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The use of passive ultrasonic irrigation and photodynamic therapy as an adjuvant in endodontic retreatment associated with endoperiodontal injury

O uso de irrigação ultra-sônica passiva e terapia fotodinâmica como adjuvante no tratamento endodôntico associado à lesão endoperiodontal

El uso de la irrigación ultrasónica pasiva y la terapia fotodinámica como adyuvante en el retratamiento endodóncico asociado a lesión endoperiodontal

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Abstract
Endodontic retreatment continues to be a challenge for Endodontics, as well as supporting techniques that aim to improve and assist in the elimination of microorganisms that have infected root canal systems and led to the development of peripicopathies, such as Passive Ultrasonic Irrigation (PUI) and Photodynamic Antimicrobial Therapy (aPDT) have been frequently used. Thus, the aim of this paper is to report a clinical case of endodontic retreatment of tooth 47 with a diagnosis of endoperiodontal injury associated with periapical lesion. The treatment was carried out in two sessions, using as intracanal medication calcium hydroxide with parachlorophenol with camphor, PUI in both final irrigations and previously the root filling was performed with aPDT. At the end of the treatment it was possible to observe a reduction in the radiolucent areas, suggesting the beginning of bone repair. This case report suggests that PUI and aPDT associated with endodontic retreatment can improve disinfection, favoring the regression of periapical alterations and, consequently, favoring the bone repair process.
Keywords: Case reports; Dental care; Endodontics; Photochemotherapy; Teaching; Ultrasonics.

Resumo
O retratamento endodôntico continua sendo um desafio para a Endodontia, assim foram desenvolvidas técnicas coadjuvantes que visam aprimorar a eliminação de microrganismos que infectaram o sistema de canais radiculares e levaram ao desenvolvimento de peripicopatias, como, por exemplo, a Irrigação Ultrassônica Passiva (PUI) e a Terapia Fotodinâmica Antimicrobiana (aPDT) que têm sido frequentemente utilizadas. Assim, o objetivo deste trabalho é relatar um caso clínico de retratamento endodôntico do dente 47 com diagnóstico de lesão de endoperio associada a lesão periapical. O tratamento foi realizado em duas sessões, utilizando como medicação intracanal hidróxido de cálcio com paramonoclorofenol canforado, na irrigação final de cada sessão foi empregada a PUI e, previamente, a obturação radicular foi realizada a aPDT. Ao final do tratamento foi possível observar uma redução das áreas radiolúcidas, sugerindo o início do reparo ósseo. Este relato de caso sugere que PUI e aPDT associados ao retratamento endodôntico podem melhorar a desinfecção, favorecendo a regressão das alterações periapicais e, consequentemente, favorecendo o processo de reparo ósseo.
Palavras-chave: Relatos de casos; Assistência odontológica; Endodontia; Terapia fotodinâmica; Ensino; Ultrassom.

Resumen
El retratamiento endodóntico continúa siendo un desafío para la Endodoncia, así como apoyar técnicas que apuntan a mejorar y asistir en la eliminación de microorganismos que han infectado los sistemas de conductos radiculares y

conducido al desarrollo de peripicopatías, como la Irrigación Ultrasónica Pasiva (PUI) y la Terapia Fotodinámica Antimicrobiana (aPDT) se ha utilizado con frecuencia. Así, el objetivo de este trabajo es reportar un caso clínico de retratamiento endodóntico del diente 47 con diagnóstico de lesión de endoperio asociada a lesión periapical. El tratamiento se realizó en dos sesiones, utilizando como medicación intracanal hidróxido de calcio con paraclorofenol con alcanfor, PUI en ambos riegos finales y previamente se realizó el relleno radicular con aPDT. Al final del tratamiento se pudo observar una reducción de las áreas radiolúcidas, sugiriendo el inicio de la reparación ósea. Este reporte de caso sugiere que la PUI y la aPDT asociadas al retratamiento endodóntico pueden mejorar la desinfección, favoreciendo la regresión de las alteraciones periapicales y, consecuentemente, favoreciendo el proceso de reparación ósea.
Palabras clave: Informes de casos; Atención odontológica; Endodoncia; Fotoquimioterapia; Enseñanza; Ultrasonido.

1. Introduction

Insufficient disinfection of the root canal system (SCR) is one of the main reasons for the persistence of periapical pathology (Amaral et al., 2019; Muhammad et al., 2014). The conventional way to disinfect the SCR consists of mechanical chemical preparation (Akcay et al., 2016; Bordea et al., 2020) that combines the physical action of the instrument with the antimicrobial chemical activity of an irrigating solution such as sodium hypochlorite (Sarda et al., 2019).

Advances in endodontic disinfection have focused on auxiliary alternatives, such as Passive Ultrasonic Irrigation (PUI), and Photodynamic Antimicrobial Therapy (aPDT) (Bordea et al., 2020; Lopes et al., 2019; Plotino et al., 2016; Tennert et al., 2015; Townsend & Maki, 2009).

The effectiveness in removing dirt from the irrigating solution is related to the direct contact with the walls of the root canals, which is limited if restricted to conventional irrigation using conventional irrigation syringes and needles. To improve this cleaning potential, it is proposed to use means that agitate the irrigating solutions, such as the PUI in which the acoustic energy is transmitted through an ultrasonic insert to the irrigating solution in the root canal driven by ultrasonic waves. This procedure can increase the penetration of disinfectant irrigants, increasing their antimicrobial effectiveness (Ahangari et al., 2021; Moreira et al., 2019; Plotino et al., 2016; Townsend & Maki, 2009).

The aPDT consists of a combination of a nontoxic photosensitizer and an irradiation with a visible light source at an appropriate wavelength, generated by a low-power laser (Bordea et al., 2020; Sarda et al., 2019). The activation of the non-toxic photosensitizer by the low power laser in the presence of oxygen and oxygen leads to the generation of reactive oxygen species that can penetrate the bacterial cell wall and induce cell death (Ahangari et al., 2021; Er Karaoglu et al., 2020; Ghorbanzadeh et al., 2020; Plotino et al., 2019; Pourhajibagher et al., 2020; Sarda et al., 2019; Tennert et al., 2015).

Endodontic retreatment is the treatment of choice when endodontic therapy fails, which aims to provide a favorable environment for periapical healing through the complete removal of filling materials, debris and microorganisms (Garcez et al., 2008). Since PUI and aPDT act as adjuvants during endodontic treatment, optimizing the disinfection of the root canal. This case report aims to describe an endodontic retreatment in which both aPDT and PUI were used to improve disinfection favoring the regression of periapical lesions.

2. Methodology

This is a descriptive and exploratory study of the case report type (Pereira et al., 2018), which aims to describe how adjuvant methodologies to endodontic treatment can be used to favor both the decontamination of the root canal system and the bone repair process. Every patient treated at undergraduate endodontic clinic of Federal University of Alfenas, as well as the patient of this case report, sign an informed consent form in which they explain what will be done and that the patients agree to undergo the proposed dental treatment, in addition to providing treatment data for dissemination, for scientific purposes. Thus, respecting all ethical and individual protection aspects.

3. Case Report

A 35-year-old female patient had discomfort in chewing on tooth 47, unsatisfactory prosthetic crown, positive tests for vertical percussion and apical palpation. The radiographic examination showed previous endodontic treatment, bone loss in the interproximal region in communication with the periapex of the mesial root and periapical lesion in the distal root (Fig 1A). The diagnosis was an endoperiodontal lesion associated with a periapical lesion in the distal root, and retreatment associated with periodontal treatment was proposed.

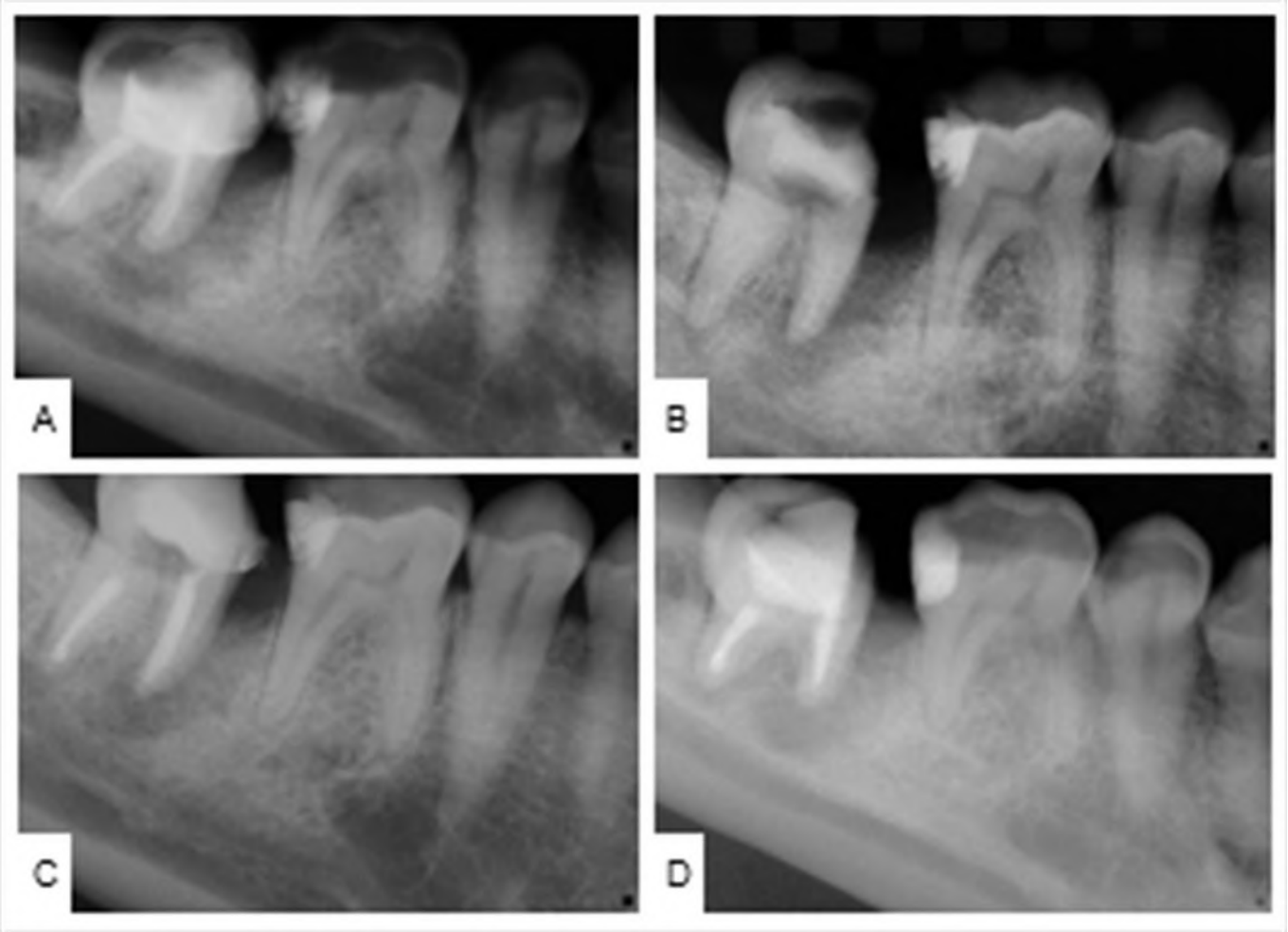
As the patient had a periapical lesion in the mesial root, periodontal treatment was performed in conjunction with endodontic treatment. The canals were prepared with the Protaper Universal-Retreatment system (Dentsply Maillefer, Petrópolis, RJ, Brazil) according to the manufacturer's recommendations. After the odontometry, the Glide Path was performed, establishing the working length (CT) and foraminal debridement in the real length of the tooth. The instrumentation was complemented with the HyFlex CM system (COLTENE, Altstätten, Switzerland) according to the manufacturer's recommendations. Between instrument changes, the canals were irrigated with 2.5% sodium hypochlorite (NaOCL) solution (ASFER, São Caetano do Sul, SP, Brazil).

In the final irrigation, the PUI was performed with the ultrasonic insert E1 – Irrisonic (Helse Ultrasonic, Santa Rosa de Viterbo, São Paulo, Brazil) positioned 2mm short of the CT. The insert was activated by the ultrasonic device, at a frequency of 50/60 Hz, power 10%, sequentially promoting 2.5% NaOCl, 17% EDTA (Formula e Ação, São Paulo, SP, Brazil) and 2 NaOCl 5% for 30 seconds. Washing was carried out with 0.9% saline solution, and then aPDT was applied with a red laser (Laser DUO, MMO, São Carlos, SP, Brazil) and 18J power. The 0.005% methylene blue dye (Chimiolux, DMC, Plantation, Florida, USA) was inserted into the canals for 3 minutes. The fiber was introduced to a point where fiber resistance was only felt, with movement from apical to cervical for 90 seconds. Irrigation with saline solution was performed until the dye was completely removed and the root canals were dry. After drying, the channels were filled with calcium hydroxide with Paramonochlorophenol Camphorated (Calen PMCC, SS White, Rio de Janeiro, RJ, Brazil).

After 20 days, the patient reported a decrease in discomfort and the radiographic examination showed a decrease in the radiolucent area (Fig 1B). After removing the MIC, the PUI protocol was performed and then another aPDT protocol, both as described above. We opted for the double realization of the aPDT with the objective of promoting greater decontamination of the microbial content as previously pointed out in the literature (Garcez et al., 2008).

The obturation was performed with the AH Plus (Dentsply Maillefer, Petrópolis, RJ, Brazil) the cavity was sealed with glass ionomer (SS White, Rio de Janeiro, RJ Brazil), and the final periapical radiograph was taken (Figure 1C). After 30 days, the patient did not report discomfort and the percussion test and vertical palpation were negative. In radiographic examination, the pattern of reduction in the radiolucent area was maintained (Figure 1D).

Figure 1. Compiled from patient radiographs.

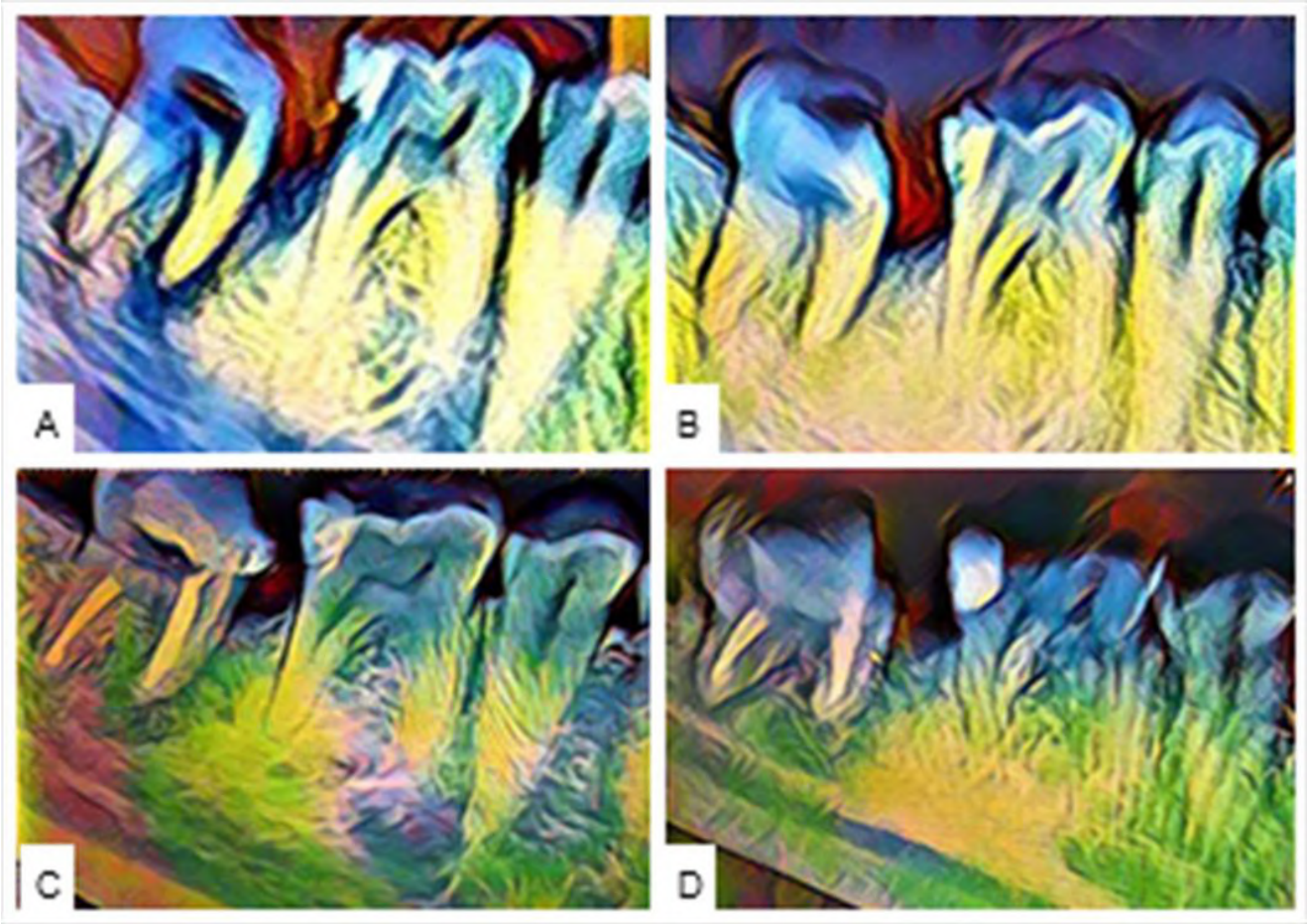


Source: Authors.

In this image is interesting to note, A: Initial radiographic examination. Presence of endoperium lesion in the mesial root (arrow) and periapical lesion in the distal root (arrow). B: – Radiographic examination after 20 days showing the filling of the root canals with MIC and a reduction in the radiolucent area (arrows). C: Final radiograph of root canal filling. D: Radiograph 30 days after canal filling.

The radiographs were photographed and the images analyzed in a LUMINI bioimpedance program (Figure 2), which acts through the principle of luminescence, allowing for even more evident verification of the decrease in the radiolucent area.

Figure 2. Radiographs analyzed in bioimpedance software.



Source: Authors.

Images analyzed in the LUMINI bioimpedance program: A- Deobturation radiograph; B- Radiograph after 20 days with MIC, showing a decrease in radiolucent areas; C- Final obturation radiograph; D- Follow-up radiograph 30 days after filling.

3. Discussion

Laboratory (Khan et al., 2020) and clinical studies (Plotino et al., 2016), as well cases reports (Amaral et al., 2019; Lopes et al., 2019) suggest that aPDT improves periapical lesion healing, showing the potential of this method in the treatment of periapical periodontitis. In this clinical case, after the use of PUI and aPDT, the clinical and radiographic success was verified, showing the additional antimicrobial action that these methods can offer, especially in microorganisms resistant to conventional treatment.

Studies show the effectiveness of aPDT in eliminating several endodontic pathogens improving SCR disinfection (Bordea et al., 2020). The application of a photosensitizer followed by a light source generates a toxic reaction in the target cells, causing the death of microorganisms (Asnaashari et al., 2016). In the present study, we chose to use methylene blue as a photosensitizer, due to its hydrophilic nature, low molecular weight and efficiency in the generation of reactive oxygen species, other studies also chose to use this dye (Amaral et al., 2019; Khan et al., 2020; Plotino et al., 2016; Pourhajibagher et al., 2020).

It is noteworthy that the periapical repairs in this case were evidenced with only 20 days of MIC, which can be justified by the action of the methods used. PUI enhances the removal of smear layer, debris and filling material residues, reducing the microbiota and enabling better MIC penetration (Asnaashari et al., 2016). On the other hand, aPDT can potentiate the microbial reduction, allowing the periapical lesion to heal, due to the removal of the causal agent (Amaral et al., 2019; Vendramini et al., 2020) in addition to optimizing the repair by regulating the inflammatory process (Khan et al., 2020). You should also consider the more even distribution of laser light across the channel, reaching hard-to-reach areas in the SCR (Afkhami et al., 2020; Amaral et al., 2019; Er Karaoglu et al., 2020; Hashem et al., 2020).

The association of aPDT and PUI for the most effective removal of biofilm was tested in a laboratory study with positive disinfection results (Ahangari et al., 2021), which reinforces the positive healing results demonstrated in this case report.

In the present work, it was radiographically verified a decrease in the radiolucent areas and not the total repair of the lesions. After controlling the endodontic infection, the inflammation of the periradicular tissues gradually decreases and the healing process begins. However, the regeneration of periodontal tissues after endodontic treatment is a difficult process due to the variety of tissues that need to be formed to restore normal conditions in the apical region. The average time for total cure is 11 to 78 months, with 1 year being the minimum time (Ricucci et al., 2014). In this case, the follow-up is until 30 days post-treatment, however, during this follow-up time, it was possible to verify satisfactory clinical and radiographic results.

4. Final Considerations

This case report suggests that the use of auxiliary methods for endodontic treatment, PUI and aPDT may favor SCR decontamination and, therefore, favor the regression of periapical alterations, even in short-term follow-up.

Given the possibility of the promising results of the combination of these therapies, it is encouraged to carry out new clinical studies that compare this association with conventional endodontic treatment, especially in the long term, to analyze both the pattern and the time required for healing of apical periodontitis or endoperiodontal injuries.

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