortunate but common complication of access preparation for endodontic therapy which accounts for at least 9.6% of endodontic failures in endodontic treatment.[6] The perforations can occur Furcal perforation is one of the most frequent accidents occur due to resorptive defects, caries and iatrogenic events that occur during and after endodontic treatment like during access cavities due to incorrect placement of bur or while searching orifices of canals in the floor of the pulp chamber, coronal shaping and post spacepreparation.[1]

Clinically, a furcal perforation can be determined by the presence of profuse bleeding which is bright red in colour and maybe pulsatile. If an apex locator is used by inserting the file in the perforation, the device will show an extended working length prematurely.[7] Radiographically,

a furcal perforation can be seen as radiolucency in the floor of the chamber that forms a communication between the pulp space and the periodontal attachment. Once detected, the perforation should be treated immediately to improve the prognosis of the affected tooth. [8]

A new bioactive calcium silicate based restorative cement; Biodentine™ (Septodont, Saint-Maur-des-Fossés Cedex, France) has been introduced. Biodentine is used as a dentin substitute repair material for crown and root, as a perforations repair material or for resorptions, apexification and as a root-end filling material. It has similar physiochemical, mechanical, biological properties to MTA but shorter setting time (9 - 12minutes).[9]

Accurate diagnosis and treatment planning are essential for any treatment; for this reason, cone beam computed tomography (CBCT) was introduced and has been widely used. CBCT technology provides a three-dimensional image viewing, enabling exact location of the separated instrument and perforation site. Use of these technologies helps the clinician to exactly determine the location of the separated instrument and perforation site there by limiting the treatment plan to only the involvedstructures.[10]

The following case report describes the clinical scenario of a separated intracanal instrument removal by means of Terauchi File Retrieval Kit (TFRK) under operative microscope using cone beam computed tomography (CBCT) for accurate diagnosis and repair of furcal perforation with biodentine. This procedure was successful with the follow up of over a 3 months postoperativeperiod.

CASE REPORT

A 28-year-old patient was referred to the Department of Conservative Dentistry and Endodontics with pain in the lower left back tooth region for the past 2 months. Patient gave history of root canal treatment 2 years back. On clinical examination tooth 37 was filled with temporary material. Radiographic examination revealed radiolucency at the furcal dentin suggesting furcal perforation and no obturation material in the root canal but a radio-opaque material was seen on the apical third of the mesial root suggesting a separated instrument [Figure 2b]. Diffuse radiolucency was evident in the periapical region of 37 suggesting the provisional diagnosis as previously treated with symptomatic apical periodontitis. To confirm the presence of perforation site and for canal configuration, Cone beam-computed tomography was performed, which revealed the perforation at furcation and the presence of separated

instrument at the apical third of mesio lingual canal. [Figure 1] After getting the consent from the patient re-treatment was planned for tooth37.

After removal of temporary filling material, endodontic access modification and rubber dam isolation was done. During the exploration of the pulp chamber floor with the help of dental operating microscope under 1 X magnification (labomed magna surgical microscope,Delhi, INDIA), four orifices were located 2 on the mesial root and 2 on the distal root. In addition to this while exploring under 1.5 X magnification there was a dark spot present at the lingual wall and pulpal floor junction suggestive of a perforation site. On further magnification a shiny spot was visible on the mesio lingual canal suggesting separarted instrument in apical third area. [Figure 2a]

The perforation site was cleaned followed by sealing with Biodentine (Septodont, Saint-Maur-des-Fossés Cedex, France) [Figure 2C]. Periapical radiograph was taken to confirm placement of biodentine in the perforation site [Figure 2d]. Since the efforts of bypassing the fragment went ineffective, file-removal system (FRS) was employed for its retrieval. Terauchi File Retrieval Kit (TFRK) was used to retrieve the instrument. Initially a Straight line access to the fragment was created and a pocket was Created between the file and the inside wall of the curve. After that Shallow groove was cut along the outer curvature of the canal and the canal was filled with EDTA solution to cool down the heat generated during ultrasonic vibration. Then the ultrasonic tip was activated in the slit and the tip was moved in "push and pull" motions. This Ultrasonic vibration and acoustic streaming helps to free from thecanal.

After loosening of the file fragment, Yoshi loop, a stainless steel micro- lasso that extends from the end of a stainless steel cannula attached to a handle with a retraction button for tightening the loop around a loosened file segment. The red retraction button is moved forward to extend the wire lasso, a DG-16 explorer tip is placed inside the lasso, and the retraction button is then carefully pulled backward until the loop is felt to tighten on the explorer tine, thus rounding the loop was done and placed around the end of the file segment. Before removing the explorer from the loop, it is rotated back to near parallel to the cannula to bend the rounded loop to a 45-degree angle. This rounded, angled loop wire is then formed to drop around the end of the file segment as moved into position. Once the loop wire is felt to tighten around the file segment, it is carefully tugged in several directions and the broken file was pulled out from the canal [Figure 2e,2f].

Periapical radiograph was taken to confirm removal of separated instrument [Figure 2g]. In the next visit the working length was established with an electronic apex locator and no. 15 k-file used to confirm four canals by radiographically. Bio-mechanical preparation was completed using master apical preparation till 25 k file and Protaper rotary files up to F2 (DentsplyMaillefer, Switzerland) in crown-down fashion as per manufacturer's recommendation. Irrigation during preparation of the canals was done with copious amounts of 3% Sodium hypochlorite, Normal saline and 17% ethylene-diamine-tetraacetic acid (EDTA; Pulpdent Corporation, Massachusets, USA). The canals after preparation were finally flushed with sterile saline, dried with sterile paper points, and a calcium hydroxide dressing was given and patient was recalled after 7 days. Intracanal medicament was changed in the subsequent appointments and once the patient was asymptomatic, root canal obturation was carried out with gutta percha cones (Dentsply, Maillefer) coated with AH-Plus sealer (Dentsply DeTrey GmbH, Konstanz, Germany) using the lateral condensation technique.After obturation, post-endodontic restoration was done with composite restoration [Figure 2h, 2i] and patient was recalled for follow up. Final prosthetic restoration with metal crown was done and patient was recalled after three months for follow-up [Figure 2j,2k].

DISCUSSION:

Procedural errors might occur during the treatment of the RCS as a result of factors that the clinician cannot control.[11]In that one of the most troublesome incidents is the fracture of endodontic instrument within root canal. Several objects have been reported to break and subsequently become lodged in root canals. The removal of foreign objects sometimes is difficult and the success rate has been reported as 55% to79%.[6]

Accurate diagnosis and thorough treatment planning are essential for any successful treatment outcome. For that preoperative radiograph should be examined for the extent and location of the instrument seperation and perforation site. Periapical radiography has some inherent limitations because it produces a 2-dimensional image from a 3- dimensional structure. Thus, the overlapping of anatomic structures can impair the diagnostic ability of this examination. For this reason, cone beam computed tomography (CBCT) was introduced and has been widely used. CBCT technology can overcome the overlapping of structures, allowing an accurate assessment of dental morphology and the diagnosis of endodontic complications and

highlighting the location of fractured instruments.[10]

In Clinical situations, the instrument fracture can be managed by bypassing the fragment. Hence in the present case, bypassing the fragment was attempted but it was ineffective, so file-removal system (FRS) was employed. Use of Terauchi File Retrieval Kit (TFRK) was effective for the removal of the separated instrument from the root canal in the present case. [5]

Several factors have to be considered before choosing to removal of fractured instruments. The chances of success have to overweigh the possible complications.[12] Studies affirm that the success of the removal of the fragment is dependent on the type of instrument fractured, the anatomy of the canal, the type of tooth involved, and the technique applied to take the broken instrument out of the root canals.[13]

Suter et al. (2005) demonstrated a lower success rate for the cases when the fragment has to be removed from the apical third than when it has to be taken out of the middle or coronal third.[14] Several methods are described to remove broken instruments or objects within root canals, such as the Masserann Kit, Endo Extractor (Brasseler USA Inc., Savannah, GA), wire loop technique, the Canal Finder System (Fa.Societé Endo Technique, Marseille, France), and ultrasonic devices. The limitations of these devices include excessive removal of root canal dentin, ledging, perforation, limited application in narrow and curved roots, and extrusion of the fractured portion through theapex.[6]

Nevertheless, successful removal of such obstructions relies on factors such as the position of the instrument in relation to the canal curvature, depth within the canal, and the type of fractured instrument.[15] The more apical the location of the fractured instrument the greater the potential for root perforation and the lower the fracture resistance of the root after removal of the instrument. Straight line access is mandatory for successful removal of instruments, but conservation of tooth structure is paramount to the tooth's resistance tofracture.

The prognosis of accidents involving pulp chamber floor anatomy is doubtful, and for many years, the only treatment was the tooth extraction. A perforation can negatively affect the prognosis of root canal therapy unless it is managed effectively and promptly. Treating a perforation may often require a multidisciplinary approach in order to establish an appropriate

treatment plan, and the clinician must decide whether to extract the tooth or treat it with a nonsurgical and/or surgical approach.[16]The objective of the treatment should be to seal the pathways of communication between the root canal system and its surrounding tissues. The prognosis of perforated teeth is better today than it was in the past, and this is largely due to use of biocompatible materials. With this approach, perforations can be more predictably repaired without surgery, thus reducing the need for invasive and more costly procedures.[17]

A study has reported that perforations are the second greatest cause of failures accounting for 9.62% of all unsuccessful cases.[16] Therefore, this communication between the root canal system and the periodontal apparatus should be sealed with a biocompatible material as soon as possible. However, prognosis depends on the contamination, size and location of perforation site. In a study by Guneser et al, Biodentine showed considerable performance as a perforation repair material even after being exposed to various endodontic irrigants as compared to MTA.[18]Hence, Biodentine was used in our case as a perforation repairmaterial.

In this case, we were able to remove the separated instrument from the root canal using file-removal system (FRS) along with non-surgical treatment of the perforation defect. With innovative diagnostic technology and advancements in endodontics, there is tremendous improvement in the quality of treatment delivered to the patients. Hence we are able to save many teeth that in the past would have been extracted and possibly replaced with an implant or a fixed or removal partialdenture.

CONCLUSION:

Prevention is the most important factor to avoid accidents during endodontic therapy. Treating a perforation may often require a multidisciplinary approach in order to establish an appropriate treatment plan, and the clinicians must decide whether to extract the tooth or treat it with a nonsurgical and/or surgical approach. File-removal system (FRS) is an effective method to remove separated instrument from the root canal when a straight line access can be obtained in curved canals to locate the coronal-most end of the instrument. Large furcal perforation defect can also be treated non-surgically by using biocompatible material like Biodentine, thus reducing the need for more expensive and invasive procedures.

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Legends:

- **Fig 1**: Pre-operative Cone beam computed tomography (CBCT) evaluation revealed the perforation at furcation and the presence of separated instrument at the apical third of mesio lingualcanal

- **Fig 2**:(a) Pre-operative clinical photograph,(b) Periapical radiograph of the left mandibular 2nd molar (#37) showing the separated file in the mesiolingual canal with detection of furcal perforation site, (c) Radiograph obtained after repair of furcal perforation with biodentine, (d) Clinical photograph after perforation repair, (e) retrieved file fragment with Yoshi loop , (f) Retrieved separated file fragment , (g) Periapical radiograph after removal of the separated file, (h) Clinical photograph after obturation, (i) Radiograph obtained after obturation and Post-endodontic restoration, (j) Clinical photograph after three months of follow-up, (k) Three months follow-upradiograph.

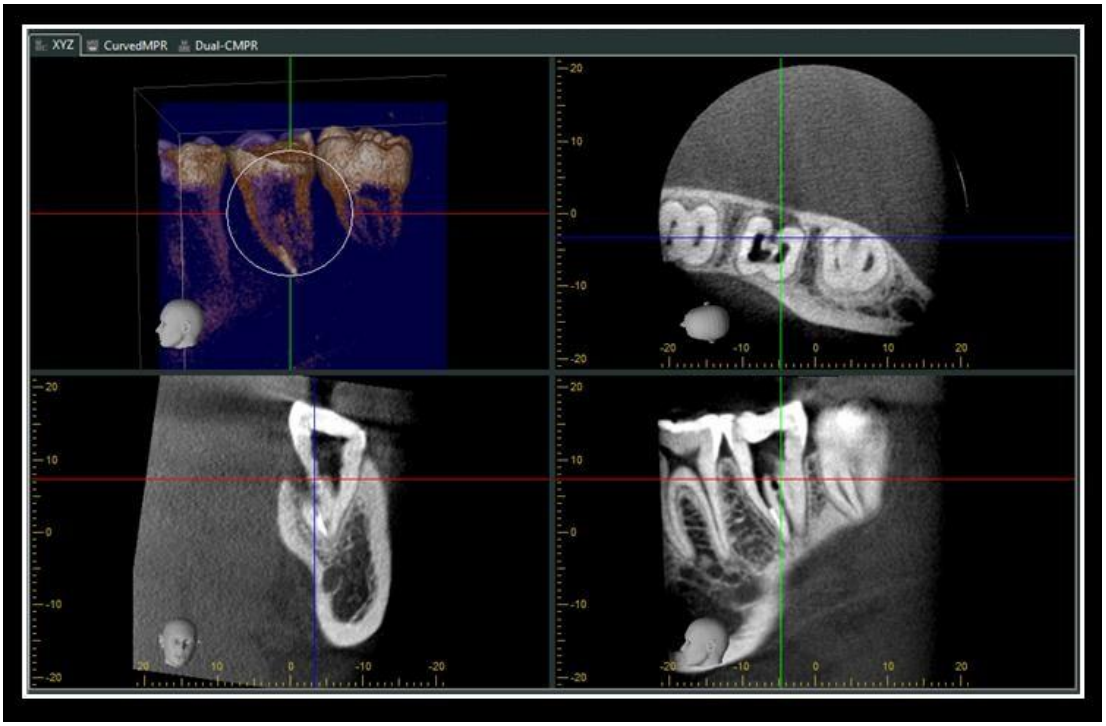

Fig: 1

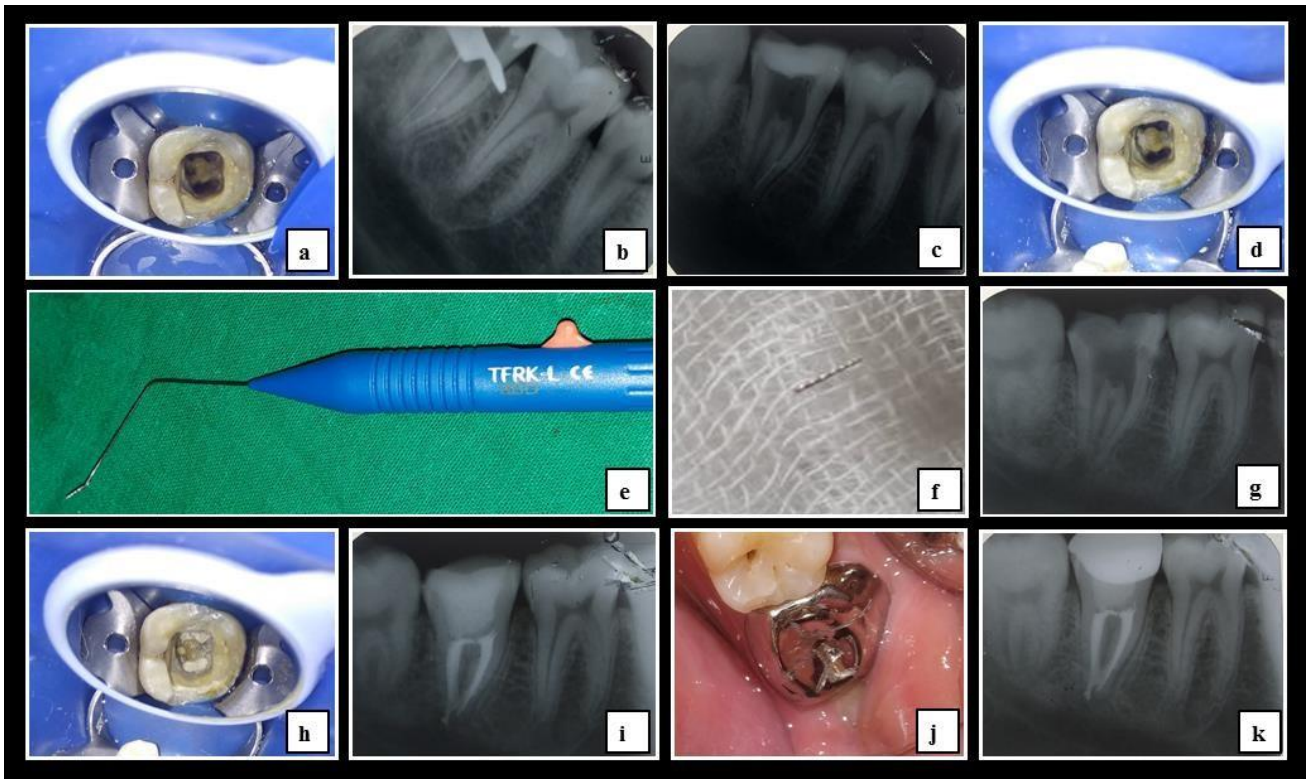

Fig: 2