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ABSTRACT
Root canal treatment aims to remove all microbial pathogens from inside the root canal mechanically by preparation using endodontic instruments, and chemically with irrigation and intra canal medicament. However, many incidents might happened during the process, one of which is the fractured instrument in the root canal. The purpose of this case report is to present a clinical case of separated instrument and its treatment with bypass in first mandibular molar. A 29-year-old woman was referred for root canal treatment of right mandibular first molar to the Department of Conservative Dentistry. One week earlier, she had an unfinished root canal treatment by former dentist because she felt a spontaneous pain since 2 weeks ago. Now she felt pain and discomfort while chewing on her lower right tooth. A clinical examination showed a deep cavity on tooth #46 (D6. Site 2, size 3), sensitive to percussion, no respond to palpation and cold test, and gingiva normal. Pre-operative radiograph showed a separated instrument in apical third disto lingual canal and diffuse periapical radiolucency with diameter of 1 mm. Considering the clinical and radiographic findings, our final diagnosis was chronic apical abscess et causa pulp necrosis and separated instrument. Therefore, root canal treatment with bypassing separated instrument was performed in this case.

Keywords: root canal treatment, separated instrument, bypass, mandibular molar

INTRODUCTION
A fractured instrument during root canal treatment is an undesirable condition. But this occurs from time to time and can cause distress for both clinician and the patient. Fractured file in the root canal will obstruct the cleaning and shaping procedures and blockade access to apical foramen, hence there are still congregation of bacteria and debris that are untouchable when doing the root canal preparation because of the separated file. Beside that, the effort to remove the fractured file is difficult and time consuming. It is important for clinician to understand the probability and the cause of fractured file
on the root canal treatment so they can prevent this condition.

The best treatment that clinicians should do when there is a fractured file is removing it. However, in a certain occasion, the effort to removing the fractured filed may cause ledge formation, over enlargement, and root canal transportation that will weaken the tooth structure. Clinician must evaluate the choices whether to remove the fractured file, doing the bypass, or leaving the fractured file in the root canal. The choice must be adjusted to the diagnosis, root canal infection, root canal anatomy, the position of fractured file, and the type of the fractured file.1,5,6

Bypass is a conservative procedure that can be done if the fractured file can not be removed. The aim of bypass technique is making the process of cleaning and shaping the root canal can be done in a working length while the fractured file is still in the root canal. This option is recommended to a condition where the fractured file is in a difficult position such as apical one-third or in a curved canal. Removing the fractured file in apical one-third has a vertical fracture risk compared to middle and coronal third of root canal. There was a research stated that leaving the fractured file while carrying out the bypass treatment would not reduce the success rate of the treatment because it would still make a favorable obturation. It is also stated that if the bypass procedure could still be done, the fractured file can also be removed.1,5,6

CASE REPORT

A 29 year old woman was presented at the clinic to continue the treatment of her right mandibular first molar. The former dentist had done a root canal treatment one week earlier, but the treatment had been unfinished and the patient was referred to the Department of Conservative Dentistry Clinic, University of Indonesia. The patient stated that she had a spontaneous intermittent pain since two weeks ago. But now she only had pain when chewing.

Intraoral examination found a temporary filling on #46. On the objective examination revealed that there was a D6 caries (site 2 size 3) on #46, sensitive to percussion, no respond to palpation and cold test.

Radiograph examination showed a normal pulp chamber, curved mesial root canal to the distal, constriction on distal root canal, and radiopaque images showing the fractured file on the distal lingual apical third of root canal. There was a widening of periodontal ligament, disconnected lamina dura and diffused radiolucency images in the periapical with 1mm diameter.

Based on the subjective, objective, and radiograph examination it can be concluded that the diagnosis of #46 is chronic periapical abscess et causa necrotic pulp and fractured file. The treatment needed to be carried out is root canal treatment on #46 with fractured file bypass and ceramage onlay restoration.
CASE MANAGEMENT

Removing the temporary filling was done on tooth 46 after rubber dam isolation, followed by completion of access opening that had been done by former dentist. After it had been suspected that there was a fractured file, patient had been informed that there was a probability that there was a fractured file on one of the root canal and the best treatment procedures would be carried out, with the probability of doing the endodontic surgery if the periradicular lesions persisted.

Figure 1. (a) Photograph of pre-operative tooth after removal of temporary filling, (b) Periapical radiograph of pre-operative tooth, (c) Photograph of the tooth after rubber dam isolation and completion of access opening.

After that, preparation of the root canal was performed on coronal two-third of the 4 orifices; 2 mesial orifices and 2 distal orifices using SX file. Initial exploration of the root canal using k-file ISO #10 through the working length, that is mesiobuccal root (MB), mesio lingual (ML), and distobuccal (DB) 18.5 mm. The working length for distal lingual root (DL) was 18 mm but the k-file could only reach 16 mm because of the fractured file at the apical third of the root. The actual working length was determined by electronic apex locator and confirmed by radiograph. Initial file was k-file #10 with 18.5 mm working length for MB, ML, and DB root canal and initial k-file #10 with 18 mm working length for DL root canal.

Preparation of MB, ML, and DB was using Protaper hand-use (Dentsply Maillefer, Switzerland) until reaching the working length. Preparation was done until root canal were clean and master apical file that was F3/18.5 mm was obtained for MB, ML, and DB. DL root canal was prepared until coronal part of the fractured file until F3/16. Irrigation was always done with 2.5% NaOCl and application of EDTA gel during the process of root canal preparation.

Afterward a radiograph of master apical cone was conducted and it could be seen that the preparation had reached the working length except for the DL root canal because of the fractured file as can be seen on Figure 2. The root canals were given Calcium Hydroxide (Calcipex, Nippon Sika-Yakuhi, Shimonoseki, Japan) as a medicament and tooth was restored with temporary filling.

Figure 2. (a) Radiograph of determination of MB and DB actual working length, (b) Radiograph of determination of ML and DL actual working length, (c) Radiograph of master apical cone of MB, ML, and DB root canal.
One week after the first visit, there was no chief complaint, negative palpation, but the percussion was still positive on tooth 46. Afterward, bypass procedure was done on the DL root canal to go through the fractured file using C+ #8 and #10 (Dentsply Maillefer, Switzerland) with watch winding movement. Estimated 18 mm working length was obtained. After the bypass technique was successfully going through the fractured file, the same process was repeated using larger hand file carefully until reaching F2/17 mm master apical file. Irrigation with 2.5% NaOCl and MD-Cleanser (Meta Biomed Co., Ltd., USA) that contained 17% EDTA as a dentin softener and RC-Prep (Premier Dental, Philadelphia, PA, USA) lubricant that contained 15% EDTA sodium were used in every use of files to ease the preparation of root canal. Working length then was reconfirmed with master apical cone radiograph. The root canals were given C1KM medicament and then the tooth was restored with temporary filling.

After the third visit there was no chief complaint, percussion and palpation were negative so obturation could be carried out with cold lateral condensation technique using non-iso gutta percha (Protaper Universal Gutta Percha, Dentsply Tulsa Dental, Switzerland) and accessory cones which were F3/18.5 mm gutta percha protaper for MB, ML, DB root canals and F2/17 mm for DL root canal. We used MTA Fillapex as the sealer. After root canals were filled, we applied glass ionomer cement as a basis and the tooth was restored with temporary filling (Caviton, GC Corporation, Japan).

Figure 3. (a) Radiograph of DL root canal bypass, (b) Radiograph of master apical cone, (c) Radiograph of root canal obturation

Permanent restoration was conducted one month after obturation using onlay ceramagic and it was done using shoulder edge design preparation. Impression was made using double impression material on tooth 46 and alginate on the antagonist jaw. Afterwards wax record and suitable color shade determination were conducted and then the model was sent to the dental lab. One week after that the placement of onlay ceramagic was conducted on tooth 46.

Figure 4. (a) Photograph of tooth 46 onlay preparation (b) Radiograph of onlay try in on tooth 46, (c) (d) Photographs of onlay ceramagic placement on tooth46.

DISCUSSION

On this case report, the fractured file is known from radiograph image, where there was a radiopaque image in the distolingual apical region of root canal.
and when the initial file exploration was conducted it could not reach the estimated working length. Before the treatment was performed, the patient was given the information about the tooth condition, the options of fractured file treatment and which one was the most likely to be done, along with the prognosis.

Based on the radiograph, the root canal was not yet to be widened and the radiopaque image of the fractured file seemed to be thin with 4 mm length. So it can be concluded that the root canal was not yet to be prepared or it was still in the initial stage and the fractured file was the initial file that was from stainless steel material and manual operated.

Several probabilities that cause fractured file in this case were access preparation that was not sufficient and the root canal anatomy that is narrow, using file without lubricant, and overuse files. Access preparation that is not excellent will cause the pulpal wall to obstruct the file to go through the canal without hindrance so there will be an excess pressure and not appropriate on the file that will cause the file easily fractured. If the file is in contact with access cavity wall during instrumentation, the potential of fractured instrument to take place will increase. Access preparation that is not sufficient will also increase the amount and severity of curvatures that is need to be negotiated by file.

The narrow root canal anatomy will cause torque fatigue on the file. Torque fatigue happens when the end of the instrument detained on the narrow root canal meanwhile the base is always rotated, so the instrument will fracture in the detached area. When the limit of elasticity of the metal material has been exceeded, the fractured file can not be avoided. In addition, the file that is fractured on this case is a small size stainless steel file. Small sized files are also said to be prone to fracture because the file diameter size will decrease the tension strength and increase the tension failure. Smaller size of files are also initial files that obtained more stress and will prone to fracture.

Using file without irrigation and lubrication will also dry the root canal and increasing friction between file and root canal wall and then will fracture the file. Hence, continual root canal lubrication with irrigation or lubricant will reduce the friction as increase the efficacy of instrumentation.

Overuse files. File has flutes which are the debris retention during preparation. If using file repeatedly from time to time the efficiency will decrease and will cause excess friction pressure and then fracture the file. Therefore the pressure during instrumentation is done periodically, flutes are cleaned from debris, and file must be replaced after several uses.

Bypass is performed after consideration of the position of fractured file, which is on the apical third of the narrow root canal, small size and shortness of fractured file, and good visualization that
can not be obtained. James L. Gutmann stated that if there is a fractured instrument that is in the apical of curvature and is in the site that is difficult to do the access such as in the apical third, the fractured file can always be left in the root canal. The effort of removing the fractured file in this position will increase the risk of iatrogenic error and excess removal of dentin tissue so the tooth will prone to vertical fracture.\textsuperscript{3,31}

Bypass aims to obtaining access until reaching the apical end of root canal so great preparation and obturation can be obtained. Bypass technique is done based on the root canal anatomy factor which usually is not perfectly round shaped so there is a probability to insert the small size between the fractured file and root canal wall.\textsuperscript{12}

Bypass procedure of the fractured file starts with using small hand file. In this case, we used C+ hand file that is from stainless steel that has a cutting end and rigid because it has been through a particular hardening process so it will not be easily bent and has a strength to penetrate the hard part.\textsuperscript{3,34} 17\% EDTA irrigation fluid is used as a dentin softener to ease the procedure of root canal preparation and will effectively remove the smear layer when directly in contact with root canal for less than 1 minute.\textsuperscript{46} In this condition, usually excellent instrumentation in the root canal can be done after bypassing the fractured instrument successfully has been carried out.

NaOCl irrigation has been used because it is a gold standard of irrigation material because of broad spectrum of antimicrobial against the microorganisms and biofilm including the microbes that are difficult to be destroyed in the root canal such as Enterococcus, Actinomyces, and fungi.\textsuperscript{15}

Calcium Hydroxide medicament is biocompatible and is an antimicrobial material with high pH effect. The mechanism of Ca(OH)\textsubscript{2} comes from its ability to dissociated to become a calcium ion and hydroxyl ion that will increase the local pH. This will cause the creation of alkali environment that will not promote the growth of bacteria. Ca(OH)\textsubscript{2} will hydrolyze the lipid part of LPS negative gram bacteria that will eliminate LPS ability to produce TNF-\alpha in the monosit peripheral blood so it will decrease the local inflammation respond and stimulate the periapical hard tissue healing. Ch\&M medicament is used because it has antimicrobial effect that is long lasting and also used as a light sedative.\textsuperscript{15}

Fractured file is not a direct cause of decreasing endodontic treatment prognosis, however it is a microbial control that is not sufficient from cleaning and shaping process that is not perfect that will increase the failure of endodontic treatment.\textsuperscript{12} Hence the bypass technique will give good prognosis because the cleaning, shaping and obturation of root canal can be reached until working length.
The prevention of fractured file that must be done are excellent preparation access so the file can be inserted to the root canal and will decrease the stress and probability of fractured file. Always irrigate and use the lubricant to decrease the friction and excess stress, also promote the instrumentation efficacy. Replace the old file with the new file if it shows damage such as flaws where there is a shiny area or unwinding at the flutes, file has been bent or wavy, the file has been overbending or excess precuring, and corrosion. Operator must notice the anatomy and curved root canal radius, rotation speed, and inappropriate torque use, and whether or not there is a glide path in the root canal.

Cold lateral condensation technique is used on the obturation of oval shaped root canal so hermetically obturation of root canal will be obtained. MTA Fillapex sealer is a biocompatible sealer, has a great flow, and has setting expansion so it will give a root canal closure and prevent the entry of the tissue and recurrence of bacteria contamination.

CONCLUSION

In this case report, the bypassing fractured file has been done in the distolingual root canal of right first molar. Bypass technique can be performed without direct visibility of fractured file so it can be a great choice if the location of the fractured instrument is in the apical third of the root canal. Bypass technique is done to prevent iatrogenic mistake such as ledge formation or when the fractured file is pushed toward the apical direction when attempted to remove the fractured file. Root canal treatment can be finished greatly as long as the working length after the bypass and subjective and objective examination has shown the good result. The treatment can be completed using onlay ceramage restoration.

REFERENCES


