

# Clinical management of endodontic instrument fracture: report of two clinical cases

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## ABSTRACT

**Introduction:** The fracture of an endodontic instrument represents a serious risk to the continuity of the endodontic treatment. Several factors contribute to the occurrence of fractures such as erroneous cinematic, exaggerated pressure and torsion movement, repetitive use of endodontic instruments, metal fatigue, and lack of knowledge about the anatomy of the root canal system. When an instrument fracture happens, there are the options of maintaining the fragment within the canal, or removing it via canal, or through periapical surgery. **Objective:** The aim of this study was to report two clinical cases of fractures of Lentulo spirals. Due to the peculiarities of each situation, the cases were approached with two different clinical conducts.

**Case reports:** Case 01 – due to anatomical favorable characteristic and to the impossibility of removing the separated fragment, it was decided to proceed to the obturation maintaining the fractured instrument within the canal. Case 02 – the separated instrument was removed via canal using a hypodermic needle associated with a manual file. **Conclusion:** Considering the exposed, clinical experience and hand ability must be associated with knowledge about anatomy and instrument features, to avoid accidents such as fractures. Following the indications of use of each instrument minimize the risk of intercurrents, and reduces the chances of complications.

**Keywords:** Endodontics. Dental instruments. Fractures, stress. Root canal preparation.

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## Introduction

The fracture of instruments is still one of the most common accidents during the endodontic treatment. Several factors contribute to the occurrence of fractures such as the design and dimension of instruments, the root canal anatomy, and the number of sterilization cycles to which the instrument was exposed. Other contributor factors are instrument deformations, erroneous cinematic, presence of tension points on the instruments, and lack of professional experience.<sup>1-3</sup>

The fracture of an instrument might occur regardless of previous signs of deformation such as in cases of fracture induced by torsion, or in those induced by cyclic fatigue.<sup>4</sup> Torsion fractures happens when the tip or any part of an instrument gets stuck into the root canal walls while the instrument axis remains rotating. On the other hand, the cyclic fatigue fracture takes place when an instrument is rotated within a curved canal, which results in alternated tension-compression. Repetitive tensions produce microstructural cumulative changings on the instrument, causing cracks that increase in number until the instrument fractures due to cyclic fatigue.<sup>5</sup>

When a fracture happens, it might not directly interfere in the prognosis of the endodontic treatment, since the separated fragment is not the cause of infection.<sup>6-8</sup> However, a fragment stuck within the canal hinders the chemical-mechanical instrumentation, and interfere in the filling procedures. These two aspects directly affect the prognosis, which is influenced by the phase in which the fracture happened, and by the condition of the periapical tissues previously to the therapy. Thus, the shaping of the canal obtained by the mechanical instrumentation, as well as the disinfection performed before the fracture of an instrument dictate the prognosis.<sup>7-12</sup> When small fragments get stuck in the apical third of the teeth, or when part of these fragments extrude from the apex foramen, its surgical removal is advised.<sup>13</sup>

Even with the technological advance of the operator microscopy, and the use of ultrasonic devices to, respectively, see and remove the separated instrument from the canal, the process of removing a fragment might not be easily successful. The removal is even harder when the fracture happens at the dilacerations of the canals.<sup>14</sup> The efforts to solve the

problem of instrument fractures must consider each treatment option with critical knowledge, highlighting the risks of removing the separated fragment.<sup>2</sup>

The removal of a fractured instrument requires deep evaluation of each case.<sup>9</sup> If it is decided to remove the fragment, then possible outcomes such as deviance of the original trajectory of the canal or perforations must be pointed out.<sup>15</sup> The real challenge is to remove the fragment using minimally invasive approaches.<sup>9</sup>

In some cases, the instrument can be bypassed, which allows effective cleaning and obturation of the root canals. When the removal of the instrument is mandatory, the clinician can already count on the methods available, such as the Masserann-Kit,<sup>16</sup> the Canal Finder System,<sup>13</sup> the braiding technique,<sup>17</sup> and the ultrasonic technique.<sup>18</sup>

Given the exposed, this study aims to report two clinical cases of fracture of Lentulo spirals within the canals. Along with the case report this study will also present a discussion about the options available to remove fractured instruments from the root canal. Due to the peculiarities of each accident, different clinical conducts were adopted for the treatment of each patient.

## Case report 1

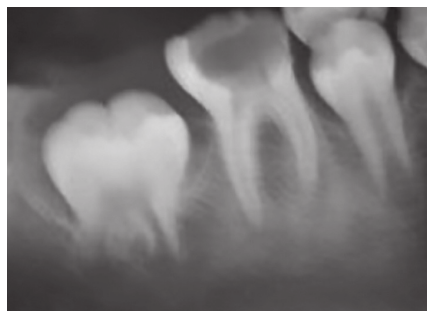
A 10-year-old healthy girl patient sought the endodontic clinic together with her mother to undergo a clinical evaluation. During the clinical assessment, it was observed heavy amount of plaque, and the radiographic examination revealed several teeth with caries lesions. One of these tooth (#46) presented wide coronary destruction and a deep lesion affecting the pulp (Fig 1). Pain was not reported. A treatment plan was elaborated, and the following procedures were sequentially organized to be performed: restoration of the teeth with caries lesions, oral hygiene instruction, endodontic treatment, and prosthetic rehabilitation of tooth #46.

On the first clinical session of the endodontic treatment, four root canals underwent chemical-mechanical preparation. In the sequence, it was decided to fill the canals with calcium hydroxide paste using a Lentulo spiral (Dentsply-Maillefer, Ballaigues, Switzerland). However, the clinician was not aware of the rotation direction of the instrument, and used the motor in an anti-clockwise direction.

Consequently, the Lentulo spiral touched the root canal walls and got stuck onto the dentin, which caused the instrument fracture within the disto-lingual canal (Fig 2).

Several attempts of removing the fragment by traction were performed using Hedstroem instruments (Dentsply-Maillefer). Due to the level of

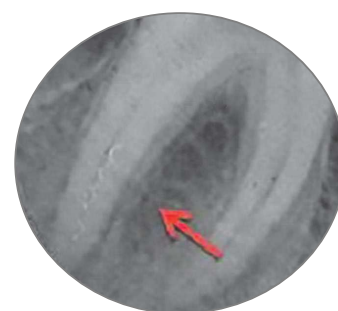
difficulty for the removal of the fragment, it was decided to leave it within the canal, since it was possible to bypass it, and complete the instrumentation until the apex foramen. Then, the obturation of the root canals was performed using the hybrid Tagger's technique (Fig 3) achieving the control of the apical foramen sealing.



**Figure 1.** Initial radiography of tooth #46 exhibiting wide coronary destruction and caries lesion with endodontic involvement.



**Figure 2.** Radiographic examination of tooth #46 showing the fragment of the fractured Lentulo spiral ( $\approx 3\text{mm}$ ).



**Figure 3.** Radiographic examination sequence showing the steps of the endodontic treatment and the final aspect of the therapy.

## Case report 2

An 18-year-old healthy women patient sought the endodontic clinic complaining about toothache. The clinical and radiographic examinations revealed that tooth #22 was seriously compromised, and it was diagnosed as the pain causative factor (Fig 4). The access cavity was performed, the pulp tissue was removed, and the root canal underwent mechanical instrumentation. Then, it was decided to fill the root canal with calcium hydroxide using a Lentulo spiral. Similarly to the previously described case, the clinician was not aware of the rotation direction of the motor, which resulted in the fracture of the Lentulo spiral (Fig 5). Differently from Case 1, the separated fragment was 10 mm long, and was located from apex foramen to the cervical third of the tooth. Since the fragment was stuck within a tooth with a linear root canal, it was decided to attempt the removal. The attempt to remove the fractured instrument by traction was unsuccessful. Thus, it was adopted a method similar to what Masserann<sup>16</sup> described in 1971. To perform this method a hypodermic needle (25 x 0,70; BD do Brasil, Curitiba, Brazil) was used, and it was externally adapted to the fragment.

When the needle was adapted to the fragment, cyanoacrylate based adhesive (Super Bonder; Loctite do Brasil, São Paulo, Brazil) was used as a manner to fix the needle to the fragment. Due to the diameter of the fractured Lentulo spiral, a manual endodontic #20 K-file was also inserted into the canal locking the fragment to the inner wall of the needle. A clockwise

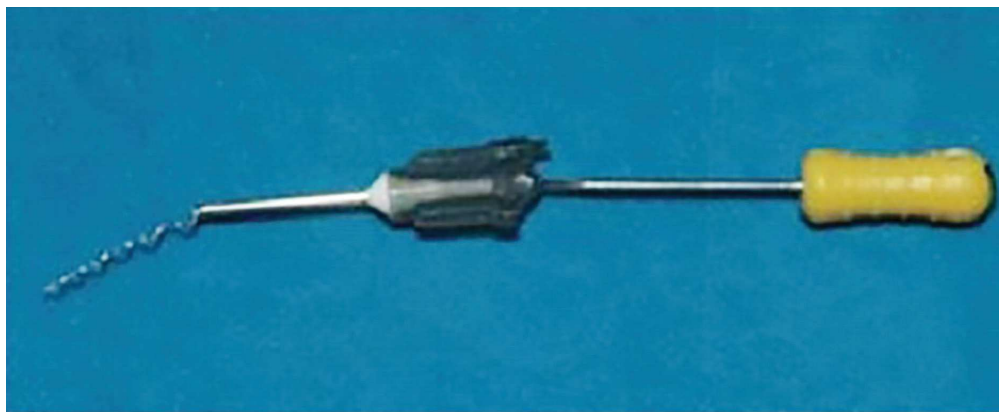


**Figure 4.** Initial radiographic examination of tooth #22.

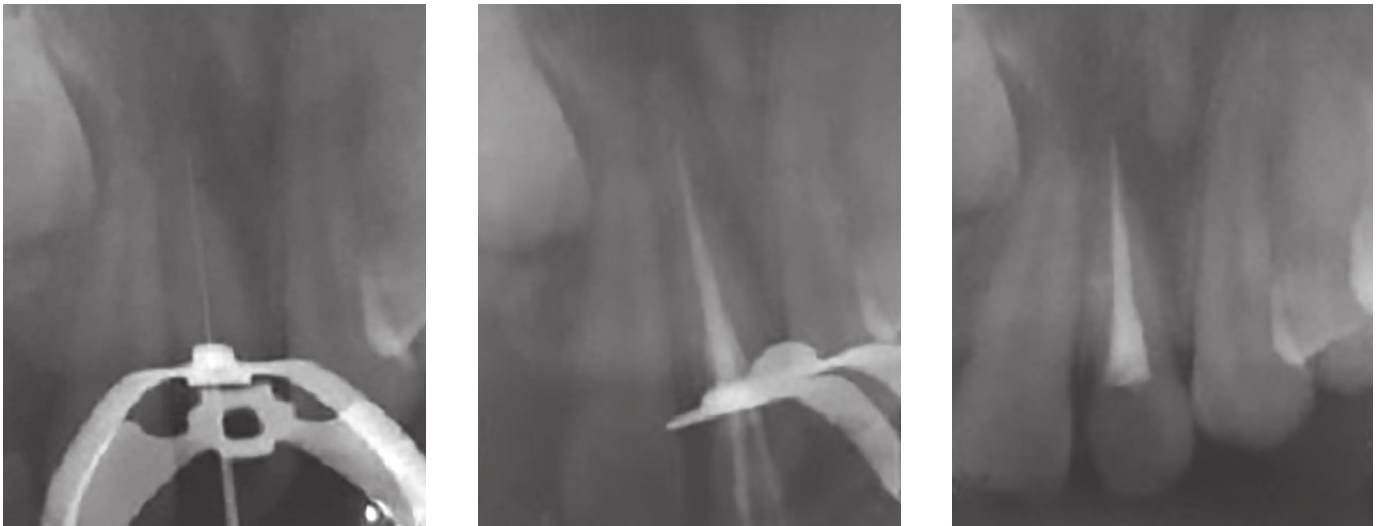
rotation was performed resulting in the complete removal of the fractured instrument (Fig 6). Finally, the obturation of the root canal was performed using the hybrid Tagger's technique (Fig 7).



**Figure 5.** Radiographic examination of tooth 22 exhibiting the fragment of the fractured Lentulo spiral.



**Figure 6.** The clinical aspect of the same fragment after its removal.



**Figure 7.** Radiographic examination sequence showing the steps of the endodontic treatment and the final aspect of the therapy.

## Discussion

The fracture of endodontic instruments is associated with the successful prognosis of the endodontic treatment in a long-term basis. This type of accident results from the erroneous or repetitive use of the instruments,<sup>19</sup> and can happen in any of the clinical steps of the endodontic therapy.<sup>20</sup>

The literature available does not point any standard technique for the successful removal of the fractured instruments. Although several methods and devices have been described, all of them exhibit a low success rate, which is dependent on a broad number of factors such as the length and localization of the fragment, the diameter and curvature of the root canal, and the way that the fragment is stuck onto the root canal walls, and the moment when it occurs. Because of that, the success rates have always to be balanced with the risk of potential complications.<sup>3,13,21,23</sup>

The recent technological advances make the use of microscopy and ultrasonic devices, the most indicated methods for the removal of fractured instruments from the root canals.<sup>3,22,24</sup> Cujé et al<sup>3</sup> suggests that the combination of excellent instruments with clinical experience increase the success rates regarding the removal of fractured instruments from the root canals. However, most of the advanced technologies are not available to the clinician at the moment of the accident.

Thus, in the event of an accident such as an instrument fracture, the clinician must know which options are available to solve the intercurrent, and proceed to a desirable end of the treatment. Besides, it is important to emphasize that the Lentulo spiral is made of stainless steel and presents a spring format, which indicates that it has to be used in clockwise rotation direction, which causes the expulsion of the instrument while it is being used to apply the intracanal medication. Following this recommendation ensures that the instrument will not get stuck onto the dentin, avoiding fractures.

The use of ultrasonic devices has been described by several investigations as an auxiliary technique to remove fractured instruments. Nevares et al<sup>12</sup> observed a global success rate of 70.5% when using the bypass technique to remove fractured instruments in 112 cases. When the fragment was visible using a microscope the success rate increased to 85.3%. Ward et al<sup>25,26</sup> obtained a success index of 76.6% in an *in vitro* study with artificial root canals, and extracted teeth. These authors also observed a success rate of 66.6% in an *in vivo* study with 24 cases in which they removed the fractured instrument using both the microscope and the ultrasonic device. Souter et al<sup>27</sup> obtained a success rate of 91.11% in an *in vitro* study using Gates-Glidden drills aided by an ultrasonic tip to remove fractured

instruments from the root canal. Depending on the type and features of the fractured instruments, the use of a specific technique does not guarantee the success. In both of the cases described in this study the use of ultrasonic agitation was not effective to remove the fractured instrument.

There are no evidences showing that a fractured instrument is capable of compromising the prognosis of the endodontic treatment.<sup>20</sup> Thus, before attempting the removal of the fragments, it is important to evaluate the possible resulting complications. For instance, in the first case presented in this study, the fractured instrument was left within the canal, since it was observed that the risks of complications overbalanced the benefits of removing the instrument from the canal. Since it was possible to bypass the fragment, the endodontic therapy could be continued and finished. The canal anatomy was also considered since the distal canals ends in a single apical foramen.

Hulsmann and Schinkel<sup>21</sup> demonstrated that grater the fragment is, the procedure of removal was easier. These authors also affirmed that it is hard to remove fragments located apically to the curvature of the root canals. The second clinical case reported in this investigation described a 10-mm fractured instrument stuck into the canal of a maxillary incisor. The characteristics of the tooth influenced the decision of removing the fragment. As the clinician did not have any specific device to remove the instrument, it was adopted an alternative technique. Thus, using a hypodermic needle and cyanoacrylate adhesive it was possible to successfully remove the instrument from the canal.

Given the exposed, the clinical conduct in the event of an accident such as a fracture requires from the professional experience and know-how, once the clinician must be aware of the features of the instruments used to perform the endodontic therapy. When facing inter-currence such as an instrument fracture, the professional must balance the risks and benefits of attempting the removal of the fractured instrument.

## Conclusion

The most reasonable clinical conduct to remove a fractured instrument depends on several variables. Among them are the localization of the fragment and the anatomy of the root canal, which are factors that influence the success of a removal attempt and the endodontic treatment. Considering these aspects, the clinicians must have experience and ability to conduct the cases successfully. The professional also must be aware of the risks and benefits of trying to remove the fragments, since carefully application of some techniques minimize the occurrence of accidents and complications.

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