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STUDY OF TREATMENT OPTIONS FOR FILE FRACTURES OCCURRING DURING ENDODONTIC PROCEDURES: LITERATURE REVIEW

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Abstract: Endodontics focuses on the diagnosis and treatment of teeth with inflammation or necrosis of the pulp, including the use of endodontic files. However, fracture of files inside the canal is a reality in Dentistry. There are different treatment techniques for this problem: bypass technique, use of ultrasound, microtube systems and endodontic surgery. This literature review was based on scientific studies from the following databases: *Google* Scholar, *PUBMED, LILACS and MEDLINE.* Fifteen studies were selected from the search for the keywords *bypass,* endodontic surgery, file fracture, microscope, ultrasound, and the application of the inclusion and exclusion criteria. The *bypass* technique is the first option in cases of fracture in the apical third or beyond the curvature. The use of ultrasound is an alternative for removing fragments in straight canals, and can be associated with the optical microscope. Periodontal surgery is a more invasive procedure, useful in cases where other techniques have not been successful or in cases of fragments located beyond the apical foramen. Finally, microtubes also remove fragments in straight canals and can be associated with adhesive systems. It is concluded that each technique available will depend on the location of the fragment, the dental anatomy and the flexibility of the fractured instrument.
Keywords: *By-pass.* Periodontal surgery. File fracture. Microscope. Ultrasound.

INTRODUCTION

Endodontics is an area of dentistry that focuses on the diagnosis and treatment of teeth that have developed extensive carious lesions to the point of reaching the pulp chamber, which can cause inflammation or necrosis of the root canal. The way to treat these cases is through chemical-mechanical preparation of the dental pulp, which involves removing the damaged pulp and cleaning the internal space of the tooth. Thus, endodontics is essential to save teeth that would otherwise be lost (Rossi *et al.,* 2013).

The chemical-mechanical preparation aims to enlarge and shape the root canal, thus providing a conical shape and a decreasing diameter in the crown-apex direction. In order to achieve these objectives, it is necessary to use endodontic files, whether manual or rotary (Lopes and Siqueira, 2020).

The selection of appropriate files depends on the anatomy of the tooth, the degree of curvature of the root canals, and the complexity of the case. Endodontists are trained to select the correct files and use appropriate techniques to ensure effective and safe root canal treatment (Estrela, 2013).

However, fracture of files inside the root canal is a reality in Dentistry. There are several factors that lead to the occurrence of these episodes, such as excessive use of the file, inadequate techniques, dentist's inexperience and the force exerted on the instrument (Berman; Hargreaves; Rotstein, 2021).

The treatment of file fractures may vary depending on the location of the fracture, with the fragments being located in the cervical, middle or apical third of the element; the stage of treatment and the condition of the tooth. All these aspects must be considered, carefully weighing the risks and benefits involved (Berman; Hargreaves; Rotstein, 2021).

Treatment options that can be considered are attempts to remove or protect the fracture. To carry out the process of removing the fragment, there are alternatives such as the use of ultrasound, bypass, parendodontic surgery, microtubes and removal with Hedstroen files. (Gonzalez, 2018).

Even with all precautions taken by the dentist, these incidents cannot be avoided with absolute certainty. Choosing the best option will depend on the dentist's detailed assessment of the situation and discussion with the patient. The professional must explain to the patient what happened and the alternatives to solve the problem, thus providing honest communication between the professional and the patient. The patient's teeth and oral health should always be preserved in the best possible way, minimizing the risk of complications (Berman; Hargreaves; Rotstein, 2021).

The research had the general objective of carrying out a literature review on the occurrence of file fractures inside the canal during endodontic procedures, in order to understand what the dentist's conduct should be when removing the fragment or not.

METHODOLOGY

A literature review was carried out based on the selection of scientific papers from the digital databases *Google* Scholar, *PUBMED, LILACS and MEDLINE*. The keywords used for the research were: bypass, endodontic surgery, file fracture, microscope, ultrasound.

Inclusion criteria: literature reviews, texts in Portuguese and texts published from 2019 onwards.

Exclusion criteria: texts that were off topic, incomplete and duplicated.

Of the 206 works found, 15 were selected, after applying the exclusion criteria, for the construction of this review.

DISCUSSION

BYPASS

Uzan (2021) conducted a study that determined the bypass technique as the first option in cases of fracture in the apical third or beyond the curvature, if the fragment does not have a large dimension. This technique consists of instrumenting a file of smaller caliber in relation to that of the fragment, in order to remove it or, in case of unsuccessful removal attempts, to create a union between the fractured instrument and the internal wall of the canal, to keep the fragment inside the canal and continue the chemical-mechanical preparation and obturation.

Furthermore, Uzan (2021) emphasizes an alternative technique to bypass, called the twisted file technique. In the procedure, approximately three files are introduced into the root canal with the aim of bypassing the fragment and then performing a rotational movement of all the files at the same time, in order to remove the fractured instrument.

On the other hand, Almeida (2022) also concluded that bypass should be the first technique to be adopted. However, a case report was analyzed in which element 38 presented symptomatic apical periodontitis, and the file fragment could not be removed due to the risk of iatrogenesis during the procedure. Therefore, it was necessary to keep the fractured file, taking due care to join the fragment to the internal wall, finally performing the obturation. After one year, the treatment was monitored and a reduction in the lesion of the element was observed, evidencing the success of the technique used.

ULTRASOUND

Lopes *et al.* (2023) discussed the use of ultrasound in Endodontics. This instrument can be used in several situations, including the removal of fractured instruments inside the root canal. There are two types of ultrasonic tips: diamond and smooth, which have, respectively, greater and lesser cutting power. The tips indicated for this removal technique are smooth, so that there is no excessive wear in the treated area. Furthermore, the study showed that ultrasound has some limitations in relation to the removal of fractured files in the apical third or beyond curvatures, thus requiring the adoption of another technique.

Petriu (2021) provided some additional ways to use ultrasound to remove file fragments from the root canal. First, the direct technique involves widening the root canal so that the operator can gain better access and, therefore, introducing the fine TRA14 intracanal ultrasound tip at an intensity of 20%. For the procedure to be successful, it is necessary to place the instrument against the fractured file, always being careful when moving.

Secondly, there is the ultrasonic association with a manual file, carrying out the same protocol for widening the canal and introducing a file up to where the fragment is located. Immediately after, the ultrasound tip is placed on the file, at 50% intensity, and with the file itself, clockwise and counterclockwise movements are performed (Petriu, 2021).

Ultrasound, because it has small-caliber tips, promotes less wear on the dental element (Lago; Clementino; Melo, 2023). However, Lima and Adeodato (2022) reiterate the need to be careful with the overheating that ultrasound can cause in the dental element. Since irrigation can be an obstacle to good visualization by the operator, it is necessary for the dentist to take short breaks between vibrations, so that no tissue is injured.

MICROSCOPE

With the use of a microscope, the dentist can better visualize complex anatomical details, such as additional canals, fissures and fractures, facilitating their location and effective treatment (Dias; Lima; Salomão, 2020). Furthermore, Ferrari and Pagliosa (2021) state that the combination of the microscope with ultrasound tips proved to be quite effective in removing file fragments in straight canals.

According to Gobbo (2022), the use of a microscope and ultrasound in the removal of fractured instruments makes it possible to expand the visualization of the fragment by enlarging the canal, but at the same time, it offers less chance of fracture and root perforations.

However, some disadvantages can be considered, such as the high cost and the need for specialized training, which are challenges for its widespread adoption. It also promotes a reduction in the area of influence, making it difficult to see the site to be worked on. However, even with these challenges, the operating microscope remains a valuable tool that increases the effectiveness, safety, and comfort of endodontic work (Silva *et al* ., 2020).

PERIODONTAL SURGERY

Endodontic surgery is closely related to the removal of fractured files, as this procedure is frequently used when there are instrument fractures within the root canal, making it impossible to perform endodontic treatment (Silva *et al.*, 2020).

Souza and Izidro (2020) state that the presence of a fractured file inside the canal can compromise the success of endodontic treatment, as it prevents the total disinfection of the area, facilitating the permanence of bacteria. When it is not possible to remove the instrument fragment in the conventional way, parendodontic surgery, which involves accessing the root apex through a small opening in the adjacent bone, allows direct access to the fragment for removal.

Fernandes *et al.* (2019) show that performing periodontal surgery requires specific planning and involves prior local anesthesia of the affected area. The dentist then makes an incision in the gum and detaches a flap to expose the periapical bone region. The professional then performs apicoectomy, which involves removing the apical portion of the tooth root, where the infection is usually concentrated. In addition, curettage of the infected tissues around the area is performed to ensure complete elimination of infectious agents. After performing apicoectomy, retrofilling of the root is normal, in which the root end is sealed with a biocompatible material to suppress new contamination.

Carvalho (2020) analyzed a case of nickel--titanium file fracture in element 36 that went beyond the apical foramen. In this case, since it was not possible to access through the root canal, the most appropriate alternative for this situation was to perform endodontic surgery. After 30 days of the fracture, the surgery was performed following the following protocol: access and curettage of the lesion, removal of the instrument with a Castroviejo needle holder, and obturation of the canal. The technique proved to be quite favorable for this case.

The postoperative period requires the patient to follow specific instructions, including oral hygiene care and the use of anti-inflammatory and analgesic medications, as prescribed by the professional, to reduce discomfort and ensure a balanced recovery. Follow-up for 12 months is necessary for clinical and radiographic evaluation of the patient. Therefore, endodontic surgery is a valuable alternative to preserve the affected tooth and ensure the elimination of possible sources of infection, in cases where a fractured file makes non-surgical endodontic treatment difficult (Schuler, 2020).

MICROTUBES

In this technique, the aid of ultrasonic tips or Gates-Glidden drills are essential to access the root canal, so that the dentist can see 2 to 3 millimeters of the fractured instrument. Soon after, the metal tube is introduced into the canal in order to capture the instrument inside the microtube. Inside the microtube, there is a screw wedge that will hold the fragment until it is removed from the canal through a counterclockwise rotation movement (Fonseca, 2022).

Microtube technique, which uses extractors associated with adhesive systems. The author states that the diameter of the tube must be larger than the file fragment. Next, cyanoacrylate adhesive must be applied to the end of the microtube, so that, when it comes into contact with the fractured instrument, the dentist can pull the extractor and, finally, remove the fragment from inside the canal.

FINAL CONSIDERATIONS

It is concluded that each technique available will depend on the location of the fragment, the dental anatomy and the flexibility of the fractured instrument. Based on the studies discussed in this review, it is known that in cases of file fracture beyond the curvature of the tooth or in the apical third, the first technique of choice is bypass. Thus, the dentist must assess whether the fragment can be removed or whether the best option is to keep it inside the canal and perform the appropriate monitoring. In cases where the fragment is located in the middle and cervical third and there is no presence of curvature, there are alternatives such as the use of ultrasound, which can be associated with a microscope to optimize the procedure, and microtube systems. Finally, parendodontic surgery is an excellent technique with a high probability of success because it is an alternative that can directly access the file

fragment through apicoectomy. In cases of file fracture located beyond the apical foramen, this technique has proven to be quite effective. However, the operator is required to have a high level of mastery of this technique, with all pre- and post-operative care, so that there is no chance of committing iatrogenic injuries to the dental element.

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