Foraminal enlargement as a complement in the endodontic treatment for the regeneration of an extensive periapical lesion. A case report

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ABSTRACT

Introduction: Foraminal enlargement refers to intentional mechanical enlargement of the foramen to reduce the bacterial load in an area frequently affected by endodontic infections beyond the limits of the apical constriction. The objective of this case report is to present the foraminal enlargement technique of a tooth with an extensive periapical lesion as a complement in the endodontic treatment and an early alternative to periapical microsurgery. **Materials and methods:** The case is presented of an endodontically treated upper lateral incisor with an extensive associated periapical lesion. Due to the clinical and radiographic history, the time elapsed since the initial endodontic treatment, and the high probability of areas of apical resorption with extra-radicular biofilm, endodontic retreatment with foraminal enlargement was indicated as the first option, postponing the indication for endodontic surgery according to evolution. **Results:** In the follow-up appointment at 2 years, a favorable clinical imaging evolution of retreatment was observed, with a total increase in bone density. The complementary endodontic surgical procedure was discarded. **Conclusion:** Foraminal enlargement is a viable complementary alternative in cases of long-term apical periodontitis with suspicion of biofilm at the foramen level. It can be considered an option before the indication of surgical endodontic retreatment.

Keywords: Periapical Periodontitis. Root Canal Therapy. Retreatment. Periapical Repair. Foraminal Enlargement.

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Introduction

Foraminal enlargement refers to intentional mechanical enlargement of the foramen to reduce the bacterial load in an area frequently affected by infections of endodontic origin beyond the limits of the apical constriction.[1] This procedure involves the use of instruments calibrated over the working length (WL) for cleaning, regularizing, and shaping the foramen; removing infected dentin and cementum;[2] and ensuring a favorable environment for the body to regenerate periapical tissues.[3]

According to Ricucci et al.,[4] teeth with peri-radicular lesions greater than 10 mm present apical biofilm in 100% of cases, harboring numerous organized bacterial species, which could explain a lower success rate of non-surgical endodontic therapy. However, the same authors confirmed the presence of extra-radicular biofilm. Although rare, this could persist despite the elimination of the intra-radicular infection, being sometimes independent of the infection of the main canal.[5,6]

Considering sodium hypochlorite (NaOCl) as the only effective irrigant against biofilm[7] and that the passage of an instrument compatible with the foramen anatomy is not enough to ensure the mechanical removal of infected tissue, active instrumentation of the apical foramen is required in areas where the irrigant cannot act.[8] The concept of foraminal enlargement was thus born as a non-surgical alternative for the disorganization and elimination of the biofilm around the foramen.

The objective of this case report is to analyze the influence of foraminal enlargement, as a complement in the endodontic treatment, on tissue regeneration of an extensive long-standing periapical lesion, evaluating the treatment options, results, and clinical aspects of the procedure.

Materials and methods

A female patient, 25 years old, with no relevant systemic history, was referred to evaluate the possibility of surgical endodontic retreatment of tooth 1.2, initially treated 8 years ago. On clinical examination, the patient was asymptomatic, and the soft tissues appeared normal. However, the patient reported the sporadic appearance of a fistula. Clinically, a tooth restored with mesio-palatal composite resin was observed in good condition, maintaining the endodontic treatment seal, and the adjacent teeth had normal positive vitality. At the initial radiographic examination, a sub-extended endodontic treatment was observed with a periapical radiolucent lesion of approximately 10 mm in diameter (Fig 1), diagnosed as asymptomatic apical periodontitis in a previously treated tooth.

Considering the time elapsed since the primary endodontic treatment, clinical signs and symptoms, the under-extension of the filling material, and the size of the apical lesion, it was possible to infer a high probability of biofilm and resorption lacunae in the foramen area. Endodontic retreatment was therefore indicated, with foraminal enlargement as the first option, postponing the indication for periapical microsurgery according to evolution.

Figure 1. Initial radiograph.

During the first session, under local anesthesia (Scandicaine 2%, Septodont, Saint-Maur-des-Fossés, France) and absolute isolation, endodontic access was performed. The desobturation of the cervical third was performed with Gates Glidden #2 and #3 (Dentsply Maillefer, Ballaigues, Switzerland) drills. The desobturation of the middle third was completed with a Wave One Gold (WOG; Dentsply Sirona, Ballaigues, Switzerland) Primary (25/07) file mounted on an X-Smart Plus motor (Dentsply Sirona). The whole desobturation process was performed with 5.25% NaOCl. The WL of 19 mm was determined with a K #10 file (Dentsply Maillefer) and electronic apex locator (Root ZX, J. Morita Corp., Tokyo, Japan). Chemo-mechanical preparation was performed with the WOG system, starting with a Primary file (25/07) and followed by a Medium file (35/06), using pecking motions according to the manufacturer's instructions. Both instruments were graduated at 20 mm (WL + 1 mm), allowing them to clean and shape the area of the apical foramen. The shaping of the canal was concluded with the Large file (45/05) calibrated to the original WL of 19 mm. Between each of the instruments, 5 mL of 5.25% NaOCl was used, to a total volume of 20 mL. The final irrigation with NaOCl used three cycles of 30 seconds each with passive ultrasonic activation (PUI), using an E1 Irrisonic ultrasonic tip (Helse Ultrasonics, Santa Rosa de Viterbo, Brazil) mounted on an ultrasonic device (NSK Brasil Ltda, São Paulo, Brazil) with a power of 20%. Finally, the canal was irrigated with 5 mL of 17% EDTA followed by 2 mL of 5.25% NaOCl. After drying with paper points, the canal was medicated with Ultracal (Ultradent Products Inc, South Jordan, UT, USA) sessions. Ketorolac (Laboratorio Chile, Santiago, Chile) was prescribed as 10 mg tablets orally every 8 hours for 3 days in case of postoperative pain. The patient underwent cone beam computed tomography (CB gx 500 fed by I-Cat; Gendex, Chicago, IL, USA) to make imaging comparisons during subsequent controls (Fig 2).

After 15 days, the intracanal medication was eliminated with 5.25% NaOCl and PUI activation, using the same final irrigation protocol as in the first session. The canal obturation used the Tagger's hybrid technique, using a WOG Large gutta-percha cone (Dentsply Sirona) with three accessory gutta-percha cones: #25 and AH Plus (Dentsply Sirona) and a Gutta-Condensor #35 (Dentsply Maillefer). The control radiograph showed adequate compaction of the filling material and a small extrusion of sealer into the periapical tissues (Fig 3). Post-treatment instructions were delivered to the patient, and clinical follow-up was arranged.

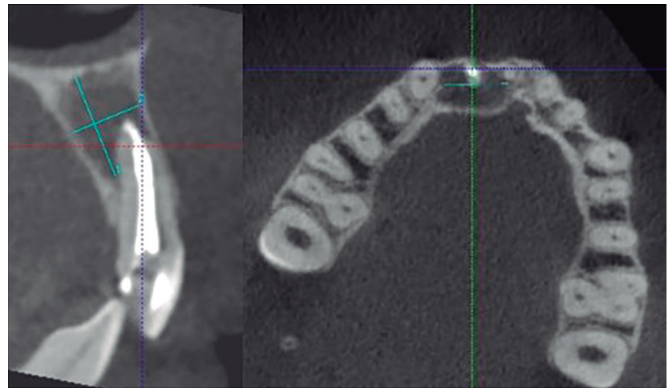

Figure 2. Initial cone beam tomography taken immediately after the first session. Lesion size of approximately 10 mm in the vertical and horizontal mesio-distal direction. Radiopaque intracanal material in sagittal view corresponds to Ultracal (Ultradent).

Figure 3. Root canal obturation control radiograph.

Results

At the 30-day control, the patient did not present or report symptoms or clinical signs. The 6- and 24-month controls were scheduled to see the evolution of the lesion. At the controls, tooth 1.2 was found asymptomatic, restored, and in function. At both appointments, a control computed tomography was performed. Significant bone regeneration was observed, with an increase in bone density of 74 Hounsfield-like units (HU) at the 6-month control and 457 HU at the 24-month control. A rectangular area of 13.4 mm^2 between corticals and superior to the apex was calculated using HU statistics software (ICAT Vision, Cone Beam Imaging LLC, US.), contrasting with an initial measurement of -8 HU in the area of the lesion. As a reference, a density of 200 HU of normal bone was taken, measured in the contralateral tooth in the same way. This corresponded to a bone regeneration of 37% at 6 months and 228.5% at 2 years. The latter percentage reflects the higher degree of condensation of the new tissue (Fig 4). Figure 5 shows the initial cone beam tomography at 6 months and 24 months with the same exposure parameters (120 kV and 5 mA). A favorable clinical and radiographic evolution of retreatment was observed, with clear bone scarring, increased thickness of the cortical bone, and decreased bulging. The complementary surgical procedure was discarded.

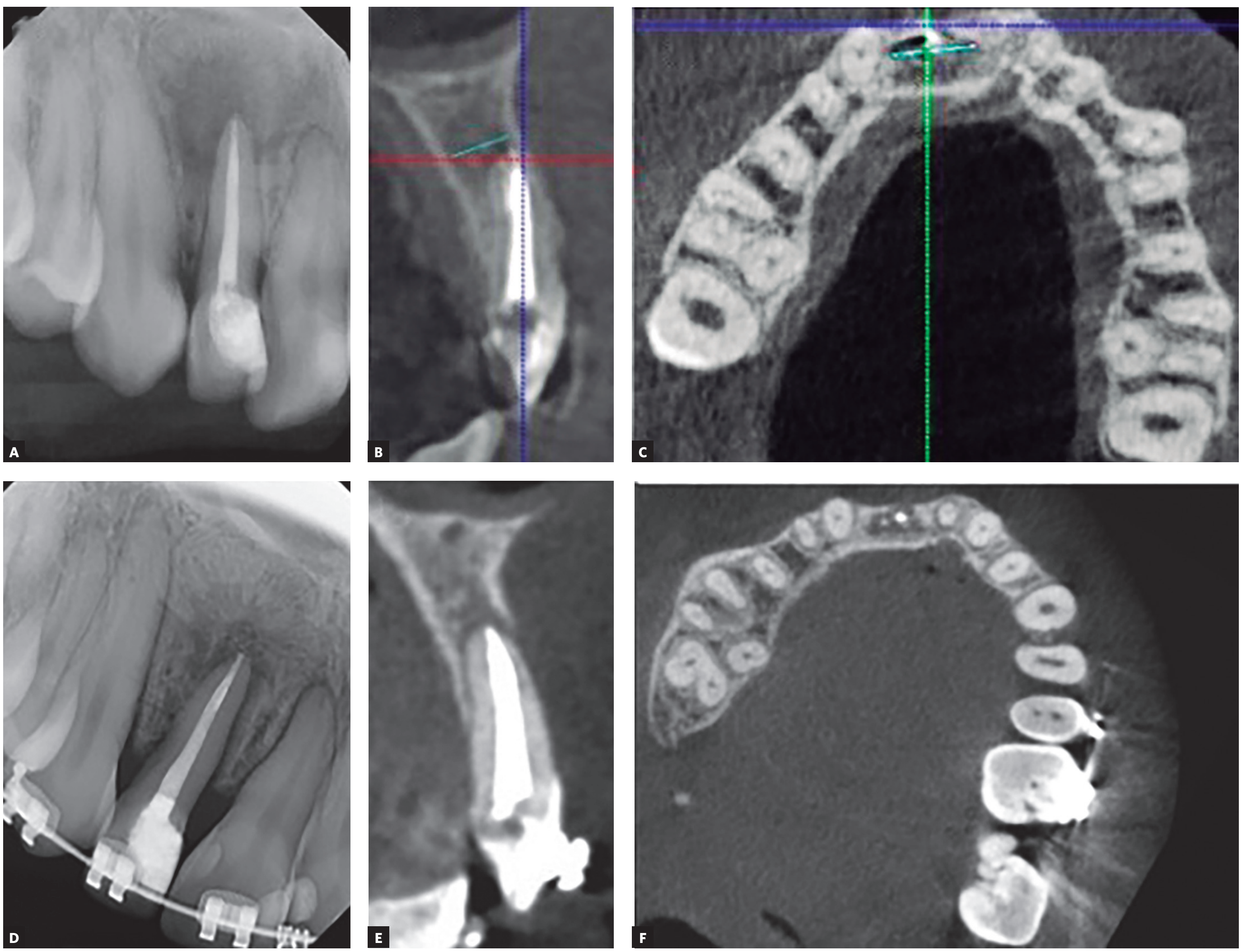

Figure 4. A) Control radiograph at 6 months. **B**) Cone beam tomography control sagittal section at 6 months. **C**) Cone beam tomography axial control section at 6 months. **D**) Control radiograph at 24 months. **E**) Cone beam tomography control sagittal section at 24 months. **F**) Cone beam tomography axial control cut at 24 months.

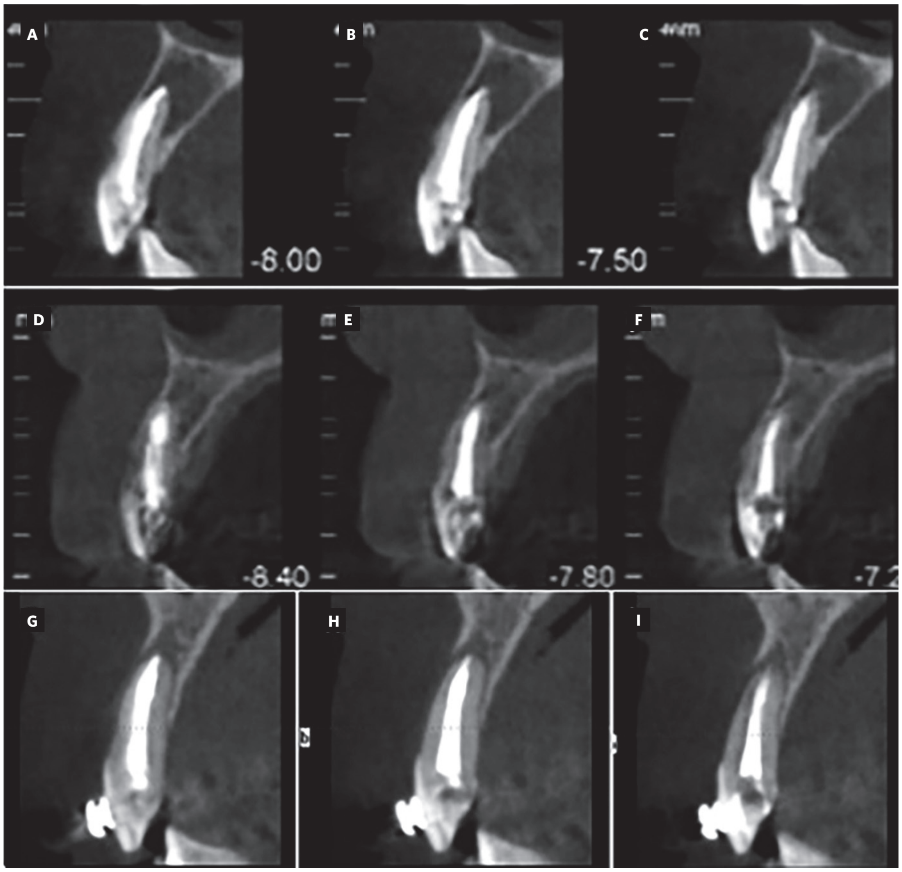

Figure 5. Cone beam tomography with cuts in the vestibule-palatal direction every 0.5 mm. (**A, B, C**) Initial lesion. (**D, E, F**) 6 months post treatment. (**G, H, I**) 24 months after treatment, imaging evidence is observed of complete bone regeneration, with a small area of less apical radiopacity compatible with a fibrous scar.

Discussion

Eliminating the microorganisms that cause pulp disease allows promotion of repair mechanisms of the periapical tissues, but leaving the root canal system free of bacteria is impossible.[9] This does not suggest treatment failure, because the existing microbiota can live in harmony with the immune system, usually in a commensal state. However, this balance can be broken, becoming parasitism and causing disease.[10] The main objective of endodontic treatment is to reduce the maximum number of microorganisms, bringing them to an equilibrium with the immune system that is compatible with the regeneration of periapical tissues. Chemical-mechanical instrumentation plays a fundamental role in this process.[11]

In teeth with peri-radicular lesions larger than 10 mm, apical biofilm is observed in 100% of cases.[4] Such lesions are significantly associated with apical periodontitis of endodontically treated teeth,[12] and the presence of a fistula generally indicates the extra-radicular presence of bacteria.[5] Therefore, in this case, it was decided to perform foraminal enlargement. The enlargement was performed with a WOG Medium 35/06 instrument, considering the 0.32 mm average diameter of the foramen of healthy upper lateral incisors described by Abdullah et al.[13]

Few clinical studies have evaluated foraminal enlargement and its effect on the regeneration of periapical lesions. A recent clinical trial by Brandão et al.[14] described a positive effect of foraminal enlargement on the regeneration of chronic apical lesions. Most studies related to this procedure have focused on morphological aspects, extrusion of the filling material, and postoperative pain. This limits the possible comparison with other studies of the results obtained in this case report.

Regarding morphological aspects, Silva Santos et al.[15] studied the deformation of the foramen when it is enlarged. The study verified that it occurred independently of the kinematics of movement used, confirming that the walls are effectively touched. Based on these results, if the area of the foramen were colonized by microorganisms, these would be effectively removed. This would be impossible to maintain by only the permeabilization of the foramen with a step file.

One of the most controversial issues about foraminal enlargement is the possibility to extrude filling material. Although the procedure promotes a greater volume of extrusion,[16] the inflammatory effect it generates is temporary and indicative of a compact and homogeneous filling of the material, avoiding empty spaces that serve as new colonization niches for microorganisms.[17]

A meta-analysis by Borges Silva et al.[18] described that foraminal enlargement can cause postoperative pain. Although it concluded that pain is significantly higher during the first days when compared with mechanical preparations without foraminal enlargement, this does not imply the need for analgesics. Therefore, it is not possible to relate it to severe postoperative pain. This agrees with the clinical trial by Kurnaz,[19] which revealed a low incidence of pain associated with foraminal enlargement. The present case involved no post-treatment pain, and the patient did not need the prescribed analgesics.

An important consideration when indicating a foraminal enlargement is the need for an immunocompetent state in the patient. When removing and disorganizing biofilm in an extra-radicular area, the possibility is high that microorganisms are ejected towards the area of the lesion and fought by antibodies, components of the complement system, and polymorphonuclear neutrophils.[20] On the other hand, forcing microorganisms with their products to the peri-radicular tissues could induce an acute inflammatory response whose intensity depends on the number and/or virulence of the extruded microorganisms; the ability of the immune system to combat attacks is therefore important.[21] In the present case of a young and immunocompetent patient, no complications were reported, reflected by the absence of symptoms and optimal tissue regeneration.

Notably, the evolution of the presented case should be attributed not only to the foraminal enlargement described but also to each of the steps of the treatment that allowed reducing the microbial load to levels compatible with tissue health. These; chemomechanical preparation, intracanal medication, PUI activation, and a proper filling in length and width, are critical to the success of non-surgical endodontic treatment.

Conclusion

Foraminal enlargement, as a complement in the endodontic treatment, is a viable alternative in cases of long-standing apical periodontitis that raise suspicion of biofilm at the foramen level. The regularization of this area makes it possible to reduce the bacterial load and create a favorable environment for regeneration of the periapical tissues, being an option before the indication of surgical endodontic retreatment.

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