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CASE STUDY

Retrieval of broken file and retreatment of previously treated mandibular left second molar

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ABSRACT

Broken files in the root canal system which are not removed may interfere with thorough cleaning of the root canals. As a result, they cannot be hermetically obturated. This imperfect cleaning can leave necrotic tissue which can potentially cause failure in root canal treatment. The purpose of this paper is to describe the management of retrieval of broken files and re-treating root canals in previously treated mandibular left second molars. The retrieval of the broken file used conventional techniques combined with a Satelec ultrasonic scaler to remove the files from the root canal. It was operated under an endodontic microscope, and after retreatment of the root canal, the tooth was restored with final restoration of endocrown. Retrieval of fractured files using conventional techniques combined with Satelec ultrasonic scaler and the root canal re-treatment followed by final endocrown restoration could restore all four tooth functions properly.

Keywords: broken instruments; extraction technique; re-root canal treatment

INTRODUCTION

Root canal treatment is performed on teeth with necrosis, irreversible pulpitis or vital teeth with certain indications that require root canal treatment. Root canal treatment aims to keep the tooth in the oral cavity for as long as possible. This treatment requires a series of procedures that must be carried out carefully to avoid instrument breakage in the root canal during treatment.[1]

Broken instruments that occur during root canal treatment are accidents that dentists often encounter. The risk of instrument breakage has increased over the years with the increasing use of rotary instruments in root canal preparation.[2] Fracture of files or instruments in these root canals can interfere with cleaning, irrigation and filling of the root canal and can affect the success of endodontic treatment.[3]

Broken file in the root canal can be caused by excessive use or pressure during root canal treatment. Flexibility and fatigue of files combined with incorrect use can cause files to be broken.[4] Based on a retrospective study of radiographic analysis, it is estimated that instrument fractures in root canals occur in approximately 2% of all cases.[4]

There are four management protocols of broken files in root canals. First, the files are retained in the root canal, and the remaining root canal is treated. Second, the broken files are left in the canal, and the canal is cleaned. Third, the separated fragment is retrieved, and the root canals are treated using surgical approach. The retrieval of the file is followed by advanced root canal treatment. Fourth, the broken file can stay inside the root canal, but the canal section coronal object must still be treated in accordance with the standard of endodontic procedures.[5]

It is important for the clinician to inform the patient if an instrument is found broken during treatment or during a routine radiographic

examination or re-treatment procedure. The first approach is non-surgical with instrumental fracture management and fragment removal. If this approach fails, fragments may be left in the root canal. If this is unsuccessful, root canal treatment and obturation of the canal to the fractured fragment should be performed.[4]

The success of removing a broken file depends on several factors, including the type of instrument, length, diameter, location, curvature of the root canal, and how far the broken file is in the root canal. The preparation stage for retrieving broken files is also important. Based on research, the percentage of successful removal of broken instruments in straight root canals is much higher than curved root canals, for example in the case of fracture fragments under the curvature of the root canal.[4] The purpose of this case study was to provide an overview of the procedure for removing broken instruments in the middle third of the root canal using a Satelec ultrasonic scaler with a 20 mm long titanium-niobium tip and a 3% taper, continued with a root canal retreatment.

METHODS

A 27-year-old male patient came to the Dental Conservation Clinic at RSGM UGM Prof. Soedomo with a complaint that he wanted to fill the lower left back tooth. The tooth was filled for the first time in one visit about 5 years earlier. The patient felt that part of his tooth filling had broken about 10 days before the examination. The dentist who handled the case had performed root canal treatment, but the treatment had not been completed, and he was referred to a dentist at the specialist clinic at RSGM UGM Prof. Soedomo. The patient did not feel pain in the tooth. He admitted that he brushed his teeth regularly, after morning shower and in the evening, and after eating sticky food. The patient often ate sweet foods at night. The treatment plan was to perform a root canal retreatment. The patient was informed about this research and signed all informed consent forms.

Case management began with subjective examinations, objective examinations, determining assessments and diagnoses, establishing treatment plans, carrying out procedures for retrieving broken files, and repeating root canal treatment. Based on subjective examination, the patient was a male patient aged 27 years. The patient's main complaint was that he wanted the previous doctor to continue the root canal treatment. The OHI-S examination obtained an OHI-S score of 2, suggesting the patient had moderate oral hygiene status.

Tooth 37 had a temporary occlusal surface filling and a tooth-colored filling on the distoclusal surface with partially broken edges. After the temporary filling was removed, a cavity was seen on the occlusal surface whose depth reached the pulp and visible gutta percha at the orifice. The results of the objective examination in the form of

Figure 1. The mandible shows the normal pattern of attrition of the anterior teeth

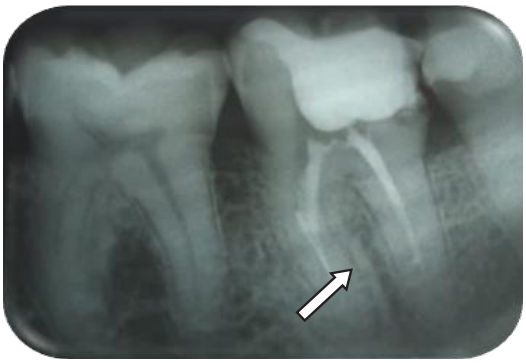

Figure 2. Preoperative radiograph of tooth 37 shows a long, thin radiopaque area in the middle third of the mesial root canal indicating a file fragment

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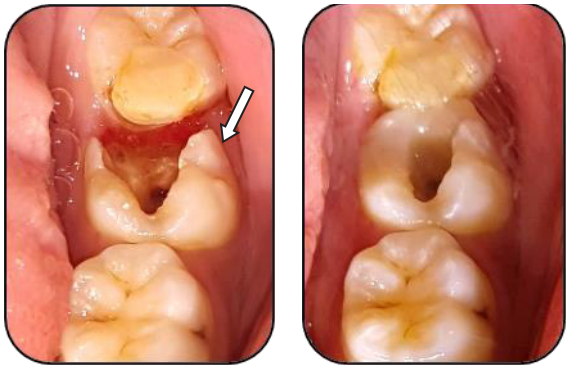


(A) (B)

Figure 3. Clinical photo of tooth 37 after cleaning the old filling (A) and after making an artificial wall (B)

(A) (B)

Figure 4. Image of changes in the position of the *file fragments* that have moved in a coronal direction (A); Radiographic image periapical tooth 37 after all root canal filling material and *file fragments* were removed (B)

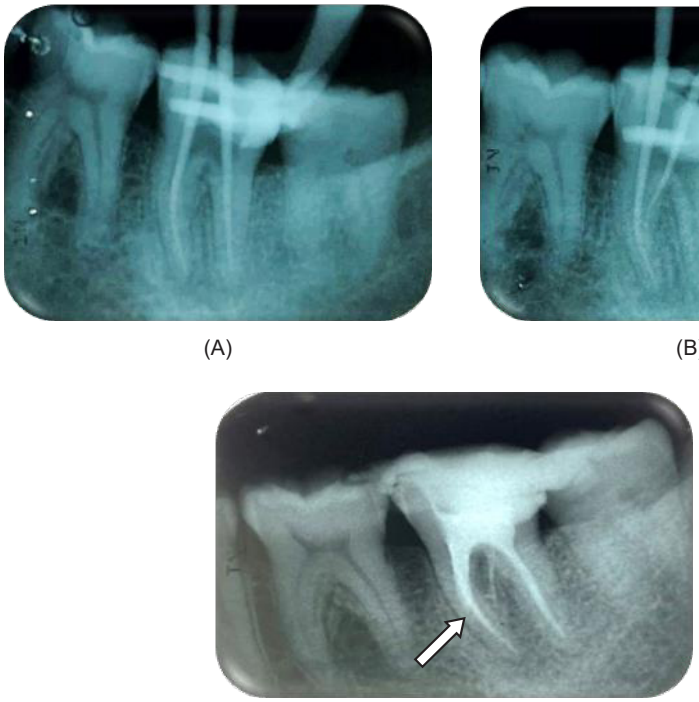
percussion and palpation showed negative results. The degree of tooth movement is classified as 0 according to the Miller classification.

Preoperative periapical radiograph examination of tooth 37 showed a radiopaque area on the crown of the tooth and on the root canal, showing that the tooth had been obturated using gutta percha. In the middle third of the mesiobuccal root canal, a radiopaque of approximately 5 millimeters was detected which indicated a file fragment in the root canal. Overall, the root canal filling appeared non-hermetic (Figure 2).

The presence of file fragments in that root canal of tooth 37 could interfere with the cleaning process in the root canal system if not removed. Tooth 37 was diagnosed with deep caries, previously treated with asymptomatic apical periodontitis accompanied by a foreign body.

Stages of treatment began on the first visit. Subjective and objective examinations and photo documentation were carried out. The patient was referred to the Periodontology Department for scaling.

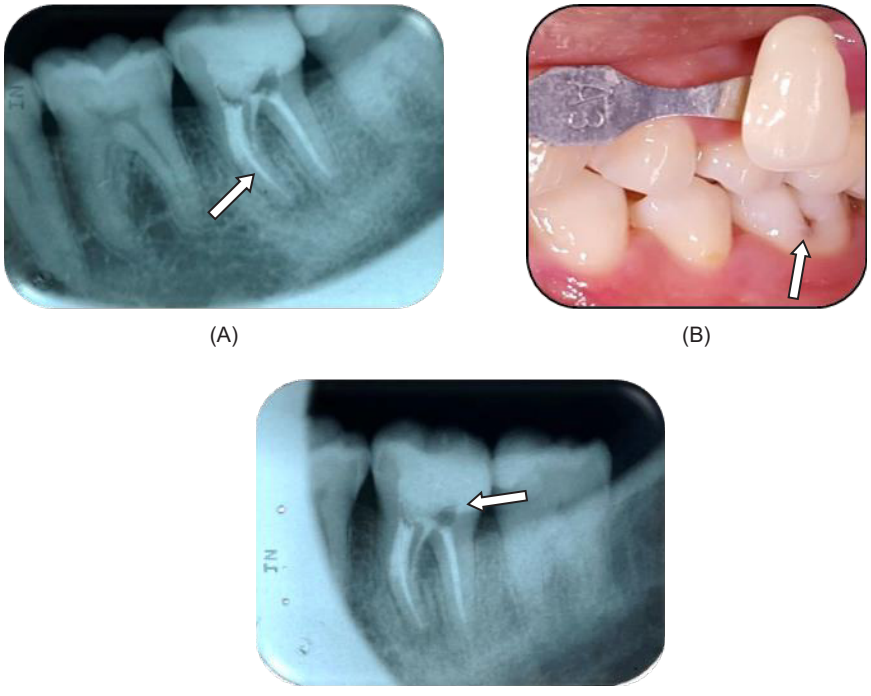
On the second visit, a subjective and objective examination was carried out, followed by an explanation to the patient about the study and the signing of the informed consent form. After the old restoration was removed, an artificial wall was constructed in the distoclusal area using A3 color packable composite resin to prevent saliva contamination. After cleaning the pulp chamber, 4 orifices were found at the base of the pulp chamber, 2 of which contained root canal filling material (mesiolingual and distolingual). Determination of working length (WL) using preoperative radiographs showed that the WL of mesiolingual canal was 21



(A) (B)

(C)

Figure 5. Overview Periapical radiograph of tooth 37 shows gutta percha appropriate apical to the constriction of the mesiolingual and distolingual ducts (A), and apical to the constriction of the distolingual and distobuccal canals (B); Periapical radiograph of tooth 37 after obturation (C)



(A) (B)

(C)

Figure 6. Periapical radiographs of teeth 37 during control of root canal treatment (A); Color matching clinical photograph of the patient's teeth (B); Periapical radiograph after application of intracanal retention and temporary filling (C)

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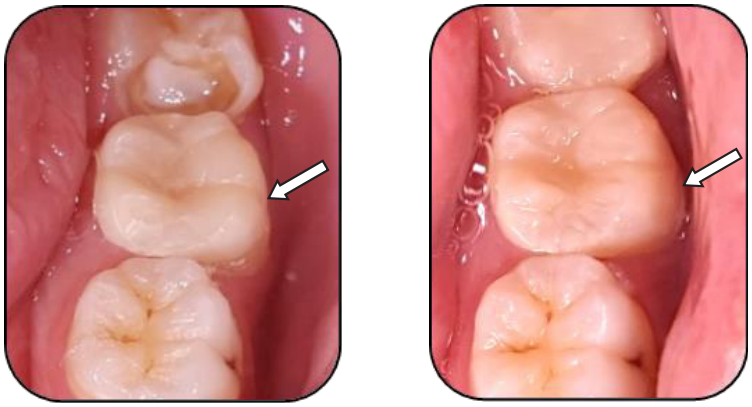
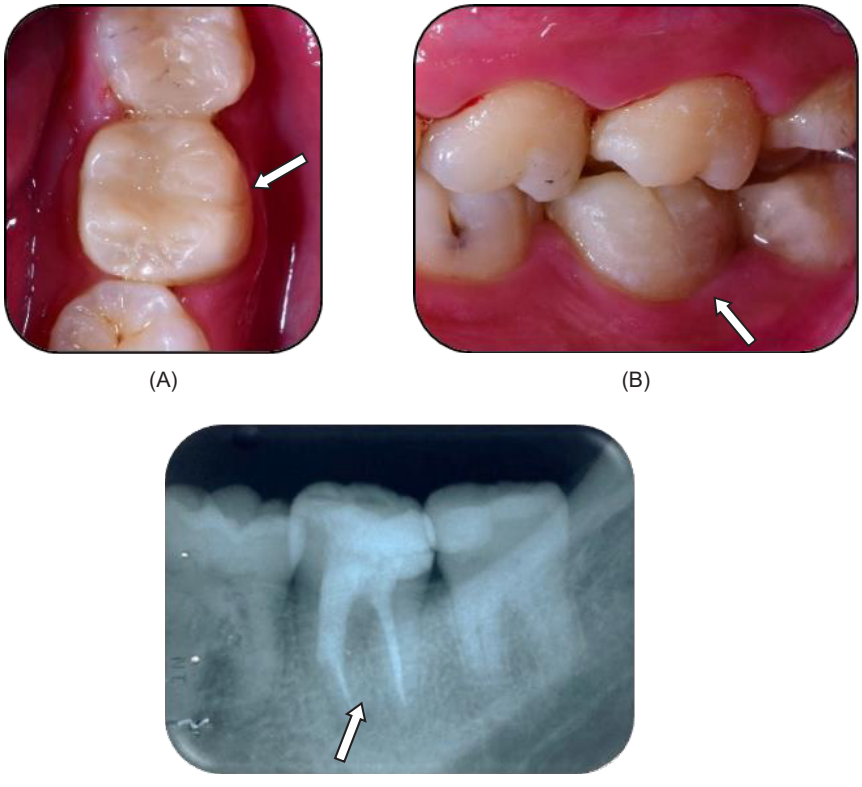


(A) (B)

Figure 7. Clinical photo of tooth 37 when the *endocrown* restoration was attempted from the occlusal direction (A) and after being cemented on tooth 37 seen from the occlusal (B) and from the buccal direction



(A) (B)

(C)

Figure 8. Clinical photo of composite resin *endocrown restoration* from the occlusal direction (A), occlusion position (B) during control; Periapical radiograph of tooth 37 during control shows a smaller radiolucent area in the periradicular area of the mesial root (C).

mm, mesiobuccal canal 22 mm, distolingual canal 20 mm, and distobuccal canal 18 mm. Removal of root canal filling material was carried out using a combination of gutta percha solvent and H-file #20 instrument. An endodontic microscope was used to ensure no gutta percha was left in the root canal. Furthermore, the root canals were irrigated with 2.5% NaOCL, 17% EDTA, 2% chlorhexidine

digluconate and interspersed with distilled water, then dried using paper points. The medicament used was calcium hydroxide paste which was applied and left in the root canal and closed with a temporary filling.

In the clinical findings, tooth 38 seemed to require treatment (degrading filling). On the third visit, a subjective examination showed that there were no complaints from the patient. Based on the objective examination, temporary filling was still good. The results of percussion and palpation were negative, and tooth 37 had grade 0 mobility. The teeth were isolated using a rubber dam, and the opening of temporary fillings used round diamond burs andexcavators. The position of the file fragment in the mesiobuccal root canal was checked using an endodontic microscope, then the remaining space around the file fragment was checked using K-file #10. The reduction of the root canal walls and changes in the position of the file fragments used a Satelec ultrasonic scaler with 20 mm long titanium-niobium tip (ET25/ET20; Satelec Corp) and 3% taper. The changes were then checked in the position of the file fragments using an endodontic microscope (Zumax OMS2350, China). The file fragments were retrieved using distilled water sprayed from a 5 ml syringe accompanied by endo suction to pull the file fragments out and prevent the file fragments from moving to other channels. Then, the presence of the file fragments in the mesiobuccal canal was rechecked. The next step was to take periapical radiographs to ensure all root canal filling materials and file fragments had been retrieved. The root canals were irrigated with 2.5% NaOCL, 17% EDTA, 2% chlorhexidine digluconate and interspersed with distilled water. Then the root canal was dried using a paper point. Calcium hydroxide paste was applied to the root canal as sealer, then covered with a temporary filling, and the rubber dam was removed.

On the fourth visit, a subjective examination showed no complaints, and an objective examination showed that visible temporary fillings were still good. The root canal was prepared using a rotary crown down technique using a progressive multiple tapering file gold (Dentsplay Mailefer, Jakarta) on mesiolingual root canal up to file F2 with WL of 21 mm, mesiobuccal root canal up to file F2 with WL of 21 mm, disto-lingual root canal up to file F3 with WL of 20 mm, and distobuccal root canal up to file F3 with WL of 20 mm. The patient was asked to come one week later.

On the fifth visit, a subjective examination and an objective examination found no complaints. The obturation used a warm vertical injectable obturation technique for mesiobuccal root canals, and a single cone technique for mesiolingual, distobuccal and distolingual root canals with epoxy resin sealer.

On the sixth visit, a periapical radiograph was examined (Figure 8 A). The etching procedure was carried out, then the teeth were rinsed with water and dried using cotton pellets and paper points. Generation V bonding material that had been mixed with a dual cure activator (DCA) (3M™ Scothbond, US) is used. The color of the patient's teeth was matched with the Vitapan Classical shade guide to obtain A3 shade. The lower jaw was printed with a double impression, and the maxilla was printed with alginate and filled with cast stone, then sent to the dental engineering laboratory. The cavity was closed with a temporary filling, then a periapical radiograph was examined.

On the seventh visit, a temporary filling was opened. Resin-based composite endocrown restorations were tried on teeth 37. Composite resin endocrown restorations were soaked in alcohol, rinsed and dried.

On the eighth visit, a subjective examination showed no complaints, while the objective examination found good gingiva, no signs of inflammation, good occlusion, good edge adaptation of composite resin endocrown restorations, no discoloration of the restoration, and no food impaction. Clinical photos and periapical radiographs were taken (Figure 8).

DISCUSSION

Some of the possible causes of file fractures inside the mandibular molar canal in root canal treatment include access to the root canal which is difficult

to find, small diameter, and sharp curvature of the root canal (complicated root canal anatomy).[6] Most of the root canal instruments are made of stainless steel and nickel titanium which could break. File fractures can also occur due to improper or excessive use of endodontic instruments, improper preparation techniques, and the highest incidence occurs in molars. Files which are used excessively for several times or until deformed, have torsional fracture. Other factors, such as the depth of the root canal, the type of broken file, the health status of the pulp tissue or infection in the root canal, determine the success of removing the broken file. Of these factors, the most significant factor is the position of the fracture relative to the root canal curvature.[7]

File fractures are most common in the apical third.[5] File fractures often occur in the middle third or apical third of the mesial canal of the mandibular molars and the mesiobuccal roots of the maxillary molars because the roots are curved distally if we observe using the periapical radiograph.[6]

The length of the broken file determines the prognosis of the root canal treatment. The prognosis is good if the file fracture occurs in a large enough root canal or in the final stages of preparation, and the broken instrument is close to working length. The prognosis is poor if the fracture occurs in the third apex area. If the file cannot be removed from the root canal, the presence of the broken file, especially in a tooth with infected pulp, necrotic or apical periodontitis, will make the prognosis for treatment unfavorable.

In general, there are three stages in retrieving broken files during root canal treatment. These are seeking clear access to determine the location of the broken files, and preparation around the instrument in such a way that the root canals are loose enough that the broken files can be easily removed.[4] There are many techniques that can be used to retrieve broken instruments in root canals, and the technique is based on the location of the broken instrument.[3] Before retrieving the broken instrument, a radiograph is taken to determine the position of the broken instrument and to estimate the thickness of the dentine around the fracture.[4] Several factors are considered in managing this case, including visibility, location of broken files, and remaining tooth structure.[8] Retrieval of broken files often requires other interventions because the risk of complications that may occur, for example the file is pushing apically, which extrudes the fragment into the apical foramen, and it has a risk of tooth fracture due to over-reduction of dentin, root perforation, and risk of ledge formation.

Advanced technology has made it possible to use several tools to retrieve broken files, including ultrasound, microtubes and a plier tool. These tools are used with the help of an endodontic microscope to facilitate maximum visibility and minimize reduction of root canal dentin.[9]

In this case, the file fragment was located in the mesiobuccal root, and the position of the file fragment in the root canal was checked with an endodontic microscope. The area around the file fragment was loosened with a #10 K-file using satelec. Loosening of the root canal walls was carried out using a Satelec ultrasonic scaler with a titanium-niobium tip with a length of 20 mm and a taper of 3%. An endodontic microscope was used to check the position of the file fragments. The file fragments were removed using distilled water which was sprayed from a 5 ml syringe followed by retrieval of the file fragments using endo suction to prevent the file fragments from moving to other root canals. The mesiobuccal root canal was checked using an endodontic microscope and confirmed by taking a periapical radiograph to ensure that there were no file fragments left.

The root canals were irrigated with 2.5% NaOCL, 17% EDTA, 2% chlorhexidine digluconate and interspersed with distilled water, then dried using paper points. Calcium hydroxide paste was applied to the root canal as sealer using a lentulo spiral, then covered with a temporary filling, and the rubber dam was removed.

Chances of success of removing broken files is greater in the coronal third and middle third of the root canal than in the apical third. This is because retrieval of a broken file in the apical third with relatively thin dentin can result in reduced root strength. Files in the coronal and middle thirds of

the root, however, can be retrieved without major complications.[10]

In this case study, the chance of achieving success of removing broken instruments using conventional techniques combined with a Satelec ultrasonic scaler was quite high. The use of an ultrasonic scaler tip was to vibrate the file in the root canal, so the retention of the file fragments against the root canal walls became loose and could be retrieved easily. The use of an ultrasonic tool has proven effective in removing instrument fragments in root canal treatment.[11] Satelec ultrasonic scalers are suitable for endodontic treatment and re-treatment procedures because they allow precise work accuracy and have a wide power range that can be adjusted. This tool also has a unique “feedback” system to measure tip resistance, regulate tip movement, thereby reducing the potential for tip damage.[12,13]

A technique mostly used before treating other broken files involves the use an endodontic microscope to improve the visualization of the broken files and precision of file removal. Endodontic microscopy is often used to observe the location of the mesiobuccal canal at high magnification. The use of an endodontic microscope can also improve the success of the management of fracture file retrieval because the gap between the fracture file and the canal wall can be observed. The use of ultrasonic tips and endodontic microscopy is a conservative but effective method of handling broken file cases.[14] The instrument’s head was cleared using a fine ultrasonic insert (ET20/ET25). The file was then removed by vibrating the instrument in an anti-clockwise way with the insert tip.[15]

The utilization of operating microscopes and small-diameter ultrasonic tips during endodontic treatment has the potential to enhance the safety of instrument extraction and optimize minimally invasive root canal preparation. Overall, instrument retrieval success rates are as follows: high for separated instruments situated prior to the canal curvature, moderate for instruments situated within the canal curvature, and diminished for instruments situated beyond the canal curvature. Studies have shown that the success rate of removing separated instruments is higher when the curvature of the canal is lower and the radius is longer. A line parallel to the separated instrument’s long axis was subsequently formed from the orifice to the fractured end of the instrument in order to determine its canal curvature. By utilizing an ultrasonic instrument in conjunction with a microscope, damaged files can be processed more delicately than with alternative techniques. It can erode dentin structure more conservatively and is less likely to damage root structure and periodontal tissues.[15]

The final restoration in this case is endocrown. Endocrowns are indirect monoblock restorations that use the pulp chamber of the endodontically treated molars for retention.[16] When recommended, endocrowns are significantly more advantageous than composite restorations due to their superior success rate. A post retained crown is less desirable than alternative options, particularly for younger individuals, because to several compelling reasons. The location of the supragingival margin enables improved gingival health and care. Additionally, it offers enhanced fracture resistance, hence reducing the likelihood of root fracture, thus improving the long-term prognosis of endodontically treated molars and has a superior ability of restoring endodontically treated molars with short crowns, calcified root canals and thin roots.[17] The type of tooth accepting an endocrown is another area of concern regarding the success of these restorations. Belleflamme et al endorsed clinically and concluded that the fabrication of endocrowns is a reliable approach for restoring both molars and premolars, even in the presence of extensive loss of tooth structure or occlusal risk factors.[18] In our 2 clinical cases of maxillary premolar endocrowns, no failure was observed after 20 months even though a smaller surface for adhesion was available. The clinical result of the restoration was not significantly affected by non-axial forces, which arise due to the tooth’s position in the arch and the involvement of premolars in lateral occlusal guidance. The reason

for this can be attributed to the lower elastic modulus of composite resins and their superior long-term survival rates in restoring maxillary premolars with endocrowns, as compared to leucite reinforced glass ceramics.[17,18]

CONCLUSION

Retrieval of fractured files using conventional techniques combined with Satelec ultrasonic scaler and root canal re-treatment followed by final endocrown restoration can restore all four tooth functions properly.

CONFLICT OF INTEREST

The authors declare no conflict of interest with the data contained in the manuscript.

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