Apical transportation

Microsurgical handling of a procedural error during apical mechanical preparation

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Endodontics is the dental specialty that is concerned with treating or preventing pulpall pathologies and apical periodontitis. The main objectives of endodontic treatment are to clean and disinfect the entire length of the root canal system up to a healthy level.1, 2 When, through meticulous treatment, such objectives are achieved, success rates can exceed 94 per cent.3, 4 In pursuit of such results, during endodontic therapy, mechanical preparation is carried out with endodontic instruments and chemical preparation with irrigating solutions.

After cleaning and shaping, endodontic filling must be performed to fill three-dimensionally and seal the endodontic space in order to prevent bacterial re-contamination, maintaining the sanitation conditions achieved through the previous steps. The mechanical preparation of the root canal system is of utmost importance in the process of establishing endodontic sanitation.3, 4, 5 It is responsible for physically removing the infected dentine and, consequently, bacteria located within the dentinal tubules. In addition, it increases the diameter and shapes the main canals, facilitating the outflow of larger volumes of irrigating solutions to the apical third.6 It also creates a favourable conical shape for endodontic filling. Therefore, it directly influences the quality of the disinfection process and, consequently, the prognosis of the case.

Procedural errors during mechanical preparation may make it impossible to achieve the required disinfection levels. Yousuf et al. evaluated 1248 endodontically treated teeth using digital radiography and found procedural errors in 12.8 per cent (154 teeth) of them. Transportation of the apical foramen, whether leading to root perforation or not, is among the most common errors during endodontic treatment, especially in curved canals.7–9

The Glossary of Endodontic Terms by the American Association of Endodontists defines ‘canal transportation’ as ‘Removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of files to re-store themselves to their original linear shape during canal preparation, may lead to ledge formation and possible perforation.’

The inadvertent use of rigid endodontic files, such as stainless steel, especially of larger diameters, without previous examination of the internal dental anatomy as part of the procedure, increases the risk of transportation of the foramen.

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Insufficient cleaning of canals, especially the apical third, predisposes treatment to endodontic failure.10–12 Transportation of the foramen may not only impair disinfection of the canal system by disabling access to its original trajectory, but also irritate the peri-apex by extruding bacteria and their by-products and derail the ideal apical adjustment of a gutta-percha cone. These technical hindrances due to operational error in the preparation phase can negatively influence apical sealing and communication with the peri-apical space exists.

• Type I represents a minor movement of the physiological position of the foramen.
• Type II represents a moderate movement of the physiological position of the foramen, resulting in a considerable iatrogenic relocation on the external root surface. In this type, a larger deviation of the physiological position of the foramen can usually be cleaned to control bleeding and to serve as a physical shield to prevent extrusion of the endodontic filling material. In these situations, placing an apical cap with mineral trioxide aggregate (MTA), followed by conventional endodontic filling, can be considered. However, in clinical cases with apical transportation of Type III, it is generally not possible to achieve cleaning, disinfection and proper filling. Thus, these steps should be performed as well as possible and be followed by an apical microsurgery to remove the untreated apical region.

Clinical case

A 55-year-old female patient (American Society of Anesthesiologists Physical Status Class I) visited the dental office complaining about spontaneous, constant pain, exacerbated during mastication and apical palpation in the region of teeth #11 and #13, which had been treated endodontically over the course of the last three months. The patient reported that she did not feel pain before the initial endodontic treatment began. After
the first endodontic session, during which teeth #13 and #11 were treated at the same time, the pain began and had worsened after the third day. On the fourth day, the patient had to receive intravenous dipyridamole and ketoprofen to control the pain. Concurrent with the systemic medication, an occlusal adjustment was performed. After two days, the pain returned and the patient went to another dentist, who administered sodium dipyridamole 500 mg/ml every four hours and nimesulide 100 mg every 12 hours orally for seven days. The pain decreased, but did not cease.

Two days after systemic medication ended, the patient again felt pain. She went to a third dental professional, who initiated endodontic retreatment of teeth #11 and #13. However, the therapy performed was not able to control the pain effectively. After four days, the patient also began showing febrile conditions. It was reported that, in none of the endodontic procedures performed, was absolute sealing achieved.

Clinical examination established endodontic access at teeth #13 and #11. Inadequate geometric configuration of endodontic access already suggested problems in chemical-mechanical preparation of the root canal system (Figs. 1 & 2). Endodontic therapy was begun in teeth #13 and #11, and transportation of the foramen Type III was radiographically observed. On tooth #12, there was a full crown, a metallic intra-radicular retainer and signs of a poor endodontic access at teeth #13. However, the therapy performed was not able to follow the apical deviation of tooth #11, however, it was not possible to follow the original trajectory (Figs. 5 & 7). The same occurred with tooth #13. Owing to the great irregularity of the walls of the canals after transportation of the foramina, it was not possible to perform the proper locking of a gutta-percha cone. For this reason, the decision was to perform an apical cap of 4 mm with MTA Repair HP cement (Angelus). The filling of the rest of the canals was performed using thermo-plasticised gutta-percha with MTA Fillapex cement (Angelus). MTA Fillapex contains particles of MTA in its composition.

After the end of this stage, the patient underwent apical microsurgery, during which the apical area corresponding to the apical isthmic region was removed with a piezoelectric instrument and a W1 tip (CVDentus). On tooth #11, a piezoelectric apicectomy was already planned for the neighbouring teeth, the decision was to perform a retrograde endodontic treatment. Treatment was initiated with the endodontic retreatment of tooth #11, followed by that of tooth #13. The canals were irrigated with 2.5% sodium hypochlorite, followed by 17% EDTA, both with passive ultrasonic irrigation and prepared with RECIPROC 50 (VDW). Using an operating microscope and periapical radiographs, it was possible to visualise the apical deviation of tooth #11, however, it was not possible to follow the original trajectory (Figs. 6 & 7). The same occurred with tooth #13. Owing to the great irregularity of the walls of the canals after transportation of the foramina, it was not possible to perform the proper locking of a gutta-percha cone. For this reason, the decision was to perform an apical cap of 4 mm with MTA Repair HP cement (Angelus). The filling of the rest of the canals was performed using thermo-plasticised gutta-percha with MTA Fillapex cement (Angelus). MTA Fillapex contains particles of MTA in its composition.

After five months after microsurgery, the patient returned for clinical and radiographic control. Clinically, she did not complain about pain or discomfort. Radiographically, a rapid repair of the perirapex of the three teeth involved was observed (Fig. 12).

Conclusion
The chemical-mechanical preparation phase of the root canal system is of utmost importance for the success of endodontic therapy. Operational errors at this stage, including transportation of the foramen, can dramatically compromise the prognosis of a case.

Therefore, it is extremely important to prevent these. Depending on the severity of the error, however, it can be repaired. Post-operative clinical and radiographic control showed that microsurgical complementation can be a safe and predictable clinical option.