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Case report

Management missed canal tooth and broken file using ultrasonic instrument

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ABSTRACT

Background: *Endodontic mishaps, such as missed canal and broken file, are procedural accidents that can affect the prognosis of endodontic treatment. A missed canal can lead to endodontic failure because of bacterial remnants in the root canal. A broken file may cause obstruction of the canal, inhibiting the process of shaping and cleaning. An ultrasonic instrument can be used under a dental microscope to manage a missed canal or broken file fragment.* ***Purpose:*** *This study aimed to show the management of missed canal and instrument separation by endodontic retreatment using an ultrasonic instrument under dental microscope.* ***Case:*** *A 31-year-old female patient presented to Dental Hospital Universitas Gadjah Mada with discomfort from chewing her upper left molar since 2 weeks (January 4, 2022). The tooth was subjected to root canal treatment 2 years ago (November 18, 2019). The percussion test yielded a positive result. The examination of radiographs showed the presence of a broken file in the middle third of the mesiobuccal root canal.* ***Case Management:*** *The first stage of the retreatment was removal of the gutta-percha. This was followed by exploration of the missed canal and retrieval of the broken file using an ultrasonic instrument under a dental microscope. Then, the root canals, including the messiobuccal2 canal, that was missed at the previous treatment, were prepared. The final step was zirconia crown restoration with a fiber post.* ***Conclusion:*** *An ultrasonic device along with a dental microscope can be used to manage a missed canal and instrument separation conservatively.*

Keywords: *broken file; dental microscope; endodontic mishap; missed canal; ultrasonic instrument*
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INTRODUCTION

During endodontic treatment, a clinician may encounter undesirable situations, namely endodontic mishaps, such as inadequately cleaned and shaped root canal system, inadequate obturation, instrument separation, perforation, transportation, vertical root fracture, and instrument aspiration, that adversely influence the treatment outcome. Endodontic mishaps may have dentolegal consequences, e.g., patient complaints. If an endodontic mishap occurs, the patient must be informed about incident, nature of the mishap, procedures carried out to correct it, alternative treatment options, and prognosis of the affected tooth. Therefore, prevention of mishaps is the best option for both the patient and clinician, and mishaps must be prevented by precise diagnosis, appropriate case selection, and compliance with standards of endodontic treatment.[1]

The process of shaping and cleaning the affected teeth is vital to the success of endodontic therapy.[2] Shaping the root canal allows for adequate debridement by facilitating chemical disinfection to remove organic debris and bacteria from the root canal. Inadequate cleaning and shaping can cause bacteria to be retained in the root canal, resulting in endodontic failure.[2,3] Several causes can hinder the cleaning and shaping process including loss of the working length, canal blockage, ledge formation, and missed canals.[1]

Missed canals can influence the prognosis of root canal therapy because they cause persistent bacterial infection. Inadequate access cavity preparation and limited operator knowledge of the complexities in canal configuration are some of the causes of missed canals.[4] Maxillary molars

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have a complex root canal system. The mesiobuccal (MB) root has two main canals: mesiobuccal1 (MB1) and mesiobuccal2 (MB2).[5,6] The occurrence of MB2 on permanent maxillary first molars in the Indonesian population is 68.5%.[5] The MB2 root canal has an orifice that is usually located 3.5 mm palatally and 2 mm mesially from the MB1 orifice. The MB2 orifice is sometimes located under a dentin wall or under calcifications in a small groove that may be missed in daily endodontic therapy, mainly if magnification is not used.[6] Therefore, clinicians must use effective strategies for locating canals; these strategies are dependent on the clinicians' knowledge of tooth anatomy, ability to interpret radiographic data; proficiency in performing cone-beam computed tomography (CBCT), magnification, and illumination; access cavity preparation skills; and proficiency in using ultrasonic devices, dyes, and disinfectants, such as sodium hypochlorite (NaOCl).[7]

Instrument separation, especially when using endodontic files, is a common mishap that occurs during endodontic treatment; it causes root canal obstruction and inhibits the process of shaping and cleaning. Using nickel titanium (NiTi) rotary instruments during root canal preparation does not reduce the risk of separation because this instrument is often overused or used incorrectly.[8] Several factors determine the prognosis of broken file removal, such as the type of separated instrument, canal depth, pulp status, and canal infection.[8] NiTi fragments are more difficult to remove than stainless steel ones because they are prone to further breakage when using an ultrasonic instrument for retrieval.[9] If the fragment is located deeper in the canal, a significant amount of dentin is lost in the process of fragment retrieval, resulting in reduced root strength. Fragment blockage commonly occurs in the apical third of the root canal due to the curvature. The presence of periapical pathology also leads to poor prognosis if the root canal is not disinfected adequately because of fragment blockage.[8]

By using an ultrasonic instrument under a dental microscope, endodontic failure due to missed canal or broken instrument can be treated. A high-magnification dental microscope and enhanced lighting can be used to identify the missed canal and instrument fragments. Ultrasonic instruments have a small tip and their abrasive coatings enables them to remove dentin in a precise manner when exploring for missed canals. They can also be used to retrieve broken files conservatively by removing the root canal wall to loosen the fragment.[9] This method increases the success of retrieval while preserving sound dentin tissue.[8] This report presents a case of missed canal and file breakage during endodontic retreatment that was managed by using an ultrasonic instrument under a dental microscope.

CASE

A 31-year-old female patient presented to Dental Hospital Universitas Gadjah Mada with a complaint of discomfort in her upper left molar while chewing food since 2 weeks (January 4, 2022 it was the date of symptom onset). The same tooth was subjected to root canal treatment and restoration 2 years ago (November 18, 2019). On intraoral examination, a restoration of the same color as the tooth on the distal and palatal surfaces of tooth 26 was observed (Figure 1). The percussion test yielded a positive result, but the palpation and vitality tests did not. Radiographic examination showed the presence of a diffuse radiolucent area on the apical third and a radiopaque broken file in the middle third of the MB root. Obturation material was found in the MB, distobuccal, and palatal root canals that had not sealed hermetically (Figure 2). As per the subjective, objective, and radiographic data, the patient was diagnosed with symptomatic apical periodontitis of a previously treated tooth, with a broken file embedded in the MB root canal. The therapy plan was retreatment and file fragment retrieval using an ultrasonic instrument followed by zirconia crown restoration with a fiber post.

CASE MANAGEMENT

The patient was informed about the treatment options and requested to sign the informed consent. The first step of the retreatment was removing the old restoration, opening the access cavity, and locating the root canal orifices using an endodontic explorer. Three orifices, i.e., MB1, distobuccal,

Figure 1. Occlusal intraoral view showing a composite restoration on maxillary left first molar.

Figure 2. Periapical radiograph image showing a broken file on the middle third of mesiobuccal root (red arrow) and material obturation that did not seal hermetically.

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and palatal, had been filled with gutta percha. The MB2 canal was missed; it was found to be located mesially and palatally from the orifice of MB1 (Figure 3) after the dentin was removed using an ultrasonic tip (Endosuccess Retreatment ETBD tip, Acteon, Mérignac, France).

The next step was removal of the gutta-percha on each orifice using a retreatment rotary file (O File, NIC, Shenzen, China) and xylol as a solvent. The estimated working length was traced on the periapical radiograph. D1, D2, and D3 were used to remove the gutta-percha from the coronal-, middle-, and apical third of the canal, respectively. A periapical radiograph was obtained to evaluate the gutta-percha removal (Figure 4). The root canals were irrigated with 2.5% NaOCl and saline, followed by the application of a temporary restoration using calcium hydroxide paste (Calcigel, Prevest Denpro Ltd., Jammu, India).

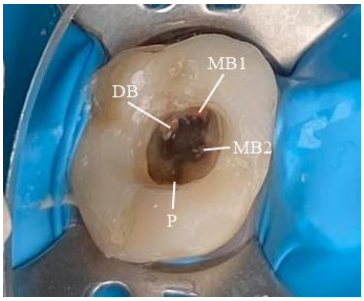

Figure 3. Occlusal intraoral view showing the messiobuccal1 (MB1), distobuccal (DB), and palatal (P) orifices filled with gutta percha previously and missed mesiobuccal2 (MB2) canal.

One week after the first visit, the broken file was retrieved under a dental operating microscope (Surgical Microscope OMS2350, Zumax, Suzhou, China). The orifice of MB2, distobuccal, and palatal were sealed with Teflon tape to prevent accidental entry of the file fragment. The MB root canal was retrieved by making a space between the exposed portion of the fragment and the root canal wall (staging platform) using an ultrasonic tip (Endosuccess Retreatment ET20 tip, Acteon, Mérignac, France). The tip was used intermittently to loosen the file from the dentin of root canal wall and provide space for the next instrument. The root canal was irrigated with ultrasonic-activated 2.5% NaOCl for cleaning and enhancing visualization. After the broken file was exposed (Figure 5A), we continued retrieval using a smaller tip (Endosuccess Retreatment ET25 tip, Acteon, Mérignac, France) with intermittent anticlockwise circular movement followed by irrigation with 2.5% NaOCl. The tip was positioned on the space between the fragment and root canal wall until the fragment came out (Figure 5B). Repeat radiography of the tooth was conducted in the periapical view to ensure that the fragment was successfully retrieved (Figure 6).

The treatment was continued with the preparation of all root canals. An electronic apex locator (E-PEX, Eighteeth, Changzou, China) was used to measure the working length. The root canals were prepared using the rotary NiTi file (M3 Pro Gold, UDG, Changzou, China) prior to using the master apical file at 25.06/18 mm of the MB1 root canal, 25.06/17.5 mm of the MB2 root canal, 25.06/17.5 mm of the distobuccal root canal, and 25.06/19 mm of the palatal root canal. The root canals were irrigated using 2.5%

Figure 4. Periapical radiograph image showing the obturation material was already removed from all root canal.

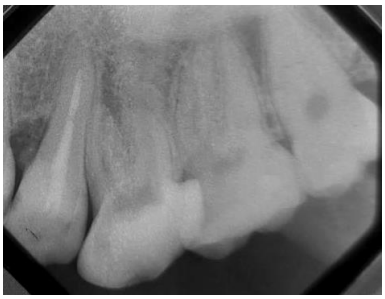

Figure 6. Periapical radiograph image showing that the broken file was removed.

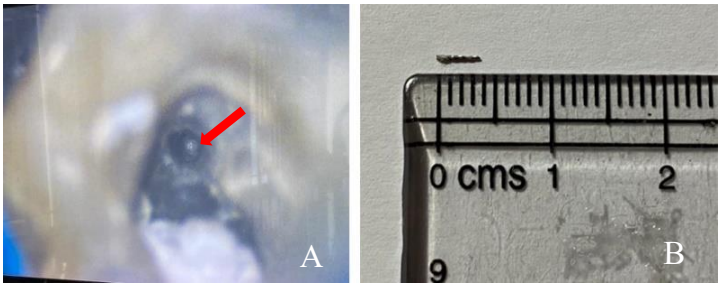

Figure 5. View under 17.0 magnification of a dental operating microscope showing the fragment (red arrow) on the mesiobuccal1 canal (A) that was approximately 4 mm in length after removal (B).

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NaOCl and saline, followed by temporary restoration with calcium hydroxide paste (Calcigel, Prevest Denpro Ltd., Jammu, India).

Two weeks after the previous visit, the tooth was asymptomatic, and percussion and palpation tests yielded negative results. The temporary restoration was then removed, and irrigation was performed using a solution of 2.5% NaOCl, 17% EDTA, 2% chlorhexidine, and saline. After drying with paper points, the MB1 root canal was obturated with gutta percha by continuous wave compaction using an endodontic obturation system (Fast-Pack and Fast Fill, Eighteeth, Changzhou, China) and the other canals were obturated by single cone compaction (Figure 7A). For obturation, 25.06 gutta-percha, as the master cone, and a resin sealer were used (AH Plus, Dentsply Maillefer, Ballaigues, Switzerland). The tooth was then subjected to periapical radiography to evaluate the obturation (Figure 7B).

One week after the obturation, the patient had no complaints, with no response on the percussion and palpation tests. The tooth was prepared for fiber post insertion on the palatal root canal using resin cement (RelyX U200, 3M ESPE, St. Paul, USA). The tooth was then prepared for zirconia crown restoration and impressed using the double impression technique (Elastomeric Impression Material, Nobilium, New York, USA). Temporary restoration (ProTemp, 3M ESPE, St. Paul, USA) was performed, and the patient was asked to return after 2 weeks. After 2 weeks, the zirconia crown was cemented using resin cement (RelyX U200, 3M ESPE, St. Paul, USA) (Figure 8).

DISCUSSION

Endodontic treatment failure can occur due to instrument separation and missed canal, both of which require endodontic retreatment.[10] The presence of instrument fragments and missed canal inhibit the cleaning and shaping process, resulting in bacteria being retained in the root canal. The bacteria and their products induce inflammatory responses in the periapical region, causing the formation of a periapical lesion.[11]

The most common causes of instrument separation during endodontic treatment are overuse of the instrument, inadequate access preparation, application of excessive radicular pressure during instrumentation, and use of a large instrument in a curved canal. The other contributing factors are operator experience, canal curvature, rotational speed and torque setting, type of rotational motions (continuous or reciprocating), instrument design and technique, manufacturing process, type of NiTi alloy, and absence of a glide path. The incidence of instrument separation ranges from 0.4% to 23%, and it is higher for NiTi rotary instruments than non-rotary instruments; it occurs more frequently in molars than in anterior teeth because of the accessibility to the canal, diameter, and curvature of root canal.[12]

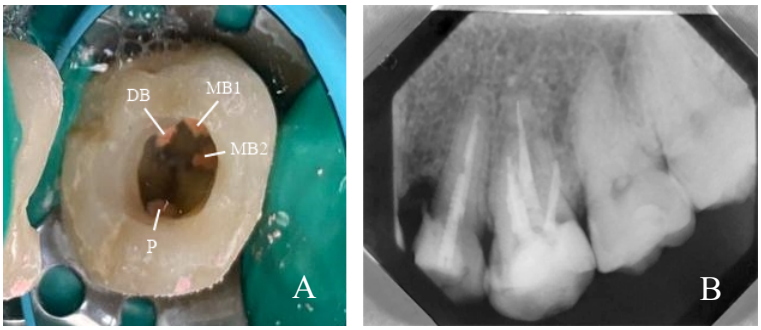

Figure 7. (A) Clinical view showing obturation on the mesiobuccal1 (MB1), mesiobuccal2 (MB2), distobuccal (DB), and palatal (P) canals; (B) radiographic view of obturation all the root canals.

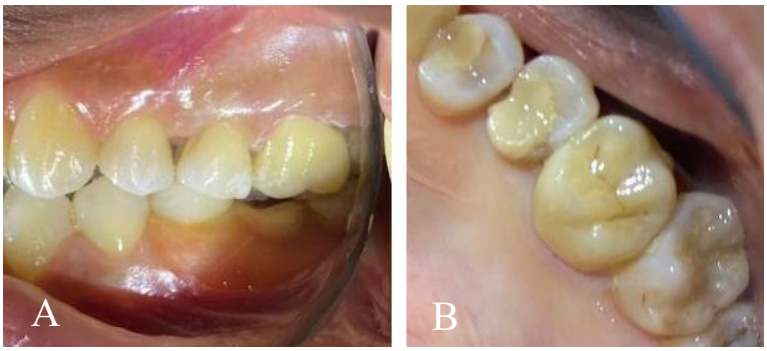

Figure 8. Zirconia crown restoration: (A) buccal view, (B) occlusal view.

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Nonsurgical or surgical approaches can be used to retrieve instrument fragments. Nonsurgical approaches include ultrasonic devices, extractors, wire loops, post-removal systems, and laser irradiation. Surgical approaches include radicular surgery, root amputation, hemi-section, and intentional replantation.[12] The methods and tools for retrieving instrument fragments are dependent on the case, especially the root canal anatomy, root size, and location of fragment. However, simple and minimally invasive methods should be selected.[13]

Using an ultrasonic instrument along with a dental microscope is a conservative method of file fragment retrieval. An ultrasonic instrument can be used to remove the dentin of the root canal wall conservatively with minimal destruction of the root structure and periodontal tissue.[14] In our patient's case, the fragment was located in the middle third of the root canal. When the fragment located below the orifice and cannot be bypassed, approximately 2 mm of the coronal fragment needs to be exposed. The ultrasonic tip is positioned on the staging platform, which is the space between the exposed portion of the fragment and the root canal wall, and vibrated in a counterclockwise manner to apply an unscrewing force to the fragment. This technique helps remove endodontic files since they have a clockwise cutting action.[12] The ultrasonic instrument that we used was made of titanium niobium alloy with diamond-coated ET20 and ET25 tips (Acteon, Mérignac, France); hence, they eroded the root canal dentin wall. The ET20 tip was used to prepare a staging platform on the coronal third, and the ET25 tip was used to loosen the fragment located on the middle third of the root canal.[14]

The success rate of the retrieval depends on the location and size of the fragments. The success rate is reported to be high, moderate, and late for fragments located coronally at the canal curvature, at the curvature, and apically the curvature, respectively. If the fragment is shorter than 4.5 mm, it can be retrieved with an ultrasonic instrument alone.[12] In our patient's case, the fragment was 4 mm long and located coronally from the curvature; thus, it could be removed successfully using an ultrasonic device alone.

Visualization and accessibility to the separated instrument play a significant role in retrieval. Retrieval of a broken file can be done in a dry condition to provide better visibility when using the dental microscope. This method may prevent procedural accidents. However, ultrasonic instruments can damage periodontal tissue by heat generation if the temperature rises above 10°C on the external root surface. Therefore, it is recommended that an irrigating solution be applied when using an ultrasonic instrument.[12] In this case, irrigating the solution using 2.5% NaOCl can dissolve the organic portions of the smear layer to ensure better visualization.[15] Besides heat generation, the use of ultrasonic instruments still has some drawbacks. Its activation can cause the original fragment to further disintegrate into smaller fragments, making it more difficult to remove the fragments. The smaller fragments are often pushed back apically into a narrow canal level. Ultrasonic devices can also cause perforation, extrusion of the fragment from the apical foramen, and excessive loss of the dentin root canal wall.[12,16]

Missed canals can lead to endodontic failure because of retention of tissue debris, bacteria, and other irritants. The most common causes of missed canals are lack of knowledge about root canal anatomy and its variations and inadequate access cavity preparation. A missed canal can be located on a radiograph or by using a magnifying loupe or microscope, accurate access cavity preparation, using ultrasonics, using dyes such as methylene blue, and using NaOCl.[1] In our patient's case, the MB2 orifice of the maxillary first molar was visible on a dental microscope and detected by an endodontic explorer after the dentin was removed using an ultrasonic tip. It was located palatally and mesially from the MB1 orifice. Several studies have shown that the incidence of the MB2 canal being located in the maxillary first molars ranges from 50% to 90%. The location of detection and treatment of the MB2 canal affect the maxillary molar endodontic treatment.[17]

In this case, an endodontically treated tooth was restored using a zirconia crown with a prefabricated fiber post. A fiber post was chosen because its elasticity modulus (approximately 20 GPa) is similar to that of dentin (approximately 18 GPa), meaning it has similar physical properties to natural dentin, so the risk of root fracture due to stress concentration areas in the dentin is reduced.[18] Moreover, fiber posts have excellent esthetic property owing to their natural translucency and similar shade to human teeth; they do not need an opaquer and are suitable for all material restorations.[19] Zirconia crowns show good performance in terms of mechanical properties, with the highest mechanical strength among all dental ceramic materials; they also have low corrosion potential, thermal conductivity, biological compatibility, and radiographic contrast. Zirconia has high fracture resistance, represented by its superior flexural strength and fracture toughness; therefore, it is the material of choice for high-functional and aesthetic issues.[20]

Endodontic mishaps such as missed canal and instrument separation can be managed by using an ultrasonic instrument under a dental microscope. The dental microscope can provide an excellent view of the target area to detect the missed canals and retrieve the broken fragments. An ultrasonic instrument can be used to remove the dentin wall that covers the orifice and loosen the broken file by removing the root canal wall. This method can be used to retrieve broken files conservatively and successfully, especially if the fragment is shorter than 4.5 mm and located toward the coronal end.

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