

CASE REPORT

Extensive external-internal root resorption 22 years after trauma and inadequate endodontic treatment: a case report with 20-year follow-up

ABSTRACT

Aim: This paper describes the management of an extensive external-internal root resorption (EIRR), 22 years after dental trauma and inadequate endodontic treatment, with a 20-year follow-up.

Summary: A 30-year-old Caucasian female patient was referred to evaluate the right maxillary central incisor, which presented a sinus tract with mild suppuration. The tooth had been compromised by a trauma, and it was endodontically treated 22 years before. There was no periodontal involvement, mild pain on vertical percussion and apical palpation, and no response to the cold sensitive test. Radiographic analysis showed poorly performed endodontic treatment, EIRR, and asymptomatic apical periodontitis. After performing root canal filling material removal and chemomechanical preparation, a calcium hydroxide paste was used for 45 days. Then, the apical root canal third, and the resorptive lesion were filled with gutta-percha/sealer and MTA, respectively. Longitudinal follow-ups (2, 9 and 20 years) were conducted, and confirmed the success of the intervention.

Key learning points:

- Dental trauma is a relevant public health problem due to its high incidence, mainly in children and adolescents.
- One of the main sequelae resulting from more aggressive dental trauma is root resorption. When an external root resorption (ERR) reaches the walls of the pulp cavity, or an internal root resorption (IRR) reaches the root surface, an external-internal root resorption (EIRR) process ensues, and represents one of the most challenging clinical situations faced by the clinician.
- In cases of EIRR, MTA allows endodontic treatment and tooth restoration to be completed more quickly, thus contributing to the longevity of teeth.

Cristina Musso¹**Ricardo Machado^{2*}**

¹Clinical practice limited to Endodontics, Vitória, Espírito Santo, Brazil

²Clinical practice limited to Endodontics, Navegantes, Santa Catarina, Brazil

Received 2022, September 27

Accepted 2022, November 5

KEYWORDS Dental trauma, endodontic treatment, MTA, root resorption.**Corresponding Author**

Ricardo Machado | Rua Brasília, 300, Apto. 503, Ed. Vila dos Ipês, Centro, Navegantes, Santa Catarina, CEP 88.300-100 | Brazil
E-mail: ricardo.machado.endo@gmail.com Tel/fax: (55 47) 3319-1625 Cel: (55) 47 98409-1561

Peer review under responsibility of Società Italiana di Endodonzia

[10.32067/GIE.2023.37.01.06](https://doi.org/10.32067/GIE.2023.37.01.06)

Società Italiana di Endodonzia. Production and hosting by Ariesdue. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).



Introduction

Dental trauma is a relevant public health problem due to its high incidence, mainly in children and adolescents. According to Dođramaci et al. (1), the prevalence of traumatic injuries in the permanent dentition of children aged 8 to 14 years ranges from 6.1 to 27.6% (2-4), with a higher incidence at ages 9 to 11 years (5, 6). The most commonly affected teeth are the maxillary central incisors (53.2 to 88.1% of all compromised teeth) (2, 4), especially in male patients (1, 3, 4). One of the main sequelae resulting from aggressive dental trauma is root resorption, which is basically divided into external and internal. External root resorption (ERR) is characterized by the loss of structure from a mineralized and/or cementless area located on the root surface, and evolves toward the pulp cavity. On the other hand, internal root resorption (IRR) is a less frequent insidious inflammatory process, which can start at any point of the pulp cavity and progress toward the root surface (7). When an ERR reaches the walls of the pulp cavity, or an IRR reaches the root surface, an external-internal root resorption (EIRR) process ensues, and represents one of the most challenging situations faced by clinicians (8).

Teeth affected by EIRR are subjected to root canal treatment to eliminate the factors stimulating bone resorption (microorganisms and bacterial toxins), and interrupt the pathological process. These measures prevent further damage to the root, and recover the integrity of periradicular tissues (9). The use of calcium hydroxide (Ca(OH)₂) as an intracanal dressing has been recommended in cases of post-traumatic EIRR, in an effort to dissolve the remaining pulpal debris, alkalize the dentin complex, control periodontal bleeding (if occurring), enhance the cleaning and disinfection process of the root canal system (RCS), and stimulate the formation and deposition of hard tissue (10).

However, the permanence of Ca(OH)₂ inside the root canal for long periods of time has been linked to the occurrence of cor-

onal and/or root cracks or fractures (11), and possible recontamination of the RCS between appointments (12). Therefore, other alternatives have been developed and investigated.

Mineral trioxide aggregate (MTA) has been recommended for several clinical situations, such as pulp capping (13), root-end filling (14), and root canal filling material to induce apexification in open-apex teeth (15), as well as reparative material in cases of root perforation (16) and root resorption (17). Its main advantages are sealing ability, biocompatibility, antimicrobial effect, radiopacity, and modulation of cytokine production (16, 18, 19). Specifically in cases of EIRR, MTA allows endodontic treatment and tooth restoration to be completed more quickly, thus avoiding possible root cracks or fractures and recontamination of the RCS – both associated with the long-term use of Ca(OH)₂ – between appointments (12, 20).

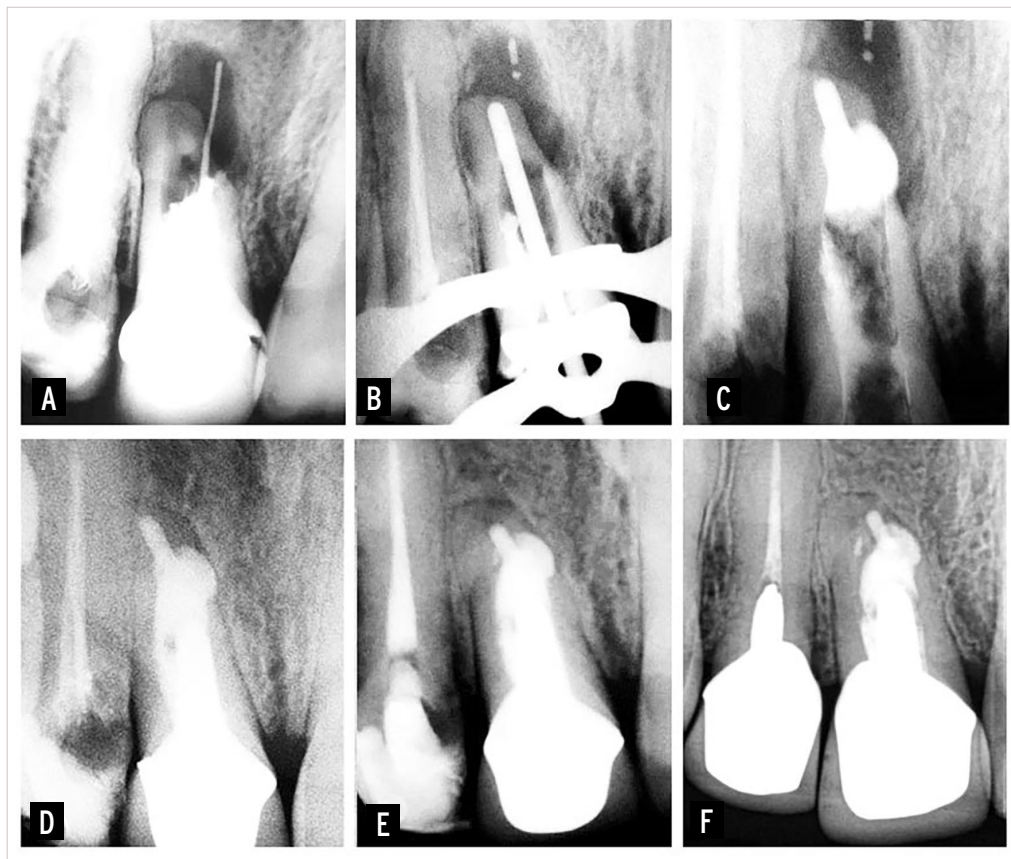
Longevity is one of the most important factors related to success in Endodontics, and most case reports published to date about non-surgical management of EIRR have mentioned follow-ups of 6 (21), 12 (22), 13 (9) and 17 months (23), and 2 (24), 3 (25), 5 (26), 6 (27) and 11 years (28). Bearing this mind, the aim of this paper was to describe an approach to treating extensive EIRR 22 years after dental trauma and inadequate endodontic treatment in a right maxillary central incisor, with a 20-year follow-up. Therefore, this is the case report with the longest follow-up period ever recorded after a non-surgical intervention performed to treat a tooth affected by EIRR.

Case report

This case report has been written according to Preferred Reporting Items for Case Reports in Endodontics (PRICE) 2020 guidelines (29). A 30-year-old Caucasian female patient was referred to the clinic of one of the authors (C.M.) to evaluate the right maxillary central incisor endodontically treated 22 years before, which presented a sinus tract with mild suppuration. Her medical history was non-contributory. The following information was

Figure 1

A) Initial radiography of the right maxillary central incisor, which had been poorly endodontically treated, and which was affected by both EIRR and asymptomatic apical periodontitis. **B)** Radiographic analysis of the main gutta-percha cone. **C)** Apical root canal third and resorptive lesion filled with gutta-percha/sealer and MTA, respectively. **D-F)** 2, 9 and 20-years follow-ups, respectively



provided by the patient during anamnesis: the tooth in question had been compromised by a traumatic injury caused by a fall when she was 8 years old. It changed color, and was subjected to root canal treatment a few months later. Some years after, the coronal portion of the tooth was fractured and replaced with a metal-ceramic crown. The clinical exam showed no periodontal involvement, mild pain on vertical percussion and apical palpation, and no response to the cold sensitive test (Endolce, Coltene/Whaledent, Cuyahoga Falls, OH, USA). Radiographic analysis showed poorly performed endodontic treatment, EIRR, and asymptomatic apical periodontitis (Figure 1A). The patient was given a detailed explanation about the particularities and limitations of her case, she agreed to the proposed endodontic retreatment, and signed an informed consent form.

In the first visit, buccal infiltrative anesthesia (2% mepivacaine with adrenaline

- 1:100.000, DFL, Rio de Janeiro/RJ, Brazil) was administered, the crown was flattened, the metal post was removed by ultrasonic energy, and a provisional crown was made. In the next visit, the same anesthetic was given, the provisional crown was removed, a rubber dam was placed, and the operative field was cleaned with 2.5% NaOCl (Biodinâmica, Ibioporá, PR, Brazil). Next, root canal filling material removal was conducted by means of Hedstrom files (Dentsply, Petrópolis, RJ, Brazil). The working length was determined radiographically 1 mm short of the root apex, and minimal instrumentation was performed with manual stainless-steel K-files (Dentsply), by gently brushing the root canal walls. Irrigation was performed with 2.5mL of 1% NaOCl (Biodinâmica) at each file use or change.

A chelating solution (17% EDTA, Herpo Produtos Dentários, Rio de Janeiro, RJ, Brazil) was applied for 3 minutes, after which the root canal was dried with ab-



sorbent paper cones (Tanari Industrial, São Paulo, SP, Brazil), and filled with a $\text{Ca}(\text{OH})_2$ paste as an intracanal dressing (Calen – S5 White, Rio de Janeiro, RJ, Brazil). The provisional crown was fixed temporarily with Dycal (Dentsply).

After 45 days, the same previous procedures were undertaken, and the intracanal dressing was removed with 2.5ml of 1% NaOCl (Biodinâmica), and the last file was used during the biomechanical preparation. Then, the root canal was flushed with 2.5 mL of 17% EDTA (Herpo Produtos Dentários) for 3 minutes, irrigated with 5 ml of saline solution, and dried with absorbent paper cones (Tanari Industrial). The main gutta-percha cone was inserted into the root canal and checked radiographically for adequate positioning (Figure 1B), after which the apical third was filled using the Schilder technique and Endofill sealer (Dentsply). Afterwards, the MTA (ProRoot, Dentsply-Maillefer) was prepared on a sterile glass plate, and introduced into the root canal with Paiva condensers (Golgran, São Caetano do Sul, SP, Brazil) to completely fill the resorptive lesion (Figure 1C), followed by once again fixing the provisional crown (as previously described). The patient was given a clear explanation of the importance of frequent follow-ups before the definitive prosthetic rehabilitation of the tooth, and was urged not to neglect this advice. The first follow-up could not be conducted before 2 years (Figure 1D). Figures 1E and F show the 9- and 20-year follow-ups, respectively, thus proving the therapy success (absence of pain, swelling and other symptoms, no sinus tract, no loss of function and radiological evidence of a normal periodontal ligament space around the root) (30).

Discussion

One of the main factors for achieving favorable prognosis is early diagnosis followed by adequate treatment, regardless of the type of root resorption. If correct diagnosis and/or treatment are not obtained in a timely manner, potential damage caused by the resorptive process can make the recovery of periradicular tissues unfeasible, and indicate tooth extraction

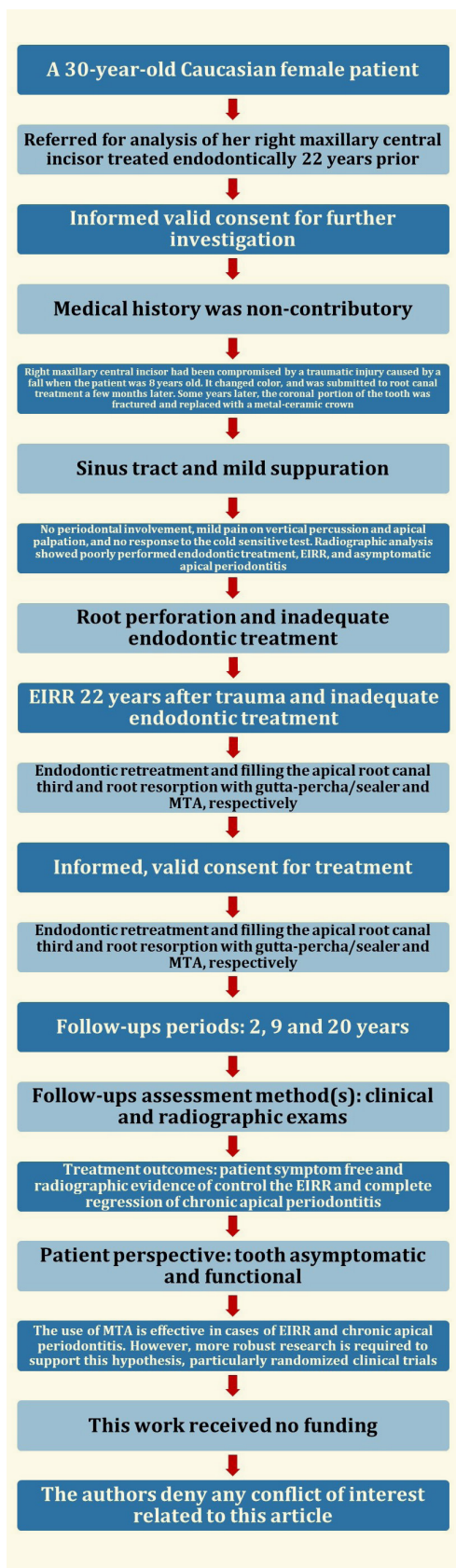
(7). The aim of this paper was to describe the management of extensive EIRR, 22 years after dental trauma and inadequate endodontic treatment of a right maxillary central incisor. The success of the intervention was proven by the longest follow-up ever recorded in the literature – 20 years (Figure 2).

In cases of EIRR, clinical procedures are considered extremely complex because effective disinfection must be performed without causing further damage to the periradicular tissues, which are normally already compromised. Moreover, as much remaining tooth structure as possible should be maintained, and an attempt made not to weaken it even further, hence leaving it at greater risk of coronal and root fracture. In the current case report, cleaning and shaping of the root canal were carefully conducted by manual stainless-steel K-files to cause as little damage to the remaining dentin as possible, and 1% NaOCl was used as the irrigation solution.

The final flushing was undertaken with a chelating solution (17% EDTA) to remove the smear layer, thus increasing the disinfection process through the use of $\text{Ca}(\text{OH})_2$ as an intracanal medication. Passive ultrasonic irrigation was not used, because the risks and potential injuries had to be weighed to determine if they outweighed the benefits of the procedure.

The use of $\text{Ca}(\text{OH})_2$ as an intracanal dressing has been recommended in cases of EIRR resulting from traumatic injuries, because this substance: i) shows excellent antimicrobial action and ii) acts as a physicochemical barrier to prevent proliferation of residual microorganisms, RCS reinfection, or invagination into the root canal of the granulation tissue present in the resorptive lesion. Furthermore, $\text{Ca}(\text{OH})_2$ can promote the necrosis of the resorptive cells located in the Howship's lacunae, thus neutralizing clastic cell acids, preventing the mineral dissolution of the root, and rendering the region unsuitable for acid hydrolases (10). These actions invariably predispose toward a better prognosis (7); however, the time required for $\text{Ca}(\text{OH})_2$ to achieve them, whether directly or indirectly, is a controversial issue.

Figure 2
PRICE 2020 flow chart



Studies have reported that Ca(OH)_2 can be used from 4 weeks to several months (7, 10). However, some studies have discouraged its long-term use due to the likely occurrence of coronal and/or root cracks or fractures, and possible RCS recontamination between appointments (12, 20). In the present case report, Ca(OH)_2 was used for 45 days (3 changes every 15 days), because this was the time required to completely stanch the intracanal bleeding resulting from EIRR. Right after the bleeding stopped, the apical third and resorptive lesion were filled with gutta-percha/sealer and MTA, respectively. In cases of EIRR, MTA has been singled out as the material of choice, owing to its excellent sealing ability and biocompatibility, antimicrobial effects, and radiopacity, as well as its ability to regenerate periodontal attachment, and induce both osteogenesis and cementogenesis (16, 18, 19). The pathological changes that occurred in the periodontal tissues close to the EIRR increased the risk of overfilling. As already mentioned in previous papers, one of the most challenging steps of the present case report was to prevent MTA extravasation to the periradicular tissues (22). However, had this situation occurred, it would not have been so critical as to compromise the prognosis of the treatment, owing to MTA biocompatibility (19).

Conclusions

The findings of the current case report let us infer that MTA is effective in cases of EIRR and asymptomatic apical periodontitis. However, more robust research is required to support this hypothesis, particularly randomized clinical trials.

Clinical relevance

In cases of EIRR, MTA allows endodontic treatment and tooth restoration to be completed more quickly, thus avoiding possible root cracks or fractures and recontamination of the RCS – both associated with the long-term use of Ca(OH)_2 – between appointments, and contributing to the longevity of teeth.



Conflict of interest

The authors deny any conflicts of interest related to this study.

Acknowledgments

The authors would like to thank Editora Santos Pub and the authors of the book “O movimento recíprocante na Endodontia” (31), for allowing the use of the image 1A, originally present in the book.

References

- Dogramaci EJ, Rossi-Fedele G, Jonest AG. Multi-disciplinary management of a patient with a post-traumatized incisor presenting concurrent replacement and inflammatory resorption: a case report. *Aust Orthod J* 2015;31(2):216-225.
- Noori AJ, Al-Obaidi WA. Traumatic dental injuries among primary school children in Sulaimani city, Iraq. *Dent Traumatol* 2009;25(4):442-446.
- Schatz JP, Hakeberg M, Ostini E, Kiliaridis S. Prevalence of traumatic injuries to permanent dentition and its association with overjet in a Swiss child population. *Dent Traumatol* 2013;29(2):110-114.
- Schuch HS, Goettems ML, Correa MB, Torriani DD, Demarco FF. Prevalence and treatment demand after traumatic dental injury in South Brazilian schoolchildren. *Dent Traumatol* 2013;29(4):297-302.
- Al-Malik M. Oral injuries in children attending a hospital in Saudi Arabia. *J Maxillofac Oral Surg* 2009;8(1):34-39.
- Ozgur B, Unverdi GE, Gungor HC, McTigue DJ, Casamassimo PS. A 3-Year retrospective study of traumatic dental injuries to the primary dentition. *Dent Traumatol* 2021;37(3):488-496.
- Patel S, Saberi N, Pimental T, Teng PH. Present status and future directions: Root resorption. *Int Endod J* 2022. Online ahead of print.
- Asgary S, Ahmadyar M. One-visit endodontic retreatment of combined external/internal root resorption using a calcium-enriched mixture. *Gen Dent* 2012;60(4):e244-248.
- Frank AL. External-internal progressive resorption and its nonsurgical correction. *J Endod* 1981;7(10):473-476.
- Mohammadi Z, Dummer PM. Properties and applications of calcium hydroxide in endodontics and dental traumatology. *Int Endod J* 2011;44(8):697-730.
- Al-Hiyasat AS, El-Farraj HS, Alebrahim MA. The effect of calcium hydroxide on dentine composition and root fracture resistance of human teeth: an in vitro study. *Eur J Oral Sci* 2021;129(4):e12798.
- Murad C, Fariniuk LF, Fidel S, Fidel RA, Sassone LM. Bacterial leakage in root canals filled with calcium hydroxide paste associated with different vehicles. *Braz Dent J* 2008;19(3):232-237.
- Shenkin J, Wilson L. Mineral trioxide aggregate may be the most effective direct pulp capping material. *J Evid Based Dent Pract* 2019;19(2):183-185.
- Safi C, Kohli MR, Kratchman SI, Setzer FC, Karabucak B. Outcome of endodontic microsurgery using mineral trioxide aggregate or root repair material as root-end filling material: a randomized controlled trial with cone-beam computed tomographic evaluation. *J Endod* 2019;45(7):831-839.
- Shaik I, Dasari B, Kolichala R, et al. Comparison of the success rate of mineral trioxide aggregate, Endosequence bioceramic root repair material, and calcium hydroxide for apexification of immature permanent teeth: systematic review and meta-analysis. *J Pharm Bioallied Sci* 2021;13(Suppl 1):S43-S47.
- Parirokh M, Torabinejad M. Mineral trioxide aggregate: a comprehensive literature review-Part III: clinical applications, drawbacks, and mechanism of action. *J Endod* 2010;36(3):400-413.
- Ashwini T, Hosmani N, Patil CR, Yalgi VS. Role of mineral trioxide aggregate in management of external root resorption. *J Conserv Dent* 2013;16(6):579-581.
- Parirokh M, Torabinejad M. Mineral trioxide aggregate: a comprehensive literature review-Part I: chemical, physical, and antibacterial properties. *J Endod* 2010;36(1):16-27.
- Torabinejad M, Parirokh M. Mineral trioxide aggregate: a comprehensive literature review-part II: leakage and biocompatibility investigations. *J Endod* 2010;36(2):190-202.
- Sevimay S, Oztan MD, Dalat D. Effects of calcium hydroxide paste medication on coronal leakage. *J Oral Rehabil* 2004;31(3):240-244.
- Kothari HJ, Kumar R. Endodontic management of a mandibular second premolar with perforating internal resorption by using MTA and cone beam computed tomography as a diagnostic aid. *J Conserv Dent* 2013;16(4):380-384.
- Bendyk-Szeffer M, Lagocka R, Trusewicz M, Lipski M, Buczkowska-Radlinska J. Perforating internal root resorption repaired with mineral trioxide aggregate caused complete resolution of odontogenic sinus mucositis: a case report. *J Endod* 2015;41(2):274-278.
- Benenati FW. Treatment of a mandibular molar with perforating internal resorption. *J Endod* 2001;27(7):474-475.
- Meire M, De Moor R. Mineral trioxide aggregate repair of a perforating internal resorption in a mandibular molar. *J Endod* 2008;34(2):220-223.
- Arnold M. Reparative endodontic treatment of a perforating internal inflammatory root resorption: a case report. *J Endod* 2021;47(1):146-155.
- Pereira da Costa R, Quaresma SA, Lopes FC, et al. Management of a perforating internal root resorption using mineral trioxide aggregate: a case report with 5-year follow-up. *Aust Endod J* 2020;46(3):452-457.
- Subay RK, Subay MO, Tuzcu SB. Endodontic management of root perforating internal replacement resorption. *Eur J Dent* 2018;12(3):450-453.
- Nunes E, Silveira FF, Soares JA, Duarte MA, Soares SM. Treatment of perforating internal root resorption with MTA: a case report. *J Oral Sci* 2012;54(1):127-131.
- Nagendrababu V, Chong BS, McCabe P, et al. PRICE 2020 guidelines for reporting case reports in Endodontics: a consensus-based development. *Int Endod J* 2020;53(5):619-626.
- European Society of Endodontics. Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *Int Endod J* 2006;39(12):921-930.
- De-Deus G, Silva E, Souza E, Versiani M, Zuolo M. O Movimento Recíprocante na Endodontia. Quintessence Publishing Brasil; 2017.