Wojciech Eliasz, Marta Mrall-Wechta, Anna Surdacka

Methods of removing fractured instruments from root canals — brief case reports and review of literature

Metody usuwania złamanych narzędzi z kanałów korzeniowych — opis przypadków i przegląd piśmiennictwa

[1] Department of Conservative Dentistry and Endodontics, Poznan University of Medical Sciences, Poland

DOI: http://dx.doi.org/10.20883/df.2019.11

ABSTRACT

Endodontic instrument fracture constitutes one of the complications of endodontic treatment, as their removal is difficult and time-consuming, and requires the use of specialist armamentarium. Even though its incidence does not seem high, it still poses a significant risk and is related with much worse prognosis in cases in which apical pathology is present The presence of the instrument itself does not lead a failure in treatment in each cases, but if the fragment blocks proper chemomechanical preparation of the canal, the microbiological aim of the treatment cannot be achieved, and complications may ensue. A variety of methods have been described for removing the fractured fragments, such as ultrasonic devices, tube-shaped devices, or lasers. If none of the approaches is feasible, the clinician may decide to perform endodontic surgery, e.g. apicoectomy or root amputation, or choose a watchful waiting approach. The following paper discusses a few clinical cases in which different therapeutic methods, which seemed most appropriate in a given clinical situation, were used.

Keywords: endodontics, root canal preparation — adverse effects, dental instruments.

STRESZCZENIE

Złamanie narzędzia stanowi jedno z istotnych powikłań w leczeniu endodontycznym, a usunięcie złamanego fragmentu zwykle nastręcza trudności i wymaga czasu oraz specjalistycznego instrumentarium. Mimo że do powikłania tego nie dochodzi często, wiąże się ono z większym ryzykiem niepowodzenia i gorszym rokowaniem, szczególnie w przypadkach zębów, przy których obserwuje się przewlekły stan zapalny w tkankach przyzębia okołowierzchołkowego. Sama obecność złamanego narzędzia nie świadczy bezwzględnie o niepowodzeniu leczenia, jednak, jeśli pęknięty fragment uniemożliwia chemomechaniczne opracowanie systemu kanałowego w odpowiedni sposób, cel terapii może nie zostać osiągnięty. W piśmiennictwie opisano różne sposoby usuwania złamanych instrumentów, za pomocą m. in. końcówek ultradźwiękowych, laserowych czy z zastosowaniem igieł. Jeśli żadna z metod nie powiedzie się, lekarz wykonujący zabieg może wykonać zabieg chirurgiczny (resekcję wierzchołka korzenia, radektomię) lub podjąć decyzję o obserwacji i okresowej kontroli. W pracy opisano dwa przypadki, w których wykorzystano różne metody usuwania złamanych narzędzi, oraz przegląd piśmiennictwa dotyczący tego powikłania.

Słowa kluczowe: endodoncja, opracowanie kanału korzeniowego — powikłania, narzędzia stomatologiczne.

Introduction

Endodontic instrument fracture constitutes one of the most common complications during endodontic treatment. According to retrospective studies based on radiographic analysis it has been estimated that instruments fracture in root canals in approximately 2% of all cases [1]. Rotary instruments fracture more frequently than hand instruments. Instruments used for root canal preparation fracture or become deformed if they are used with force exceeding their stability which is lowest at their thin tip. The risk of fatigue fracture occurring due to constant rotary movement of the instrument is particularly high in curved canals [2]. Removing fractured instrument fragments is difficult and time-consuming; it also requires the use of specialist armamentarium. Instrument fracture is a failure in treatment not due to the presence of the instrument in the canal per se but because the fragment blocks proper chemomechanical

preparation of the canal. In such cases proper microbiological cleanliness of the root canal cannot be achieved [3].

Success in treatment in cases of attempted broken instrument fragment removal depends on the type of the instrument, its length, diameter, location, as well as the diameter, curvature of the canal and the degree to which the instrument is lodged within the root canal. The stage of preparation during which the fracture occurs is also important. According to research, success rate in cases of removing the instrument from a straight canal is much higher than from curved root canals (in cases in which the fractured fragment is located below the curvature) [4].

Various methods of removing foreign bodies left in root canals by dental professionals have been described. The following paper discusses a few clinical cases in which different therapeutic methods, which seemed most appropriate in a given clinical situation, were used [5].

Case 1

A 37-year-old male patient reported to the Department for comprehensive dental treatment including conservative, prosthodontic and surgical treatment. The patient was referred to a panoramic x-ray. The radiograph revealed underfilled root canals and a broken instrument fragment (**Figure 1**).

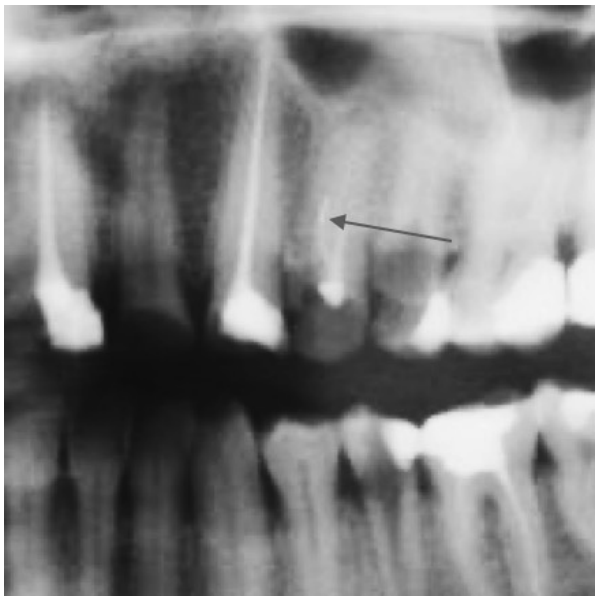

Figure 1. Preoperative radiograph of the tooth 24. Note underfilled canals and fractured instrument fragment in the canal (arrow)

Rycina 1. *Zdjęcie rtg zęba 24. Proszę zwrócić uwagę na niedopełnienie kanałów korzeniowych i złamane narzędzie (strzałka)*

The diagnosis was confirmed after taking a periapical radiograph. In the first stage obturating material was removed from the canal with the use of rotary instruments and gutta-percha solvent (Eukaliptol, Cerkamed). Root canals were thoroughly irrigated with 2% sodium hypochlorite. The fractured instrument fragment was visualised with the aid of dental operating microscope in the buccal canal. The fractured fragment was removed using the ultrasonic tool – Endo-chuck – with stainless steel K-file mounted on it. Endo-chuck was used to remove dentin surrounding the instrument, which led to the loosening of the fragment and its removal during copious 2% sodium hypochlorite irrigation. The canals were prepared to full working length (WL) and a control radiograph with instruments was taken. Calcium hydroxide dressing was put in the canals and the tooth was temporarily restored with glass-ionomer cement. The canals were obturated during the next appointment with gutta-percha points and AH-Plus sealer using lateral condensation technique (**Figure 2**).

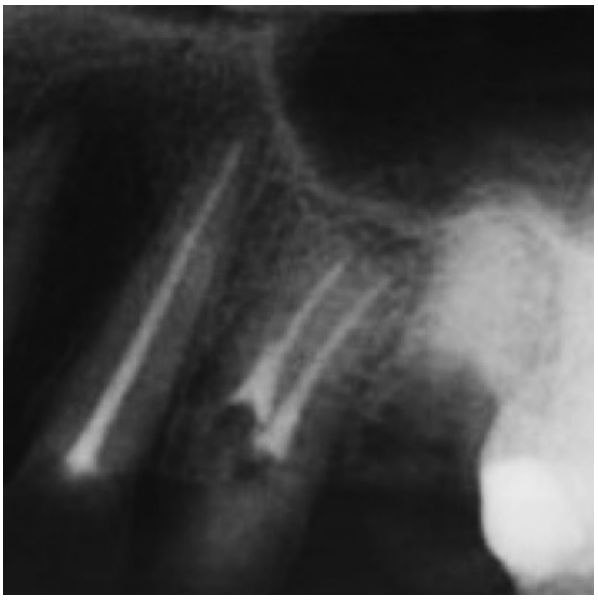

Figure 2. Post-operative radiograph of the tooth 24 taken after root canal obturation

Rycina 2. *Zdjęcie rtg zęba 24 po wypełnieniu kanałów korzeniowych*

Case 2

23-year-old male patient reported to continue endodontic treatment of the tooth 26 begun at another dental office and to have the fractured instrument removed. The instrument was located in the palatal root canal and had been left there during earlier endodontic treatment attempt. The radio-

graphs revealed that the fractured instrument was located approximately 3 mm from the radiographical apex of the palatal root canal (**Figure 3**). Attempts were made to remove the fractured instrument fragment. At the beginning the orifice of the root canal was widely prepared using Gates-Glidden burs #4 and #5. The fractured instrument fragment was then visualised under operating microscope. Dentin surrounding the fractured fragment was removed up to the depth of 2mm with the use of ultrasonic Endo-chuck tool with SS K-file mounted on it, thanks to which a slight mobility of the tool was achieved. During the procedure the canal was irrigated with 2% sodium hypochlorite. Injection needle (size 6) with aspirated dual cement (Elite Maxcem, Kerr) was then placed on the exposed end of the fractured instrument. After the cement had begun to set, the needle was carefully removed with the instrument in it. The removal of the instrument was confirmed with a control radiograph (**Figure 4**). Root canals were then finally prepared chemomechanically and obturated with gutta-percha and AH-Plus sealer using lateral condensation technique.

Figure 3. Preoperative radiograph of the tooth 16 — fractured instrument fragment visible in the palatal root

Rycina 3. *Zdjęcie rtg zęba 16 — fragment złamanego narzędzia widoczny w kanale podniebiennym*

Figure 4. Radiograph of the tooth 16 after successful removal of the fractured instrument fragment from the palatal root canal

Rycina 4. *Zdjęcie rtg zęba 16 po usunięciu fragmentu złamanego instrumentu z kanału podniebiennego*

Discussion

Endodontic instrument separation remains an important issue in daily clinical practice. Even though its incidence does not seem high, it still poses a significant risk and is related with much worse prognosis in cases in which apical pathology is present [4]. Also, the treatment is then much more time- and cost-consuming for the patient. Even though several approaches to this clinical issue have been proposed in literature, there are, basically, three ways of managing the problem: (1) removal of the separated fragment during orthograde endodontic treatment, (2) leaving the separated fragment in place and "entombing" it, and (3) removal of the separated fragment with the use of endodontic surgery [6]. Each technique has its advantages and disadvantages, and the degree to which it is feasible and reasonable depends on the variety of factors such as preoperative status, root canal anatomy, and the location of the tooth being treated.

A variety of methods have been described for removing the fractured fragments, such as ultrasonic devices, tube-shaped devices, or lasers [7]. Success rate in the use of each techniques depends primarily on the possibility of achieving appropriate straight-line access to the fragment of the root canal in which the fragment is located. That is why each of the techniques, independent of the tools used, is related with removing radicular dentin. Depending on the amount of tooth structure that needs to be removed, the tooth may become structurally less stable and research studies seem to indicate that teeth in which a lot of dentin is removed, are more prone to root fracture [8]. Such fractures, if located below the level

of the bone, result in the tooth becoming non-restorable. Therefore, several criteria have to be met before the clinician undertakes the trial to remove an instrument: 1) the procedure has to be performed in magnification, and 2) the clinician needs to use instruments in such matter that they cut dentin peripherally to the location of furcation, or cut dentin in such area in which dentin thickness is the highest. In order to be successful at achieving this aim, 3D radiographic assessment may be of highest importance [9]. The second way of manging the problem is "entombing" the instrument within the root canal. Another widely accepted technique is to by-pass the instrument with a precurved small instrument (e.g. size 6, 8, or 10 SS K-file, C-pilots, D-finders) in order to regain patency. After patency is achieved and working length is established, preparation of the root canal space is achieved. In such cases copious irrigation is mandatory. There is no agreement regarding the method of root canal preparation (hand of engine-driven) but hand instrumentation provides the highest degree of control over the instrument and the process. If, however, one decides to use engine-driven files, those of max. 4% taper should be used. Success in this approach is based on the belief that there is no possibility for bacteria to gain access to nutrients if the root canal space is appropriately sealed [4].

Eventually, if none of the previous approaches is possible, the clinician may decide to perform endodontic surgery, e.g. apicoectomy or root amputation [10]. However, this approach is the most invasive one of all the previously mentioned. It has regained some of its importance with the advent of wider availability of magnifying devices, and bioceramic materials. Even tough long-term stability seems not to be influenced by the loss of even large apical fragments of the root, the use of such approach may not be feasible in all cases due to anatomical factors such as e.g. proximity to important anatomical structures – maxillary sinus (in maxillary molars), inferior alveolar nerve (in mandibular molars), mental nerve (in mandibular premolars), nasal cavity (upper anterior teeth). Also, this technique requires high degree of manual dexterity and is the most traumatic [11, 12].

Conclusions

In conclusion, success in removing fractured instruments from root canals depends on numerous factors. There are several methods of removing fractured instruments left in the canal and choice should be appropriate for a given clinical situation. The basic aim is the removal of the instrument from the canal and chemomechanical preparation of the root canal to full working length. There are, however, some situations in which attempting to remove fractured instrument fragment may even lead to the necessity of extraction. In such cases the possibility of leaving the fractured instrument fragment in canal should be considered, and the risk-cost ratio should be assessed carefully. The patient should then be fully informed and advised to check the state of the tooth radiographically periodically in the long term.

Oświadczenia

Oświadczenie dotyczące konfliktu interesów
Autorzy deklarują brak konfliktu interesów w autorstwie oraz publikacji pracy.

Źródła finansowania
Autorzy deklarują brak źródeł finansowania.

Piśmiennictwo

[1] Iqbal MK, Kohli MR, Kim JS. A Retrospective Clinical Study of Incidence of Root Canal Instrument Separation in an Endodontics Graduate Program: A PennEndo Database Study. J Endod. 2006;32(11): 1048–52.
[2] Alfouzan K, Jamleh A. Fracture of nickel titanium rotary instrument during root canal treatment and retreatment: a 5-year retrospective study. Int Endod J. 51(2):157–63.
[3] Hülsmann M. Prevention and management of problems during root canal treatment – A problem-based approach to root canal treatment . Part II. ENDO (Lond Engl) 2016;10(3):141–51.
[4] Mcguigan MB, Louca C, Duncan HF. The impact of fractured endodontic instruments on treatment outcome. Br Dent J. 2013;214(6):285–9.
[5] Solomonov M, Webber M, Keinan D. Fractured Endodontic Instrument: A Clinical Dilemma Retrieve, Bypass or Entomb? J Mich Dent Assoc. 2015;97(9):44–6.
[6] McGuigan MB, Louca C, Duncan HF. Clinical decision-making after endodontic instrument fracture. Br Dent J. 2013;214(8):395–400.
[7] Spili P Messer HH PP. The impact of instrument fracture on outcome of endodontic treatment. J Endod. 2005;31(12):845–50.
[8] Madarati AA, Hunter MJ, Dummer PMH. Management of Intracanal Separated Instruments. J Endod. 2018 Mar 3;39(5):569–81.
[9] Yang Q, Cheung GS-P, Shen Y, Huang D, Zhou X, Gao Y. The remaining dentin thickness investigation of the attempt to remove broken instrument from mesiobuccal canals of maxillary first molars with virtual simulation technique. BMC Oral Health. 2015;15(1):87.
[10] Patel S, Dawood A, Pitt Ford T, Whaites E. The potential applications of cone beam computed tomogra-

phy in the management of endodontic problems. Int Endod J. 2007;40(10):818–30.
[11] Sukegawa S, Kanno T, Shibata A, Matsumoto K, Sukegawa-Takahashi Y, Sakaida K, et al. Use of an intraoperative navigation system for retrieving a broken dental instrument in the mandible: a case report. J Med Case Rep. 2017;11(1):14.
[12] von Arx T, Roux E, Bürgin W. Treatment Decisions in 330 Cases Referred for Apical Surgery. J Endod. 2018 Mar 3;40(2):187–91.

Zaakceptowano do edycji: 2019-11-16
Zaakceptowano do publikacji: 2019-12-12

Adres do korespondencji:
Wojciech Eliasz,
Department of Conservative Dentistry and Endodontics
Poznan University of Medical Sciences
70 Bukowska Street, 60-812 Poznań, Poland
Phone: +48 618547027
e-mail: wojciecheliasz@gmail.com