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CASE REPORT

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Removal of a fractured endodontic instrument from primary molar root canal: a case report

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ABSTRACT

The pediatric dentist may encounter the fracture of an endodontic instrument during pulp treatment. In such cases, removal of the object is necessary, as it may lead to abscess formation, root resorption, and tooth mobility, which could ultimately affect the permanent tooth. The technique used to remove the instrument will depend on its location. This case presents a 4-year and 11-month-old girl who, upon clinical examination, reported pain on vertical percussion. The radiographic evaluation revealed the presence of a radiopaque image in the mesiobuccal root of tooth 54, consistent with the fracture of an endodontic instrument. This fragment, approximately 7 mm in length, extends from the cervical third to the apical region. The final diagnosis was symptomatic apical periodontitis in tooth 54, associated with a previous root canal treatment and a fractured instrument in the mesiobuccal canal. The fractured instrument was successfully removed with favorable results. During the six-month follow-up, a reduction in the widening of the periodontal ligament space in the mesial root was observed, along with the absence of interradicular radiolucency.

Keywords: primary tooth; pediatric dentistry; pulpectomy; case report.

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INTRODUCTION

The literature reports a high number of root canal treatments performed in dental practice (6 to 10 per month) (1). Additionally, there is a large population of children requiring this intervention, making it the second most commonly performed pulp treatment. Specifically, its incidence is higher among children aged 3 to 5 years and in females, with the maxillary first molar being the most frequently affected (2). Pulpectomy is a treatment that removes organic pulpal tissue, remnants of infected pulp, and bacteria from the root canal system. This procedure can be performed using mechanical endodontic instruments in combination with irrigation of the canal system with a disinfecting solution. However, 94.8% of general dentists encounter complications during root canal treatments, the most common being instrument fracture, damage to the root canal wall, and overfilling. Fracture of the endodontic instrument may occur during canal exploration or shaping (1). Clinical reports indicate that this complication occurs with a frequency ranging from 1.83% to 8.2% (3).

If a fractured endodontic instrument in a primary tooth is not removed, it may lead to dental abscesses, pathological root resorption, and premature tooth mobility, ultimately affecting eruption of permanent teeth. This is a serious complication that can hinder canal preparation and obturation, resulting in treatment failure (4). Moreover, several factors influence the removal of a fractured instrument, including the child's age, the presence of clinical signs and symptoms, and the degree of root resorption (5). In this context, stainless-steel hand endodontic instruments have a reported fracture rate ranging from 0.2% to 10%, in contrast to nickel-titanium rotary instruments, which range from 0.4% to 3.7% in permanent teeth (6). Thus, the dentist's experience, instrument use, their design and manufacturing type, sterilization, root canal anatomy, and the tooth's location are key factors contributing to instrument fracture (7).

The use of a lentulo spiral with a micromotor facilitates the placement of obturation paste within the root canal in primary dentition (8). This stainless-steel instrument has a conical shape with spirals that enhance the homogeneous distribution of the material and eliminate potential air bubbles. However, improper handling may cause fracture, with a 93% success rate reported for its removal (9). Various methods have been described for the removal of fractured instruments (10), and the choice of technique depends on fragment visibility (9).

The use of ultrasound is one of the methods employed for the retrieval of fractured instruments (11). Reports have described its application in combined techniques with favorable outcomes (12). This technique prevents excessive dentin removal, making it a safe and conservative method (13). The location and size of the fractured endodontic instrument play a crucial role, as instruments located at the apical level pose a higher risk of perforation during retrieval attempts, whereas smaller fragments increase the level of difficulty (14).

In the reviewed case reports, most pediatric patients reported moderate pain following instrument fracture, with a high success rate recorded when the fracture occurred at the cervical level (5). Therefore, each case should be carefully assessed by the pediatric dentist (15).

This case reports presents an alternative approach for the removal of a fractured instrument from the root canal of a primary molar.

CASE PRESENTATION

A 4-year-11-month-old female pediatric patient presented to the Pediatric Dentistry Clinic of Universidad Privada San Juan Bautista (Lima, Peru) for urgent dental care, accompanied by her mother. The mother reported that the child had been undergoing root canal treatment when, during the final stage of obturation, she made an unexpected movement, resulting in instrument fracture. During the dental clinical examination, the child showed a positive behavior according to the Frankl Behavior Rating Scale (16). The right maxillary primary first molar showed a temporary restoration (Figure 1A) and was tender to vertical percussion. Radiographically, tooth #54 revealed a coronal radiopaque image consistent with a restoration. Additionally, a radiopaque intraradicular image was identified in the distobuccal canal, consistent with obturation material. In the mesiobuccal canal, a radiopaque image compatible with a fractured lentulo spiral approximately 7 mm length, apparently extending beyond the apex.

Widening of the periodontal ligament space was observed on the distal surface of the mesiobuccal root. At the interradicular level, a radiolucent image (RLI) with loss of the lamina dura was identified, along with root resorption in the apical third of the tooth (Figure 1B). The pulpal diagnosis was previous root canal treatment, while the periapical diagnosis corresponded to symptomatic apical periodontitis of the right maxillary primary first molar, with a fractured instrument in the mesiobuccal canal. Retrieval of the fractured endodontic instrument followed by root canal retreatment was indicated.

At the second appointment, after obtaining written informed consent from the patient's mother, removal of the fractured instrument was performed. Local anesthesia was administered using Newcaina® 2%, and rubber dam isolation of the tooth was achieved. Subsequently, the temporary obturation material was completely removed to expose the fractured instrument.

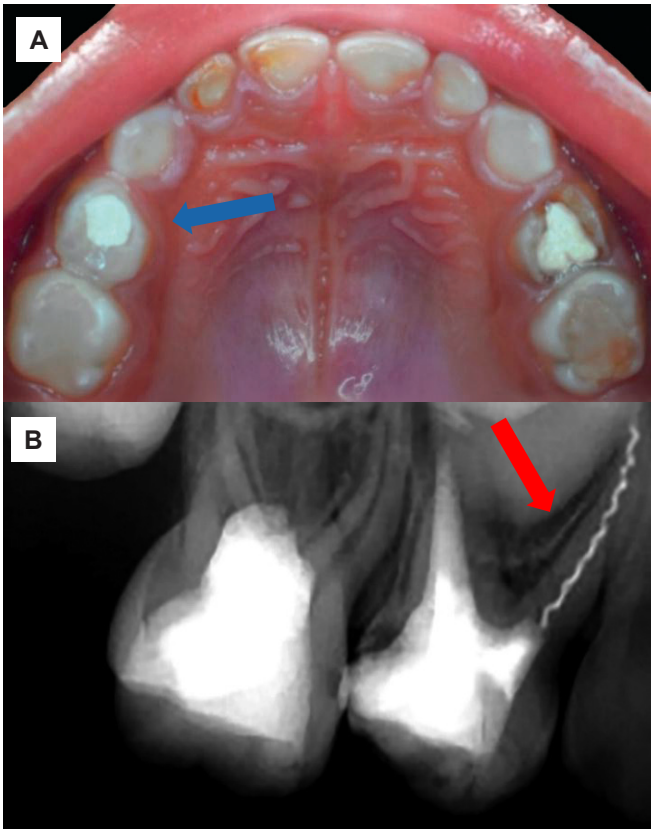

Figure 1. Clinical and radiographic examination of tooth #54. A) Occlusal view of the maxillary arch showing tooth #54 with a temporary restoration. B) Periapical radiograph of tooth #54 showing a radiopaque image projected within the mesiobuccal root canal, consistent with a fractured endodontic instrument.

Retrieval was performed with an ultrasonic dental device (UDS-E LED, Woodpecker®, Guilin, Guangxi, China), using a P3 ultrasonic tip applied to the canal walls and operated in a counterclockwise direction, at power level 2 (approximately 20% of the maximum output) (Figure 2A). The ultrasonic device was used intermittently, with the application of ethylenediaminetetraacetic acid (EDTA) to facilitate fragment loosening.

Once the lentulo spiral became visible, it was disengaged with a Maillefer curette No. 45–46 (Figure 2B) and then completely removed using curved mosquito forceps (Figure 2C). The canal was irrigated with 2% chlorhexidine, dried, and filled with a sterile cotton pellet, followed by temporary obturation. A postoperative radiograph was then taken to evaluate the canal after lentulo removal, revealing a mesiobuccal root canal free of fractured instrument remnants, as well as a radiopaque image in the distobuccal root canal consistent with obturation material.

At the interradicular level, a radiolucent image compatible with loss of the lamina dura and widening of the periodontal ligament space on the distal surface of the mesiobuccal root was observed (Figure 2D).

At the third appointment, pulpectomy was completed, and the empty canal was obturated with a white CTZ paste (chloramphenicol, tetracycline, and zinc oxide in a 1:1:6 ratio) of fluid consistency (Figure 3A). Final restoration of the tooth was performed using a direct resin inlay (Figures 3B, 3C, 3D, 3E).

A week later, at the follow-up appointment, the patient exhibited no pain to vertical percussion during the clinical examination. Likewise, grade 1 tooth mobility was observed, determined by applying pressure in a buccopalatal direction using two metallic instruments. Radiographically, an intraradicular radiopaque image consistent with root canal obturation was observed, as well as an interradicular radiolucent image with loss of the lamina dura and widening of the periodontal ligament space on the distal surface of the mesiobuccal root (Figure 4A).

Three months later, the patient presented the same clinical and radiographic characteristics (Figure 4B). At six months, the patient reported no discomfort, pain, or tooth mobility, and no clinical signs of odontogenic infection were observed. Radiographically, a reduction in the widening of the periodontal ligament space on the distal surface of the mesiobuccal root was noted, along with the absence of an interradicular radiolucent image, indicating repair of the lamina dura (Figure 4C).

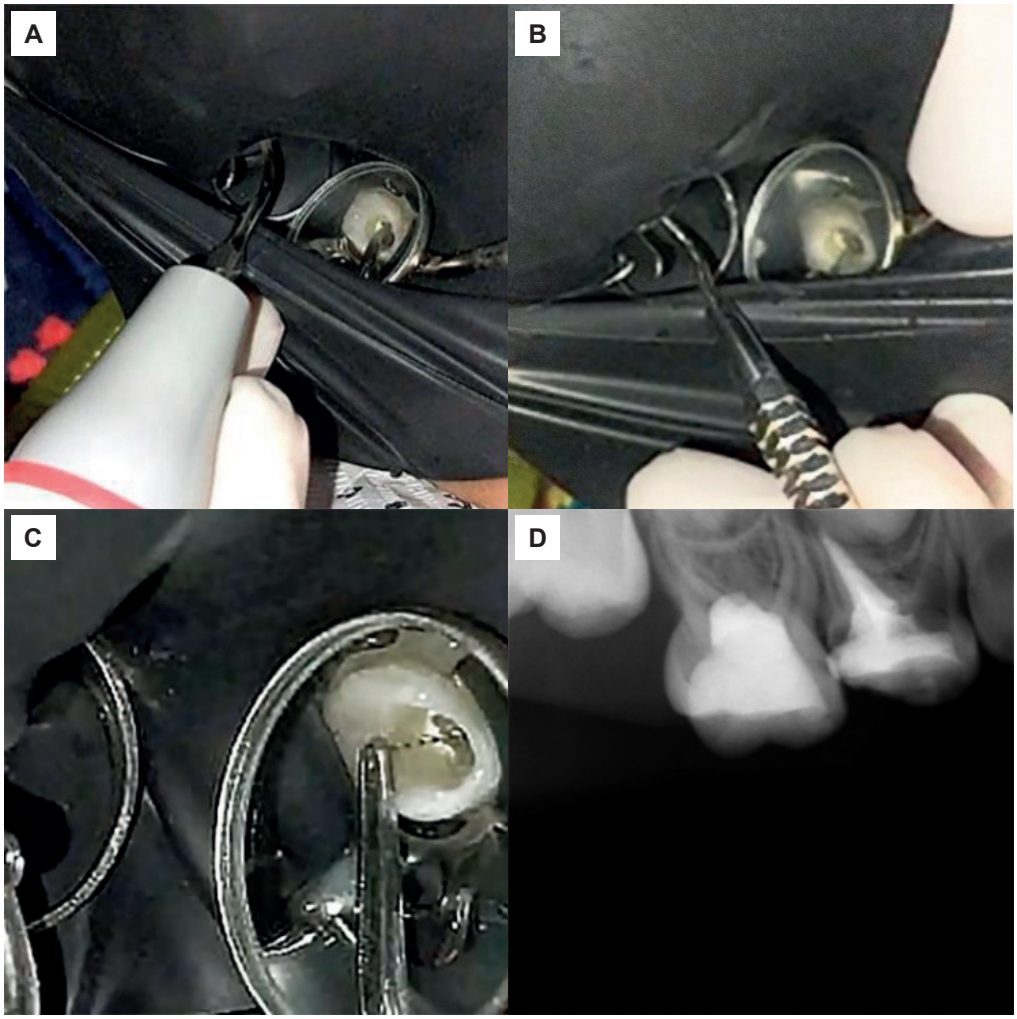

Figure 2. Removal of the fractured instrument A) Use of the USD-E LED ultrasonic device with a P3 ultrasonic tip. B) Use of a Maillefer curette No. 45-46. C) Removal of the lentulo spiral with curved mosquito forceps. D) Radiograph showing the extraction of the fractured instrument.

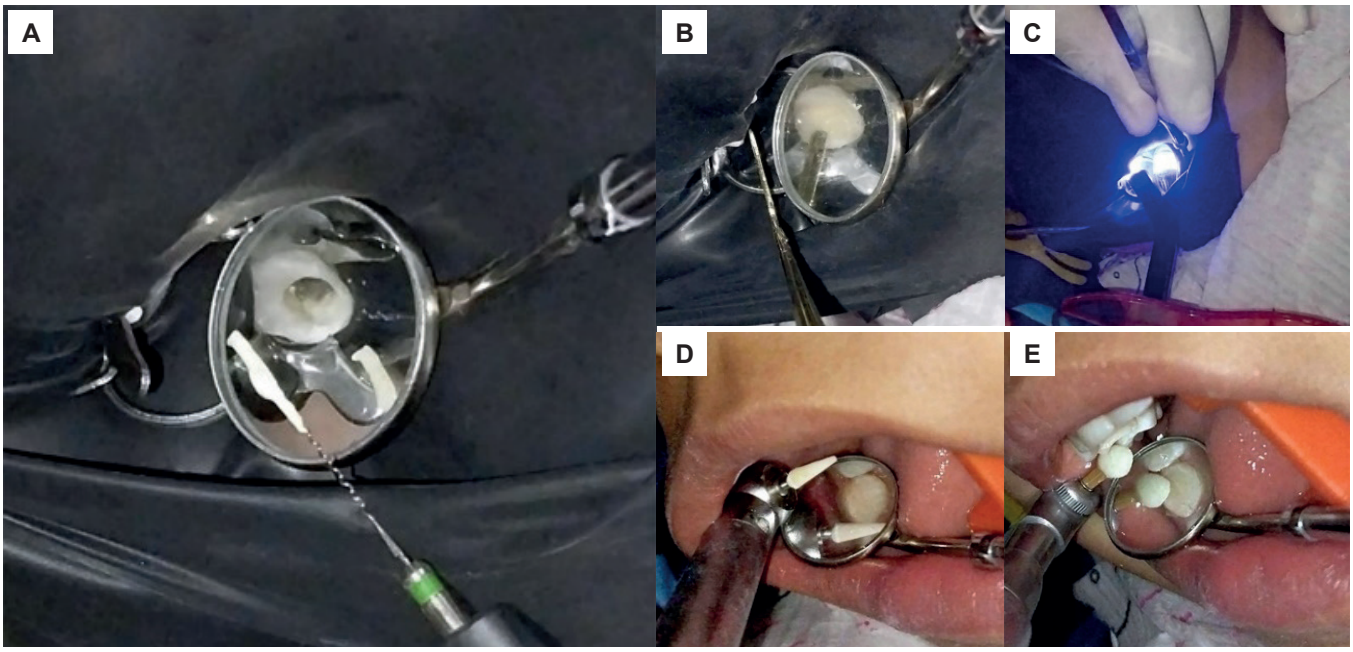

Figure 3. Root canal obturation and definitive restoration of tooth #54. A) Obturation with white CTZ medicated paste (chloramphenicol, tetracycline, and zinc oxide in a 1:1:6 ratio). B) Direct resin inlay. C) Light curing for 20 seconds. D) Finishing of the inlay with Arkansas stones. E) Polishing with composite polishing rubbers (Enhance®, Dentsply Sirona).

Figure 4. Radiographic follow-up after instrument removal**.** A and B) At one week and three months: interradicular radiolucent area with loss of the lamina dura. Widening of the periodontal ligament space on the distal surface of the mesiobuccal root. C) At six months: reduction in the widening of the periodontal ligament space on the distal surface of the mesiobuccal root, with absence of interradicular radiolucency.

DISCUSSION

Although technical information regarding the removal of fractured instruments in primary teeth is limited, the few reported cases have shown promising outcomes. Complications may arise during pulpectomy, the most common being the fracture of an endodontic instrument within the root canal, which constitutes a frequent reason for dental care. According to Avoaka-Boni et al. (1), a fractured endodontic instrument extending beyond the apex may become embedded in the bone and act as a foreign body, triggering infectious processes and adversely affecting the eruption of the permanent successor (4).

In this case, due to the lentulo fracture and its extension 2 mm beyond the apex, removal was deemed necessary to prevent complications such as a severe infection that could compromise the permanent tooth. Primary teeth play a key role in maintaining space for permanent teeth, preventing deleterious tongue habits, supporting speech development, and preserving dental esthetics (5). Accordingly, the decision was made to preserve the primary molar in its functional state, thereby promoting the patient's oral health and development. The decision to remove a fractured endodontic instrument depends on radiographic analysis, its location, and its length (7). It has been reported that the removal of a fractured instrument located in the cervical third has a higher success rate compared with those positioned in the middle or apical thirds (15). In this case, the radiographic examination revealed that the fragment extended from the cervical third to 2 mm beyond the root canal, which was considered a favorable position for its removal.

A study comparing three different root canal obturation techniques in primary teeth found that the use of a motor-driven lentulo spiral, although common, was less effective in terms of obturation length and density. However, careful handling of this instrument can reduce the risk of fracture (8). In the present clinical case, the fracture of the lentulo spiral occurred within the mesiobuccal canal of a maxillary primary first molar. Since no similar reports were found, the scarce available literature was consulted. It is emphasized that when an endodontic instrument fractures in a primary tooth, prompt management is essential to preserve the tooth until its natural exfoliation.

Various methods and devices can be used for the removal of fractured endodontic instruments (7), with ultrasonics being one of the techniques showing the most favorable outcomes (12). This method has been reported to have a high success rate due to its safety and conservative nature (13). One of the most widely used combined strategies is the Terauchi File Retrieval Kit (TFRK), which includes an ultrasonic tip and a loop device that facilitate the removal of the instrument without excessively compromising the root canal structure (17).

In the present clinical case, the fractured instrument was removed with a combined technique—using ultrasonics, a double-ended Maillefer dentin curette, and a curved mosquito forceps—helped minimize unnecessary dentin removal and reduce the risk of root perforation. As a result, the treatment achieved a successful outcome, ensuring the functionality and preservation of the primary tooth.

CONCLUSIONS

The risk of fracture of an endodontic instrument is always present during the biomechanical preparation of the root canal; however, this type of complication is uncommon in primary teeth. If it occurs, fragment retrieval should be considered, as retained fragments may act as a foreign body, hindering proper biomechanical preparation and subsequent canal obturation. Its persistence could lead to abscess formation, root

resorption, and tooth mobility, eventually resulting in treatment failure. Furthermore, this complication could negatively affect the development and eruption of the permanent tooth germ.

When the fracture of the endodontic instrument occurs in the cervical third, it is advisable to attempt its removal, since the success rate is higher in this area and the risk of root perforation is lower. In pediatric dentistry, the choice of technique for removing a fractured instrument from the root canal depends on the clinical signs and symptoms, the location of the fractured instrument, the degree of root resorption, the child's age, and behavior.

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FMSS: conceptualization, research, visualization, writing – original draft, writing – review & editing.
MEDP: conceptualization, research, visualization, methodology, supervision, writing – original draft, writing – review & editing.
GTR: conceptualization, visualization, methodology, supervision, writing – original draft

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