Microsurgical Handling of Procedural Error During Apical Mechanical Preparation Phase in Endodontics: Apical Transportation.

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Endodontics is the specialty that treats or prevents pulpal pathologies and apical periodontitis. The main objectives of endodontic treatment is to clean and disinfect the entire length of the root canal system up to a healthy level (Siqueira et al 2000). When, through a meticulous treatment, such objectives are achieved, success rates can exceed 94% (Imura et al. 2007; Lazarski et al. 2001). Seeking these results, during endodontic therapy, the mechanical preparation is carried out with endodontic instruments and chemical preparation with irrigating solutions.

After cleaning and molding, the endodontic filling must fill three-dimensionally and seal the endodontic space in order to prevent bacterial recontamination, keeping the sanitation conditions achieved through the previous steps.

The mechanical preparation of the root canal system is of utmost importance in the process of endodontic sanitization (Al-Sudani D, Al-Shahrani 2006). It is responsible for physically removing the infected dentin and, consequently, bacteria located within the dentinal tubules. In addition, it increases the diameter and molds the main canals providing the arrival of larger volume of irrigating solutions to the apical third (Shuping et al 1999, Siqueira et al 2000). It also creates a favorable 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 the mechanical preparation phase may make it impossible to reach the required disinfection levels. Yousuf W et al. 2015 made the digital radiographic evaluation of 1748 teeth treated endodontically and found procedural errors in 32.8% (574 teeth) of the teeth examined. Transportation of the apical foramen, leading or not to root perforation, is among the most common errors committed during endodontic treatment, especially in curved canals (Fogarty TJ & S Montgomery 1991; Camara AC et al. 2007; Gergi et al 2010).

According to the Glossary of Endodontic Terms of the American Association of Endodontics, canal transportation is defined as "Removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of files to restore 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 calibers, without previous study of the internal dental anatomy part of the procedure, increases the risk of transposition of the foramen.

Improper cleaning of canals, especially the apical third, predisposes endodontic failure (Sjogren et al 1990; Nair PN et al 1990). Transportation of the foramen may not only impair the disinfection of the canal system by disabling access to its original trajectory, as well as irritate the periapex by extruding bacteria and their by-products and derail the ideal apical adjustment of a gutta-percha cone. These technical disabilities imposed by operational error in the preparation phase can negatively influence apical sealing and appropriate bacterial control (Wu M et al 2002). As a result, they worsen the prognosis of the clinical case involved.

According to Gluskin et al 2008, transportation of the foramen can be classified into three categories:

Type I - represents a minor movement of the physiologic position of the foramen.

Type II - represents a moderate movement of the physiologic position of the foramen, resulting in a considerable iatrogenic relocation on the external root surface. In this type, a larger communication with the periapical space exists.

Type III - represents a severe movement of the physiologic position of the foramen and the canal, resulting in a significant iatrogenic relocation.

Treatment of apical transportation cases can be made by different clinical approaches. Canals with Type I transposition can usually be cleaned and filled; with Type II may be filled after the application of an apical barrier to control bleeding and to serve as a physical shield to prevent extrusion of the endodontic filling material. In these situations, it can also be considered placing an apical cap with MTA followed by conventional endodontic filling.

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 best as possible followed by an apical microsurgery to remove the untreated apical region.

CLINICAL CASE

Female patient, 55 years old, ASA I, visited the dental office complaining of spontaneous, constant pain, exacerbated during mastication and apical palpation in the region of teeth 13 and 11 that were being treated endodontically the last 3 months. The measured blood pressure was 128X78 mmHg, heart rate 82 bpm, oxygen saturation of 98% and body temperature of 38.5 oC.

The patient reported that she did not feel pain before the start of the initial endodontic treatments and they were indicated for rehabilitative reasons. After the first endodontic session, where teeth 13 and 11 were treated at the same time, the pain began and exacerbated after the third day. On the fourth day the patient had to receive intravenous dipyrone and ketoprofen to control the pain. Concurrently to the systemic medication, an occlusal adjustment was performed. After 2 days the pain returned and the patient went to another dentist who administered sodium dipyrone 500mg/ml every 04 hours and Nimesulide 100mg every 12 hours orally for 7 days. The pain decreased, but did not cease. Two days after the end of the use of systemic medication, the patient again felt pain. She then went to a third professional who initiated the endodontic reintervention of teeth 11 and 13. However, the therapy that was being performed was not able to effectively control pain. After 4 days the patient also began presenting febrile conditions. It was reported that in none of the endodontic procedures performed, absolute sealing was used.

Clinical examination revealed endodontic access on teeth 13 and 11. Inadequate geometric configuration of endodontic access already suggested problems in chemical-mechanical preparation steps of the root canal system (FIGURE 1, FIGURE 2). Endodontic therapy started in teeth 13 and 11 with transportation of the foramen Type III was radiographically observed. On tooth 12, there was a full crown, metallic intraradicular retainer and poor endodontic treatment (FIGURE 3). On the tomography it was possible to highlight the transposition of the foramen on the two teeth (FIGURE 4, FIGURE 5).

Figure 01.
Initial clinical aspect of tooth 11

Figure 02.
Initial clinical aspect of tooth 13

Figure 03.
Initial radiography

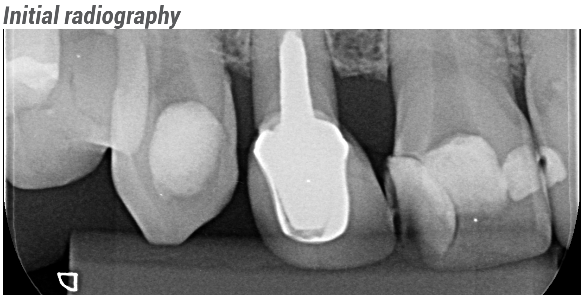


Figure 04.
Tomographic image demonstrating the transportation of the foramen on tooth 11

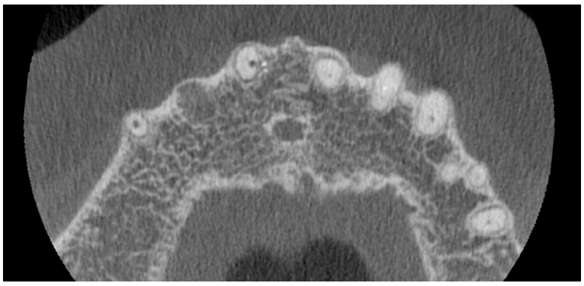
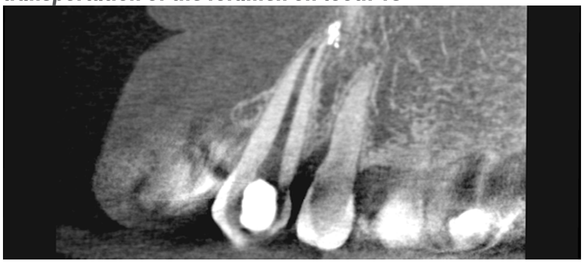


Figure 05.
Tomographic image demonstrating the transportation of the foramen on tooth 13



Due to the severity of the apical deviation on teeth 13 and 11, the recommended treatment was endodontic reintervention complemented by an apical microsurgery. Treatment of tooth 12 was also needed through cleaning, molding and disinfection of the canal system with consequent endodontic filling. However, as the prosthetic crown of this element was adapted and microsurgery was already planned for the neighboring teeth, the decision was to perform a retro endodontic treatment.

Treatment was initiated with the endodontic reintervention of tooth 11 followed by tooth 13. The canals were irrigated with sodium hypochlorite 2.5% followed by 17% EDTA, both with PUI and prepared with Reciproc 50 (VDW- Munich- Germany). Through the operating microscope and periapical x-rays, it was possible to visualize the apical deviation of tooth 11, however, it was not possible to resume the original trajectory (FIGURE 6, FIGURE 7). The same occurred with tooth 13. Due to the great irregularity of the walls of the canals after the transposition of the foramen, 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-HP (Angelus, Londrina, Brazil) (FIGURE 8). The filling of the rest of the canals was performed using thermoplasticized gutta-percha with Fillapex MTA cement. Fillapex MTA cement contains particles of MTA in its composition.

Figure 06.
Clinical image of operating microscope showing the original canal trajectory and apical deviation of tooth 11

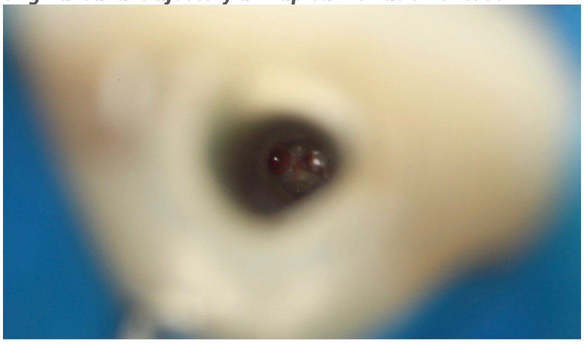


Figure 07.
Radiographic image of endodontic file positioned in the apical deviation of tooth 11

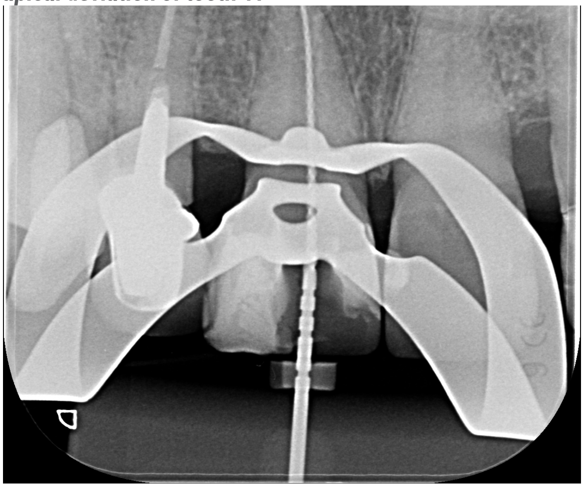
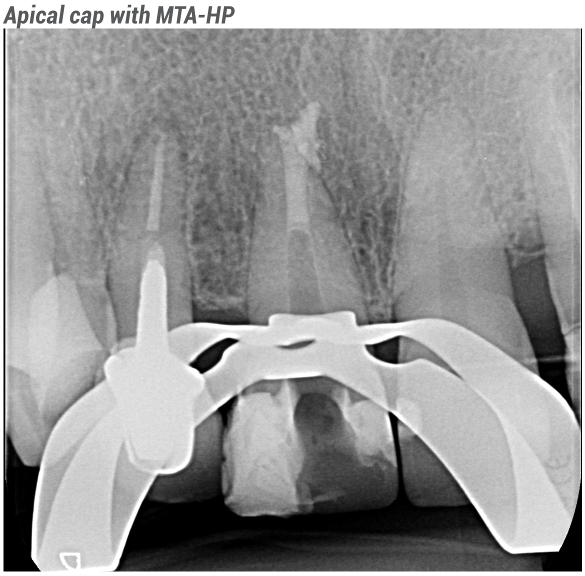


Figure 08.
Apical cap with MTA-HP



After the end of this stage, the patient underwent apical microsurgery, where the apical area corresponding to the apical iatrogenic region was removed with Piezoelectric ultrasound and a W1-CVDentus tip. On tooth 12 was performed a Piezoelectric apicoectomy with the same instruments, and the canal was retro prepared to the depth corresponding to the apex of the molten metal core present. After drying the canal with a surgical suction pump (Endo Tips 0.014" - Angelus - Londrina - Brazil) coupled to a vacuum pump, the procedure continued with the retro-filling using MTA-HP (Angelus - Londrina - Brazil) (FIGURE 9, FIGURE 10, FIGURE 11).

Figure 09.
Canal drying of tooth 12 with SurgiTip

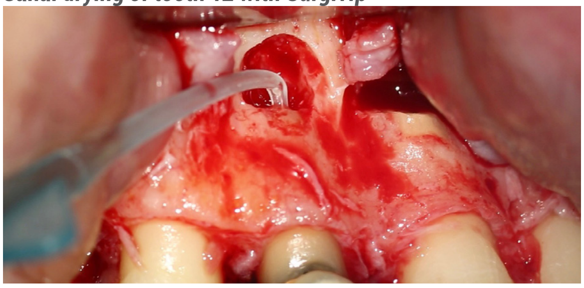


Figure 10.
Retrofilling of tooth 12 with MTA-HP

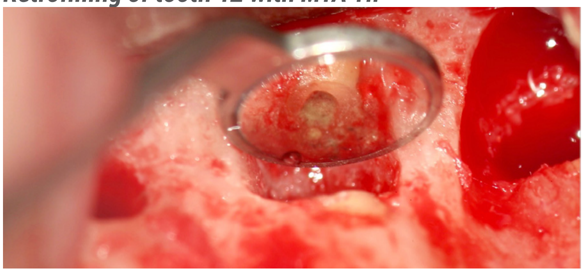
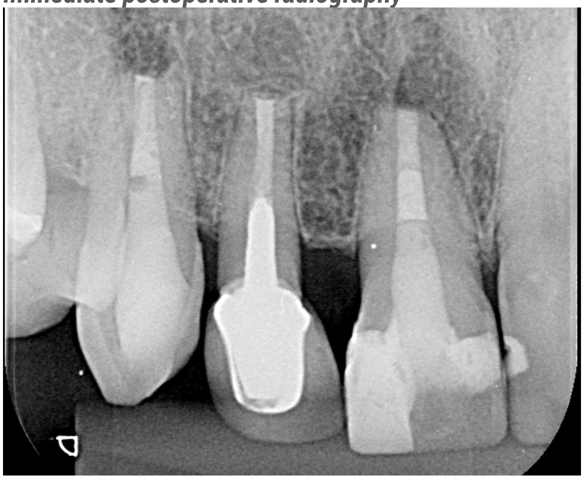


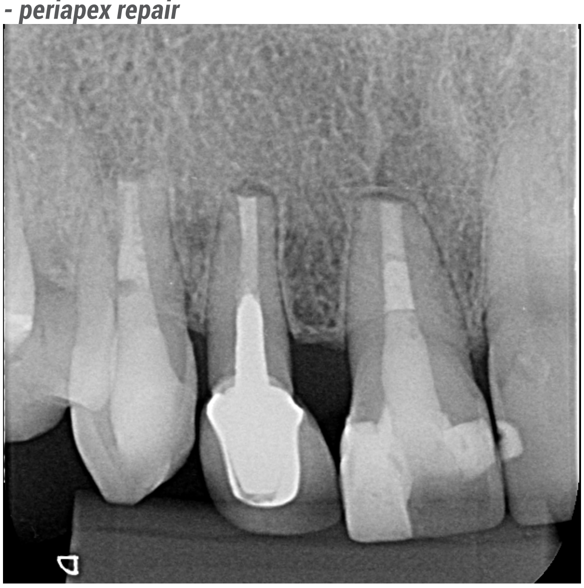
Figure 11.
Immediate postoperative radiography



MTA has been the material of choice for sealing perforations, retro preparations and apices with irregular morphology, not circular, due to root resorption or incorrect apical preparations. Its superior features of marginal adaptation, biocompatibility, sealing ability in wet environments, induction and conduction of hard tissue formation, cementogenesis with consequent formation of normal periodontal adhesion, make it the most suitable material for these clinical situations. MTA-HP is also presented in powder and liquid form. It preserves all the features of traditional MTA adding easier clinical handling. This characteristic of improved clinical handling is due to a change in the particle size of the MTA powder and the addition of a plasticizer to the liquid.

After 5 months of microsurgery the patient returned for clinical radiographic control. Clinically, she no longer had any complaints of pain or discomfort. Radiographically, it was observed rapid repair of the periapex in the three teeth involved (FIGURE 12).

Figure 12.
Control Radiography five months later - periapex repair



CONCLUSION

The mechanical chemical 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 the case. Therefore, it is extremely important to prevent them.

However, depending on the severity of the error, it can be repaired. Postoperative radiographic and clinical control of this clinical case show that the microsurgical complementation can be a safe and predictable clinical option.

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