Photodynamic therapy as an endodontic treatment coadjuvant: case report

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ABSTRACT

Introduction: Photodynamic therapy appears in endodontics as a treatment method that uses low level laser therapy with analgesic, anti-inflammatory and antibacterial. **Goal:** This paper aims to present and discuss through an endodontic treatment using photodynamic therapy as an ally against persistent bacteria after chemical-mechanical canal preparation. **Case report:** GR patient, 40, appeared in private practice, with throbbing pain, sensitive to shock, with acute apical periodontitis, the element 22. After anamnesis, X-ray examinations and tooth, endodontic treatment was performed with the system ProTaper Universal® (Dentsply), hybrid technique; irrigation with sodium hypochlorite 2.5%, ultrasonic agitation associated; instrumented and dry. Then it was applied to photodynamic therapy, 0.005% methylene blue dye was applied in the dry channel for 5 minutes followed by red laser for 180 seconds totaling 18J (Portable Laser DUO-MMO®) with the apex moves to the incisal, the new sequence NaOCl irrigation and after EDTA 17% with ultrasonic agitation for one minute followed by 2.5% NaOCl for neutralizing medium; Dry the canal obturation was performed with the single cone F3 ProTaper® Universal and cementation with AHPLUS®. **Conclusion:** We conclude that photodynamic therapy is a method of quick and easy application that comes as an adjunct to endodontic treatment, and is indicated for the elimination of persistent microorganisms after chemical-mechanical preparation of root canals.

Keywords: Endodontics. Laser therapy. Microbiota.

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Introduction

Endodontic infection is caused by the continuous growth of pathogenic microorganisms associated with the bacterial biofilm. This proliferation of microorganisms tends to reach the root canals and constitute pulp disease, as there is a need for endodontic intervention.[1] Even after the chemical-mechanical preparation of root canal systems, some bacteria can survive inside the channels.[2] These persistent microorganisms are organized in communities with strong protection against other competitive bacteria, the immune system and antiseptic and antimicrobial substances.[3]

The irrigating agents used in endodontics still present some flaws related to the antimicrobial action.[4] In view of the vast organization of the biofilm of Enterococcus faecalis, it is a gram-positive bacterium of great virulence and difficult to eliminate in the endondontic treatment.[5] Therefore, it is necessary an association of efficient methods for a correct disinfection of the root canals.[6,7]

Thus, for adequate elimination of pulp microorganisms, studies have demonstrated a good effectiveness of photodynamic therapy as an adjunct to endodontic treatment. Its action seeks to eliminate microorganisms present after the chemical-mechanical preparation of the root canal system.[8,9] Thus, the technique is a treatment method that uses low-power laser therapy with analgesic, anti-inflammatory and antibacterial.[8]

In vitro studies indicate that the photodynamic therapy associated with sodium hypochlorite (NaOCl), act positively for the elimination of intra-radicular bacteria.[10] The technique uses low-intensity laser during its daily clinical use in endodontic procedures,[11] acting against infection and bacterial resistance, but it must be used in conjunction with the conventional channel cleaning treatment.[12]

The objective of this clinical case report is to present the photodynamic therapy (PDT) technique as an adjunct to endodontic treatment for disinfection of root canal systems.

Materials and methods

The information collected for this case report was obtained from articles cataloged in the Medline, PubMed and Scielo databases, including systematic and non-systematic reviews, case-control studies and clinical research. The bibliographic analysis comprises articles from 2010 to 2017, with adaptation of important sections to the theme during the months of July and August of 2017. The descriptors used for this search were: "Endodontic", E/OR "Laserterapia", E/OR Microbiota ". Thus, the selected articles were those that obtained an adequate delineation as a database for the work.

The present case report did not use a microbiological culture for analysis. After the endodontic treatment, an 18-month follow-up was performed. This follow-up was made through clinical and radiographic examination of case proservation to verify the success of endodontic treatment and photodynamic therapy.

Case report

Patient GR, 40 years old, presented in a private practice with pulsatile pain, sensitive to percussion, with diagnosis of acute apical periodontitis in element 22. After anamnesis, initial radiographic examination (Fig 1) and odontometry, endodontics was performed with ProTaper® Universal System (Dentsply), by the instrumentation hybrid technique (following the technique of the Campinas-SP endodontic team); irrigation with 2.5% sodium hypochlorite (Fig 2), associated ultrasonic agitation, following the PUI irrigation protocol (three 20 second applications) for both sodium hypochlorite and 17% EDTA (Fig 3), and the channel was then instrumented and dried. Then, the photodynamic therapy was applied with the use of the optical fibers of the MMO: the 0.005% methylene blue dye was applied in the channel and dried for 5 minutes (Fig 4), the use of methylene blue is indicated as being highly soluble in water, which would avoid staining of the dental element. Then, the red laser was applied for 180 seconds, totaling 18 J (Fig 5, 6 and 7).This protocol was carried out following the guidelines of the manufacturer of the Laser DUO Portable-MMO® device, which is characterized by a GaA1As and INGaAIP semiconductor laser, with the output diameter of the beam in the nozzle of the laser pen measuring 3mm². The application of the laser light was performed with apical to incisal movements, with the optical fiber reaching the entire working length of the tooth. Further, NaOCl irrigation was performed, followed by application of 17%

Figure 1. Initial radiograph.

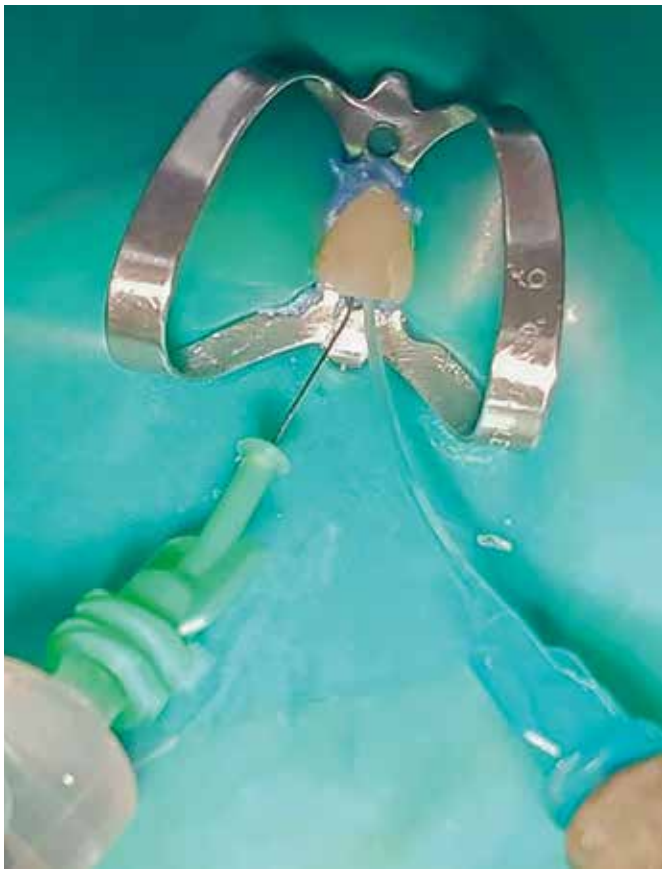

Figure 2. Irrigation of the root canal, with 2.5% Sodium Hypochlorite.

Figure 3. Ultrasonic agitation with irrigated root canal.

Figure 4. Application of 0.005% Methylene Blue in the dry root canal.

Figure 5. Red laser pointer to be introduced into the root canal.

Figure 6. Application of intracanal red laser (18J in 180s).

EDTA, with ultrasonic agitation for one minute followed by 2.5% NaOCl, and to obtain neutralization of the medium, and finish irrigation 0.9% saline solution. The endodontic treatment was performed in a single session and, therefore, the ultrasonic agitation was carried out, aiming at a potentiation of the irrigating liquids. Dry the canal, the obturation was performed with ProTaper® Universal single cone F3 (Fig 8) and cementation with AHPLUS® (Fig 9 and 10). To confirm the canal seal, a final periapical radiograph was performed (Fig 11). After 18 months a periapical radiography of the case was performed (Fig 12).

Figure 7. Application of intracanal red laser, with patient properly protected with glasses against laser radiation.

Figure 8. Single Cone F3 of ProTaper® Universal.

Figure 9. Material for root canal obturation - AHPLUS® cement.

Figure 10. Root canal obturation.

Figure 11. Final periapical radiograph.

Figure 12. Periapical radiography after 18 months.

Discussion

Endodontic treatment

Endodontic treatment should aim to eliminate microorganisms and prevent future reinfection.[13] For Silva et al. (2013),[14] the choice of sessions is a consequence of the professional's technique and clinical knowledge based on the best available evidence, and may be single or multiple sessions depending on the anatomy domain, infection control and dental screening. What makes single session treatment possible is the advent of rotary nickel-titanium systems.

The cleaning of root canal systems of infected pulp necrosis teeth, with or without periapical lesion, in a single session is a viable choice, provided that the professional has available time, mastery of the technique and the anatomy of the channels, to be successful in the therapeutics.[13,14]

Electronic foraminal locators have become an accurate and efficient method for determining the length of teeth with or without vitality of the pulp. These have several advantages, such as less amount of radiographic exposure and less loss in clinical time to determine a correct working length (CRT).[15]

The hybrid instrumentation technique consists in using an irrigation solution, manual files and rotary limb systems for the preparation of root canals, facilitating the professionals' work in the successful endodontic treatment. In the instrumentation phase, this technique becomes very effective, especially in single session treatments and in teeth with anatomical variations of the root canals, such as supernumerary channels and sharp root curvatures,[16,17] and in root canal treatments of internal root resorption.[18] The ProTaper® Universal system is reported as the best choice for again instrumentation in endodontic retreatments in the apical third.[19]

Sydney and colleagues (2014)[20] cite in their research concerning the implementation of the use of rotary endodontic systems, that the systems most used by dentists were ProTaper® (Dentsply/Maillefer) and Mtwo® (VDW).

For good disinfection and elimination of microorganisms in the root canals, NaOCl has been shown to be a good endodontic irrigator and, especially, effective in the elimination of Enterococcus faecalis[21]. In addition, the NaOCl irrigation solution provides an effective antifungal action against the microorganism Candida albicans.[22]

Yildirim et al. (2013)[23] compared the use of 5% NaOCl associated with photodynamic therapy in four groups. In 70 extracted teeth, the control group did not receive the treatment. Group 1 was treated with 5% NaOCl; in groups 2, 3 and 4, methylene blue and 660nm photosensitizer were used for 1,2 and 4 minutes. After instrumentation, they were irrigated with NaOCl solution, ethylene diamine-tetraacetic acid and saline solution. They were then autoclaved and stored for 21 days to verify biofilm formation. It has been found that the antimicrobial efficiency of the conventional technique compared to laser therapy has the same efficacy against Enteroccocus faecalis.

In order to evaluate the penetration of irrigators up to the working length in curved and conical root canals, two irrigation substances were used: 5.25% NaOCl and 17% EDTA in two methods of agitation after instrumentation. For this, a sample of 68 mesiolingual channels of lower molars with curvature between 30 ° and 40 ° was used. The teeth were radiographed, instrumented and irrigated with 5.25% NaOCl and after randomly divided into 2 groups. Group 1: Passive ultrasonic activation (PIU) + 17% EDTA; and, group 2: sonic irrigation (SI) + 17% EDTA. The results indicate that the PIU capacity to reach the working length was higher than that of SI.[24]

In the obturation phase, Tavares et al. (2012)[25] ensure that the Tagger hybrid technique is an important ally in obtaining a better apical seal and secondary canals in the middle and cervical third of root canals. The technique consists of - after the clean and dry channels - the placement of the gutta-percha cone with endodontic cement in the apical portion, by lateral condensation technique. Cones attachments are introduced into the middle and cervical portion of the channels and are thermoplasticized with the Mc Spadden compactor, at low speed and rotating clockwise. With the channel properly sealed, vertical condensation is made, with heated condensers. Also, they cite other benefits of this technique that avoids the apical extravasation of the cement, demands less clinical time and material saving.

In a randomized clinical trial, Maniglia-Ferreira et al. (2011)[26] analyzed the thickness of the endodontic cement line in obturated channels with three different techniques: the Tagger hybrid, the hydraulic compression and the lateral condensation. In conclusion, they stated statistically that the hybrid technique of Tagger was superior, with a lower thickness of cement, allowing a better sealing of the root canal with the material shutter.

Photodynamic therapy as an adjunct to endodontics

The procedure consists of the association of the agent triad: photosensitizer, light with specific wavelength and oxygen; generating reactive species capable of penetrating the cells of the pathogenic microflora, with the purpose of destroying them. This method presents several variables such as the dye to be used, the type of light or the time of irradiation.[27]

The PDT has as its characteristic to enable the elimination of persistent microorganisms after the chemical-mechanical preparation of the root canal system.[8] The 980nm diode laser acts on the elimination of bacteria that have already migrated into the dentin.[28] Thus, it is an indication of assistance in the treatment of oral infections, in order to facilitate the therapeutic process.[29]

The PDT in endodontics has the possibility of eliminating persistent microorganisms after the chemical-mechanical preparation of the root canal system. The 980nm diode laser acts on the elimination of bacteria that have already migrated into the dentin.[30] This is an indication of assistance in the treatment of oral infections in order to facilitate the therapeutic process.[29] The mechanism of action is based on the physical interaction, which is based on the production of irrigating waves in the root canals by infrared lasers that act directly for the thermal decontamination, PDT is a chemical reaction with bactericidal power.[12]

Scientific studies have shown significant reduction of the microbiota and claim that the use of laser therapy action, as well as the use of methylene blue or low-power laser in the visible red range act as a positive aspect in clinical procedures, although it is a procedure little diffused among the Dental Surgeons.[31]

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The way in which fungi and bacteria are destroyed by PDT comprises the rupture of the membrane and cell wall of these microorganisms by methylene blue, by the oxygen present, in which it will be sensitized by low intensity laser light, causing changes inside the cell, destroying it without causing damage to normal cells. Although several studies have proved the efficacy of PDT, there is still no clinical protocol for its use in endodontic treatments in the clinical daily life.[32]

Oliveira et al. (2014)[33] evaluated the action of PDT on four main microorganisms present in dental pathologies, in vitro: Candida albicans, Pseudomonas aeruginosa, Enterococcus faecalis and Staphylococcus aureus, when compared to no treatment, to observe the efficacy of PDT in reducing the number of these bacteria. The analysis was done in culture plates with no treatment and using methylene blue (50uM) and low power laser (660nm, 100mW and 9J). The results were collected from the number of microorganism forming colonies in the culture plate, showing a statistically significant reduction in the number of these bacteria when using PDT with methylene blue, reducing 74.90% of Candida albicans, 72.41 % of Pseudomonas aeruginosa, 96.44% of Enterococcus faecalis and 95.42% of Staphylococcus aureus, demonstrating the efficacy of the treatment alone, especially against Enterococcus faecalis and Staphylococcus aureus.

The technique of photodynamic therapy, coupled with mechanical chemical preparation during treatment of root canals, positively cooperates for better decontamination, which tends to have a better success in endodontic treatment.[11,12] This form of disinfection acts in the elimination against primary infections of Enterococcus faecalis,[23,34] especially in cases of effective endodontic retreatment,[35] followed by correct modeling and disinfection and complete sterilization of the root systems.[36]

Another in vitro study evaluated adjuvant PDT in various irrigation protocols, including chlorhexidine and NaOCl. The results have suggested that both NaOCl and chlorhexidine associated with PDT demonstrate an efficiency in the reduction of bacterial biofilm in the root canals in extracted human teeth.[37]

There are numerous bacterial resistance to antibiotics. Therefore, there is a significant increase in the interest of dental professionals in making use of an efficient alternative such as PDT in a supportive and allied way against persistent endodontic infections after conventional treatment.[27]

However, Mesquita et al. (2013)[38] and Rosa et al. (2014)[39] conclude that there is a need to obtain a standardization of the dental office technique.

Conclusion

Photodynamic therapy is a method of easy and quick application, well accepted by the patient. However, it should not be used as a substitute in conventional endodontic procedures, since it appears as an adjunct to the endodontic treatment for the elimination of persistent microorganisms after the chemical-mechanical preparation of the root canals.

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