v. 1, n. 6, 2021

International Journal of Health Science

USE OF ANTIMICROBIAL PHOTODYNAMIC THERAPY IN THE TREATMENT OF INTRAORAL FISTULA: CASE REPORT

Hannah Barros Simões
Faculty of Dentistry, Federal University of Bahia
Salvador – Bahia
ORCID: 0000-0001-9820-0251

Luis Cardoso Rasquin
Faculty of Dentistry, Federal University of Bahia
Salvador – Bahia
ORCID: 0000-0002-5797-9999

Fabiola Bastos de Carvalho
Faculty of Dentistry, Federal University of Bahia
Salvador – Bahia
ORCID: 0000-0001-5326-9562

Abstract: Antimicrobial Photodynamic Therapy (aPDT) has been used as an adjunct in endodontic treatment to optimize the effectiveness of disinfection of the root canal system, thus increasing its success rate. Objective: To describe the use of aPDT via fistula as a non-invasive therapeutic approach in case of chronic periapical abscess with persistent fistula. A 19-year-old male patient came to the clinic complaining of the presence of a blister on the hard palate, also reporting that he had suffered dental trauma some years ago. During the clinical examination, a fistula was detected in the palate, close to tooth 11 and a negative response to the cold sensitivity test. Imaging examinations, periapical radiography and cone beam computed tomography showed a circumscribed radiolucent area associated with the apex of tooth 11, a hypodense area and palatal bone fenestration, and an image suggestive of an open apex, respectively. The suggestive diagnosis was chronic periapical abscess. The initial treatment plan included coronary opening, neutralization of the necrotic content of the root canal, and intracanal medication based on calcium hydroxide/pmcc for 15 days. After this period, it was observed that the fistula had not regressed, choosing to perform aPDT in the root canal (methylene blue 0.005%, pre-irradiation time 3 minutes, Laser AsGaAl λ 660nm, 100mW, 9J using optical fiber) and exchange of intracanal medication for another 15 days. Upon return, the clinical examination showed that the fistula was still present and active, so it was decided to perform aPDT in the fistula, with the same parameters used previously in the root canal. Fifteen days after performing aPDT on the fistula, the patient had no signs and symptoms. Before filling the root canal, an apical plug was performed with MTA flow (Ultradent, South Jordan – Utah/USA). Clinical, radiographic and tomographic control after 1 year of treatment showed absence of symptoms and bone neoformation in the periapical region, indicating that the therapeutic approach used proved to be effective in controlling the infection.
Keywords: Photodynamic Therapy, Fistula, Bacterial Biofilms.

INTRODUCTION

Microorganisms and their toxins are considered the main etiological agents of pulp and periradicular lesions and are the targets of endodontic treatment, since their reduction allows the repair of adjacent tissues (CHINIFORUSH et al., 2016; BORDEA et al., 2019). However, due to the complexity of root canal systems, with the presence of lateral canals, accessories, isthmuses and apical delta, as well as the presence of bacterial biofilms, chemical-mechanical debridement, a fundamental step in endodontic treatment, can be complemented with resources medications (intracanal medication) and adjuvant therapies with a view to improving disinfection, helping with residual and persistent infections. (CHINIFORUSH et al., 2016; SILVA et al., 2019; BORDEA et al., 2019).

Among these adjuvant therapies is the antimicrobial photodynamic therapy (aPDT), considered a non-invasive and non-causing method of microbial resistance, which consists of the use of a photosensitizer, associated with a light source that allows its activation through the length of suitable wave. The photosensitizer excited by light reacts with molecular oxygen providing the formation of singlet oxygen and free radicals that damage bacterial and fungal cells (CHINIFORUSH et al., 2016; SILVA et al., 2018; GARCEZ et al., 2018; BORDEA et al., 2019).

The main advantages of using a PDT are the absence of microbial resistance, thus allowing its repeated use, absence of allergic reactions, and strictly local effect, thus avoiding any

damage to adjacent tissues (CONEJERO et al., 2021).

In the literature a variety of aPDT protocols is found, either with different photosensitizers such as methylene blue (BORSATO et al., 2016; GARCEZ et al., 2018), toluidine blue (POURHAJIBAGHER et al., 2017; AFKHAMI et al. , 2020), phenothiazine chloride (HOEDKE et al., 2018; SILVA et al., 2019) or with different light sources such as laser diodes, Nd: YAG, Er: YSGG (MANG et al., 2015; BORDEA et al., 2019) and LED (ASNAASHARI et al., 2017; AFKHAMI et al, 2020). But, in general, the findings of the association of endodontic treatment with aPDT are the decrease in bacterial diversity, load and toxins, in addition to the repair of periapical tissues (BORDEA et al., 2019).

A randomized in-vivo study with 21 patients diagnosed with chronic apical periodontitis initially isolated an average of 4.57 bacterial species per root canal. After chemical-mechanical preparation, this average decreases to 2.57 bacterial species. And when chemical-mechanical preparation was associated with aPDT, 52.4% of root canals did not show colony-forming units (JURIC et al., 2014).

Silva et al. (2018) performed a clinical and molecular microbiological study in 5 patients, totaling 10 teeth, divided into 2 groups. Control group in which all operative steps were performed, filling the canal with calcium hydroxide paste and paramonochlorophenol for 7 days and subsequently filling the root canal. And the test group in which after chemical-mechanical preparation, the channel was filled with methylene blue 100 lg mL-1 for 5 minutes and irradiated with a GaAlP laser with a wavelength of 660nm, power of 100mW, dose of 4J through fiber optics. Obtaining as a result a statistically significant decrease in the amount of E. faecalis and Candida spp. in the test group.

Chronic periapical abscess is understood as a variation of periradicular lesions, in which the necrotic content of the root canal promotes inflammation in adjacent tissues, generating a communication pathway between the internal and external media, known as fistula (RICUCCI et al., 2014). Ricucci et al. (2014) presented a series of cases with histological and histobacteriological analyses, after performing periapical surgeries, demonstrated that factors such as the presence of bacterial biofilms on the outer surface of the root, between the layers of cemental tissue and in the lumen of the periapical lesion were associated to persistent infections even with endodontic treatment considered satisfactory.

Therefore, the aim of this article was to describe the use of antimicrobial photodynamic therapy via fistula, as a non-invasive therapeutic approach in case of chronic periapical abscess with persistent fistula.

CASE REPORT

Patient A.M.S.F, male, 19 years old, attended the clinic of the Integrated Clinic of the Faculty of Dentistry, Federal University of Bahia complaining of the presence of a "bubble" in the roof of the mouth, reporting having suffered dental trauma some years ago. The patient did not report any relevant medical history.

During clinical examination, a coronary access was observed with exposure of the pulp chamber (Figure 1A) and the presence of a fistula in the hard palate (Figure 1B), close to the anterior teeth. The response to the cold sensitivity test was negative on tooth 11 and positive on tooth 12. In tests of apical palpation and vertical percussion, the patient reported mild soreness. Imaging examinations, periapical radiography and cone beam computed tomography revealed a circumscribed radiolucent area associated

with the apex of tooth 11, a hypodense area, bone fenestration in the palate and an image suggestive of an open apex, respectively (Figure 1C and 1D).

After evaluating the clinical and radiographic data, a probable diagnosis of chronic periapical abscess in tooth 11 was reached. Endodontic treatment (necropulpectomy) was proposed as the first treatment option.

Under absolute isolation, coronary access was performed with a 1014 spherical diamond drill (KG Sorensen – Cotia – São Paulo – Brazil) and 3082 inactive end truncated conical diamond drill (KG Sorensen – Cotia – São Paulo – Brazil), followed by content neutralization canal necrotic in the crown apex direction, disinfectant penetration, with manual files type K number 120 to 80 (Dentsply/Sirona – Ballaigues - Switzerland), using irrigation with 2.5% sodium hypochlorite (Asfer, Santa Maria - São Caetano do Sul – SP, Brazil). Subsequently, odontometry (Figure 2A) was performed to obtain the actual working length (CRT), foraminal cleaning and chemical mechanical preparation with manual files, using irrigation with 2.5% sodium hypochlorite (Asfer, Santa Maria - São Caetano do South – SP, Brazil). After the preparation was completed, the root canal was washed with 0.5 ml of 17% Trisodium EDTA Liquid at 17% (Biodynamics – Ibiporã – Paraná – Brazil) and agitated for 01 minute with the ultrasonic insert Irrisonic (Helse – Santa Rosa de Viterbo - São Paulo, Brazil) coupled to the ultrasonic device (Enac – Osada - Japan). This protocol was repeated 3 times, with 17% EDTA renewal, totaling 1.5 ml at the end. Then, the canals were irrigated with 1ml NaOCl at 2.5% and then, with the dry canal, it was filled with intracanal medication (Figure 2B) based on calcium hydroxide with camphorized paramonochlorophenol (Calen PMCC SSWhite, Duflex – São Cristovão – Rio de Janeiro - Brazil) and the opening sealed with light-curing Ionofast glass ionomer cement (Biodynamics – Ibiporã – Paraná – Brazil).

After 15 days of the first session, it was observed that the fistula, present in the hard palate, was still active (Figure 3). It was then decided to perform aPDT via the root canal. Under absolute isolation, intracanal medication was removed, and then a final wash with EDTA and sodium hypochlorite was performed, similar to the previous session, and the root canal was then dried with sterilized absorbent paper tips and filled with 0.005% methylene blue (Pharmacy Pollen - Salvador - Bahia - Brazil) left for 3 minutes (pre-irradiation time), and then a AsGaAl red laser was used (Laser Duo – MMOptics - São Carlos - São Paulo - Brazil) λ 660nm, 100mW, 9J, 90s applied through optical fiber in the channel in helical movements in the CRT. Then, the canal was irrigated with 2.5% sodium hypochlorite, neutralized with saline solution, dried with an absorbent paper tip and refilled with calcium hydroxide with camphorized paramonochlorophenol (Calen PMCC SSWhite, Duflex – São Cristovão – Rio de Janeiro - Brazil) and the opening sealed with light-curing Ionofast glass ionomer cement (Biodynamics – Ibiporã – Paraná – Brazil).

At the third visit, the clinical examination showed that the fistula had not yet regressed (Figure 4A), thus choosing to perform aPDT via fistula. With the aid of a disposable syringe, 1ml of 0.005% methylene blue was inserted into the fistula, waiting for the pre-irradiation period of 3 minutes,performing right after aPDT with the aid of optical fiber inside the fistula, using the same parameters mentioned above (Figure 4B, 4C and 4D). In this session, the intracanal medication was not removed, and the patient was instructed to return after 15 days for a new evaluation.

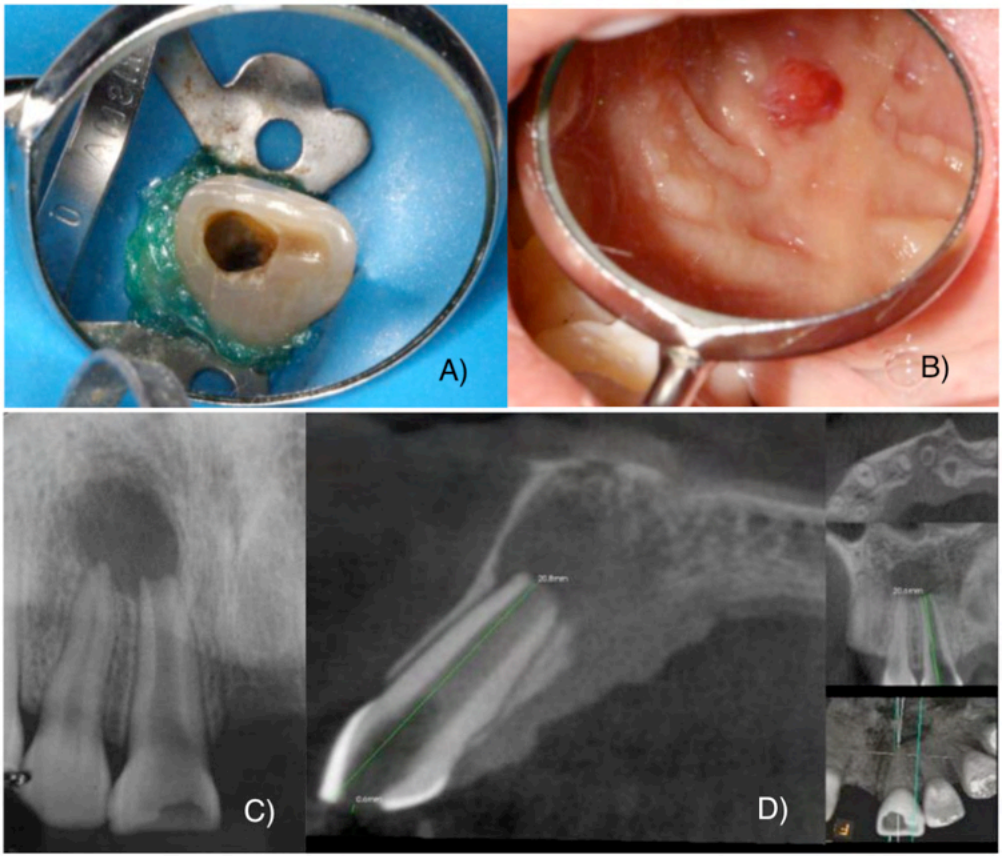

Figure 1: Initial clinical and imaging aspects. A) Initial clinical appearance of the fistula; B) Clinical image before the coronary opening; C) Periapical radiography; D) Sagittal section of cone beam computed tomography.

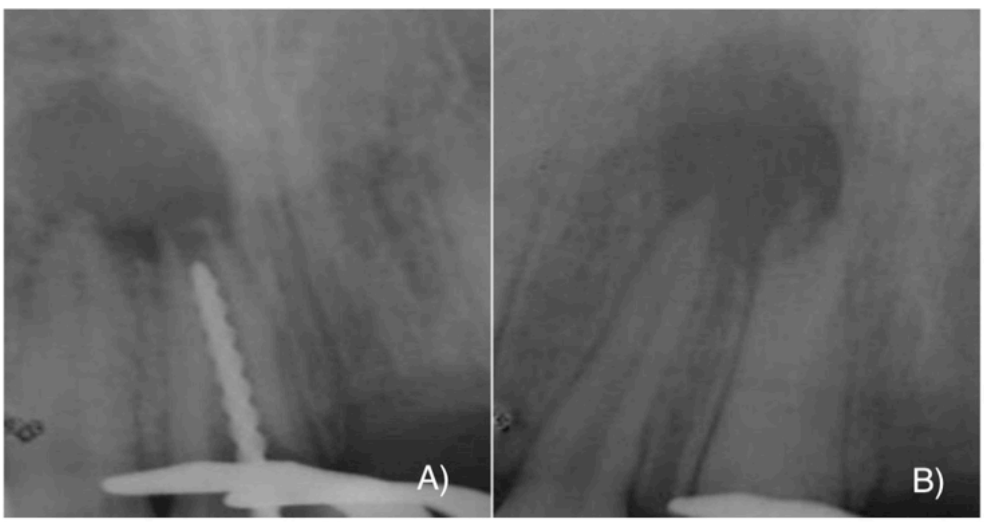

Figure 2: Operative steps of the first session. A) Odontometry; B) Intracanal medication – Callen PMCC.

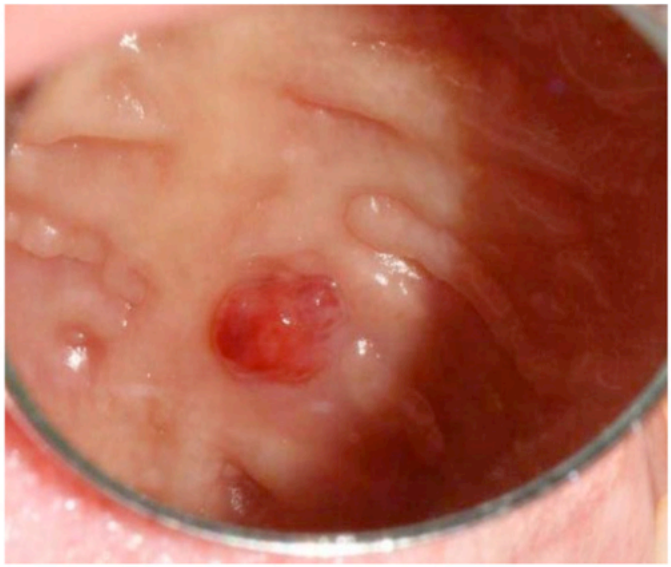

Figure 3: Clinical aspect of the fistula in the second session.

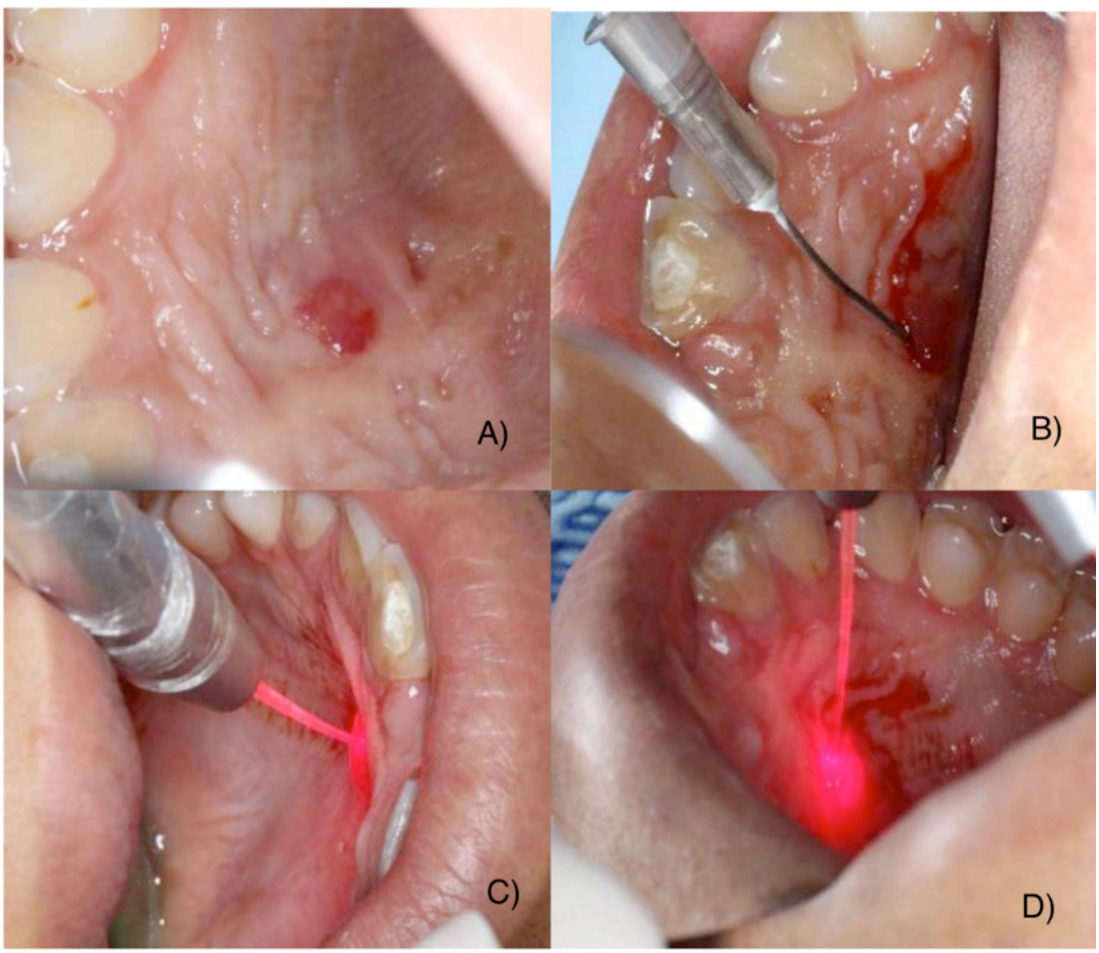

Figure 4: Third query. A) Clinical aspect of the fistula; B) Insertion of methylene blue inside the fistula; C and D) Application of the laser inside the fistula with the aid of optical fiber.

When the patient returned, it was possible to observe the complete regression of the fistula (Figure 5A) and the presence of a possibly expelled foreign body (Figure 5B) after the aPDT procedure. Thus, it was decided to carry out the filling of the root canal. Under absolute isolation, the intracanal medication was removed and the final wash was carried out with 17% EDTA and 2.5% sodium hypochlorite, and neutralized with saline solution. As this is a dental unit with an open apex, an apical plug (Figure 5C) was made with MTA flow (Ultradent, South Jordan – Utah/USA), and then root canal filling was performed with gutta percha and endodontic cement (Figure 5D).

After 1 year of follow-up, it was clinically possible to observe the absence of the fistula (Figure 6A) and any other sign or symptom, in addition to radiographically and on tomography images, the presence of an image suggestive of bone neoformation at the site of the periapical lesion (Figure 6B and 6C).

DISCUSSION

A fistula of endodontic origin is caused by pulp necrosis and invasion of microorganisms and by-products in the periradicular tissues. The presence of these causes inflammation in the region, with exudate production that seeks a less resistant route for drainage (PASTERNAK-JUNIOR et al., 2009). Treatment is based on eliminating the cause, which consists of usually in root canal disinfection, through endodontic treatment, providing a favorable environment for the spontaneous repair of the fistula (SLUTZKY-GOLDBERG et al., 2009).

However, due to the anatomical complexity of the root canal system, persistence of areas not touched by endodontic instruments, it is sometimes not possible to eliminate microorganisms from the root canals at subclinical levels that allow for repair, resulting in persistent infections. (ASNAASHARI et al., 2017).

In the present case, aPDT was performed via fistula associated with endodontic treatment in order to optimize disinfection and thus obtain the resolution of the chronic abscess in unit 11, in a more conservative way, since even after intracanal medication changes and aPDT via the root canal, the fistula remained active. A similar procedure was performed by Moreira et al. (2015) reporting two cases in which, even after quality endodontic retreatment, the fistula persisted, so before indicating surgical intervention, patients underwent aPDT via fistula with 0.01% methylene blue and 660nm laser irradiation , 40mW, 90J/cm2, in addition to laser photobiomodulation in the periapical region by the buccal and lingual regions, obtaining as a result, in both cases, fistula repair and a reduction in the periapical lesion.

Ricucci et al. (2018) performed a histobacteriological study to verify the apical conditions of the roots and periapical tissues of teeth associated with fistulas. For this, 24 human teeth with the presence of fistula (16 endodontically treated and 8 without endodontic treatment) were biopsied. As a result, it was possible to observe that in 22 teeth there was the presence of bacteria in the main canal, in addition 17 teeth had numerous apical branches, and at least one of them contained bacteria. Only 4 teeth (2 with endodontic treatment and 2 without endodontic treatment) did not show evidence of extra radicular infection, in the others there was the presence of bacterial biofilm adhered to the external surface of the root or planktonic bacteria close to the body of the lesions.

In view of this extra radicular infection present in cases of teeth associated with fistulas, the therapeutic value of the associated use of endodontic treatment and aPDT is highlighted, as Mang et al. (2015) demonstrated that aPDT, although it does

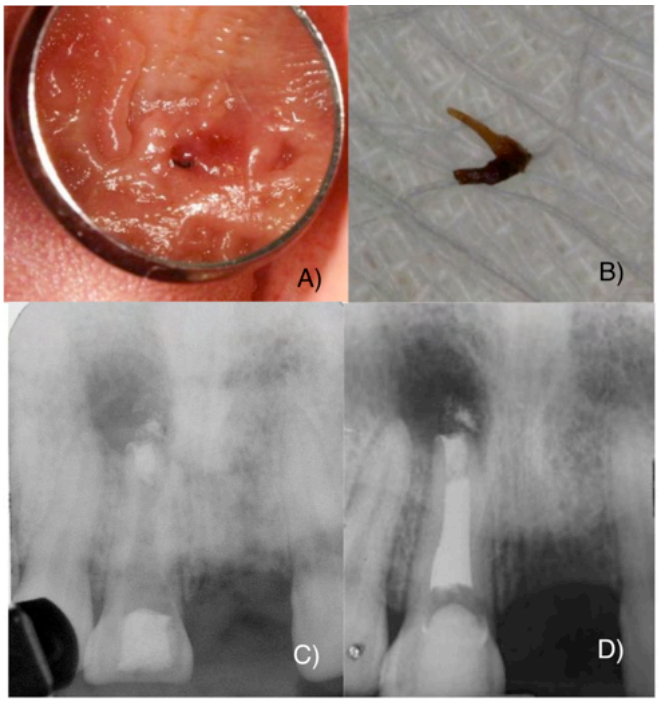

Figure 5: Fourth query. A) Clinical image of the fully healed fistula; B) Foreign body expelled; C) Apical plug; D) Root canal filling.

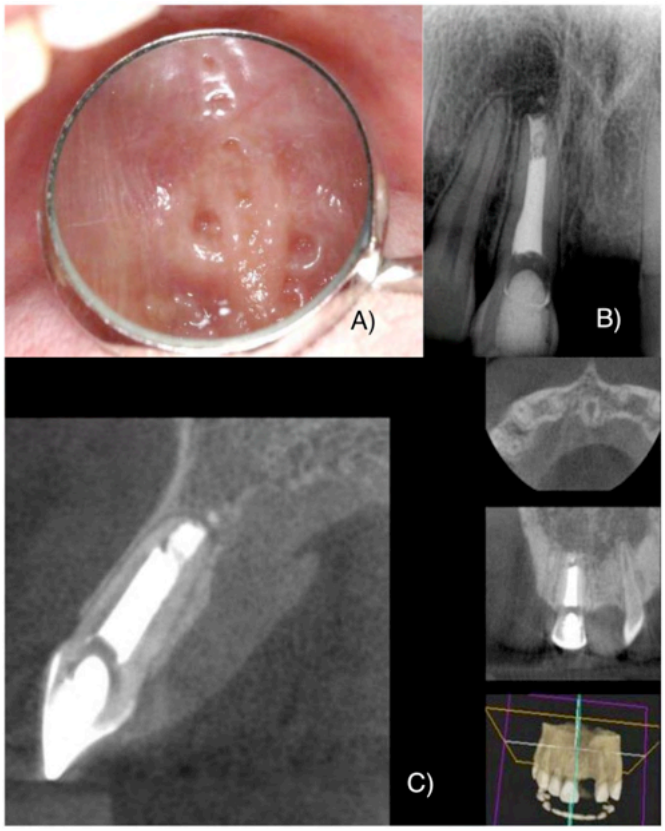

Figure 6: Proservation after 1 year. A) Clinical aspect of the hard palate; B) Periapical radiography; C) Sagittal section of cone beam computed tomography.

not cause changes in the architecture of the bacterial biofilm, through reactive oxygen species causes the loss of carbohydrate components in the biofilm, as well as impacts on its adhesion and formation. In addition to affecting the integrity of the cell membrane and interfering with the rate of cell division and virulence of microorganisms.

The present case report and the findings in the literature show that the association of aPDT with endodontic treatment seemed to be very beneficial, since singlet oxygen and free radicals can damage areas colonized by bacteria that could not be accessed by endodontic treatment.

FINAL CONSIDERATIONS

The clinical, radiographic and tomographic control after 1 year of endodontic treatment associated with aPDT via root canal and via fistula showed absence of painful symptoms, total regression of the fistula and image suggestive of bone neoformation in the periapical region, indicating that the therapeutic approach used proved to be effective in controlling the infection.

REFERENCES

AFKHAMI, F. et al. Evaluation of antimicrobial photodynamic therapy with toluidine blue against *Enterococcus faecalis:* Laser vs LED. **Photodiagnosis and photodynamic therapy**, Amsterdã, v. 32, p. 1-9. 2020.

ASNAASHARI, M. et al. A comparison between effect of photodynamic therapy by LED and calcium hydroxide therapy for root canal disinfection against *Enterococcus faecalis*: A randomized controlled trial. **Photodiagnosis and photodynamic therapy**, Amsterdã, v.17, p.226-232. 2017.

BORDEA, I.R. et al. Evaluation of the outcome of various laser therapy applications in root canal disinfection: A systematic review. **Photodiagnosis and photodynamic therapy**, Amsterdã, v. 29, p. 30271-6. 2020.

BORSATTO, M.C. et al. One-session root canal treatment with antimicrobial photodynamic therapy (aPDT): na in vivo study. **International Endodontic Journal**, Oxford, v. 49, p. 511-518. 2016.

CONEJERO, M.J. et al. Retrospective clinical evaluation of root canal treatment with or without photodynamic therapy for necrotic teeth and teeth subjected to retreatment. **Journal of Oral Science**, Tokyo, v.63, n. 2, p. 163-166. 2021.

GARCEZ, A.S.; HAMBLIN, M.R. Methylene Blue and Hydrogen Peroxide for Photodynamic Inactivation in Root Canal - A New Protocol for Use In Endodontics. **European Endodontic Journal**, Istambul, v.2, n.1, p. 1-16. 2017.

HOEDKE, D. et al. Effect of photodynamic therapy in combination with various irrigation protocols on an endodontic multispecies biofilm ex vivo. **International Endodontic Journal**, Oxford, v. 51, Suplemento 1, p. 23-34. 2018.

JURIC, B.I. et al. The antimicrobial effectiveness of photodynamic therapy used as an addition to the conventional endodontic re-treatment: A clinical study. **Photodiagnosis and Photodynamic Therapy**, Amsterdã, v. 11, n. 4, p. 549-555. 2014.

MANG, T. et al. Antimicrobial photodynamic therapy (aPDT) induction of biofilm matrix architectural and bioadhesive modifications. **Photodiagnosis and photodynamic therapy**, Amsterdã, v.13, p. 22-28. 2015.

MOREIRA, M.S.N.A. et al. Post-Treatment Apical Periodontitis Successfully Treated with Antimicrobial Photodynamic Therapy Via Sinus Tract and Laser Phototherapy: Report of Two Cases. **Photomedicine and Laser Surgery**, Nova York, v. 33, n.10, p. 1-5. 2015.

PASTERNAK-JÚNIOR, B. et al. Diagnosis and treatment of odontogenic cutaneous sinus tracts of endodontic origin: three case studies. **International Endodontic Journal**, Oxford, v. 42, p. 271-276. 2009.

POURHAJIBAGHER, M. et al. The evaluation of cultivable microbiota profile in patients with secondary endodontic infection before and after photoactivated disinfection. **Photodiagnosis and Photodynamic Therapy**, Amsterdã, v. 18, p.198-203. 2017.

RICUCCI, D. et al. Extraradicular Infection as the Cause of Persistent Symptoms: A Case Series. **Journal of Endodontic**, Maryland Heights, v. 41, n.2, p. 265-273. 2015.

RICUCCI, D. et al. Histobacteriologic Conditions of the Apical Root Canal System and Periapical Tissues in Teeth Associated with Sinus Tracts. **Journal of Endodontic**, Maryland Heights, v. 44, n.3, p. 405-413. 2018.

SILVA, C.C. et al. Antimicrobial Photodynamic Therapy Associated with Conventional Endodontic Treatment: A Clinical and Molecular Microbiological Study. **Photochemistry and Photobiology**, Lausanne, v. 94, n. 2, p. 351-356. 2018.

SILVA, L.A.B. et al. Comparison of apical periodontitis repair in endodontic treatment with calcium hydroxide-dressing and aPDT. **Brazilian Oral Research**, São Paulo, v. 33, p.1-13. 2019.

SLUTZKY-GOLDBERG, I. et al. Odontogenic sinus tracts: A cohort study. **Quintessence International**, Berlim, v. 40, n.1, p. 13-18. 2009.