The use of antimicrobial photodynamic therapy in the successful management of an invasive cervical resorption class 4: A case report with five years follow-up

Abstract

A 41-year-old male with a history of invasive cervical resorption (ICR) was initially treated with a surgical endodontics approach and secondly with antimicrobial photodynamic therapy (aPDT) along with endodontic retreatment. The use of aPDT was essential to promote the bacterial reduction in the resorption defect. Combining these techniques corroborates clinical, radiographic, and tomographic success after five years of follow-up.

Key Words: Antimicrobial photodynamic therapy, cone-beam computed tomography, endodontics, invasive cervical resorption

1. Introduction

Invasive cervical resorption (ICR) is a resorptive dental process originating as an entry point on the external root surface with the loss of the cementum's protective layer. Direct exposure of dentin to the periodontal ligament may lead to the invasion of clastic cells into the dentinal tissue. The tissue is then progressively replaced by inflammatory granulomatous tissue, and, in more advanced stages, it can demonstrate fibro-osseous characteristics. Such a resorptive process can have an irregular and random pattern, and the pericanalar wall is one of the last structures to suffer from the resorption process because of the presence of a non-mineralized predentin layer. However, the root canal may be perforated by the advancing resorptive lesion. ICR expands first coronally and, after that, apically, encircling the root canal [1, 2].

ICR's etiology is not fully understood, and there may be etiological factors that have not yet been identified. A previous history of dental trauma and/or orthodontic treatment are the factors most commonly associated with it [1]. Recently, the European Society of Endodontology published a position statement

on external cervical root resorption [3]. However, there have been only a few original clinical studies in this research area.

Antimicrobial photodynamic therapy (aPDT) is based on a photosensitizer (PS) and a resonant light source. In the presence of oxygen, the PS absorbs the resonant wavelength, and reactive oxygen species are generated. The procedure is effective against many microorganisms, such as bacteria and fungi, which may be present in the root canal system and dentinal tubules and may lead to periapical inflammation and failure [4,5].

The present case report describes using aPDT as an adjunctive treatment in a case that presented with severe ICR class 4, in which the surgical approach was not successfully achieved due to the severity of root canal resorption and probably persistent microorganisms located in the resorption area.

2. Case Report

A 41-year-old male patient was referred to an endodontist in Belo Horizonte, Minas Gerais, Brazil, to assess tooth #9. The patient had no history of medication or systemic diseases. An intraoral examination revealed no pain on palpation or tenderness to percussion. Clinical image and high-resolution cone-beam computed tomography (CBCT) showing the ICR can be seen in (Fig. 1A). The patient signed informed consent after discussing the clinical approach, prognosis, and the predictability of success. Surgical treatment was initially chosen to repair the root resorption defect.

The patient was anesthetized with 2% lignocaine with epinephrine 1:100,000 (DFL). An intrasulcular incision was made from the mesial of tooth #8 to the mesial of tooth #11 (Fig. 1B) with full thickness. After exposing the resorption area, the rubber dam was placed (Fig. 1C). The restoration performed on the palatal surface for endodontic access was adequately removed. A long-neck high-speed spherical diamond bur size 3 (FKG Dentaire, La Chaux-de-Fonds, Switzerland) was used to access the resorption area. With the aid of curettes, the inflammatory tissue was removed, and an extensive resorption area was revealed (Fig. 1D). The tissue was sent for histopathological analysis, which confirmed that

it had the characteristics of osteoid tissue (Fig. 1E, F). The refinement of the dentinal tissue was performed with a spherical carbide bur with low rotation. With the aid of a centrix syringe, the cavity was filled with a restorative glass ionomer (Ketac Fil Plus Aplicap, 3M, St. Paul, MN, USA) (Fig. 1G). The flap was repositioned and sutured with Vicryl 6.0 (Ethicon).

After a 30-day follow-up, the patient presented with a sinus tract in the area (Fig. 2A, B). A new CBCT scan showed incomplete sealing of the resorption defect (Fig. 2 C, D). Therefore, endodontic retreatment was recommended. Gutta-percha was removed to access the resorption defect, and the area was cleaned with a spherical diamond bur size 3 (FKG Dentaire) and using the ultrasonic tip E3D ball diamond and E2D conical diamond (Helse Ultrasonic, Santa Rosa de Viterbo, Brazil). The tooth was then instrumented with ProTaper Next up to size #50.06. Irrigation with 3 mL of 2.5% NaOCl solution was performed after each enlarging instrument throughout the preparation using a sterile disposable plastic syringe. Upon completing cleaning and shaping, the root canals were irrigated with 3 mL of 17% EDTA solution, pH 7.4, for three minutes, followed by final irrigation with 3 mL of 2.5% NaOCl solution. Afterward, irrigation with 3 mL of 3% hydrogen peroxide was performed inside the root canal and left inside for one minute to eliminate residual NaOCl solution, which would interfere with the photosensitizer. Then the root canals were irrigated with 0.005% methylene blue solution (Chimiolux; DMC, São Carlos, Brazil) (Fig. 2E) used as a photosensitizer (PS). The methylene blue solution within the canal was irradiated with a low-intensity laser (Therapy XT; DMC, São Carlos, Brazil) using the following parameters: 100 mW, 9 J energy , continuous emission, 660 nm wavelength, and 90 s time. A light diffuser was coupled to the diode laser and inserted into the root canal (Fig. 2F). Between the application of the PS and the laser activation, a 5 min waiting period was taken. After laser irradiation was performed, the root canals were irrigated with 3 mL of 2.5% NaOCl to remove residual methylene blue solution and dried with paper points (Dentsply Latin America, Petrópolis, RJ, Brazil). Our group previously described this protocol. (4)

The root canal was filled with calcium hydroxide UltraCal XS (Ultradent, South Jordan, UT, USA) for 15 days (Fig. 2G, H). Later, it was removed, and the root

canal was filled with gutta-percha cones and a bioceramic sealer (Bio-C Sealer; Angelus, Londrina, Brazil). No systemic antibiotic was prescribed to the patient. The tooth was restored with composite resin (Fig. 2I).

3. Results

After periodic evaluations at 3, 6, 12, and 60 months, the tooth was completely asymptomatic and functional. Radiographic and tomographic examination revealed the successful approaches after five years of follow-up (Fig. 2J, K, L).

4. Discussion

According to Heithersay´s classification system, ICR is divided into four classes, depending on the extent of the lesion. Class 1 refers to a small invasive resorptive lesion near the cervical area with shallow penetration into dentin. Class 2 is characterized by a well-defined invasive resorptive lesion that has penetrated close to the coronal pulp chamber but shows little or no extension into the radicular dentin. Class 3 is defined by a deeper invasion into the dentin by resorbing tissue, involving the coronal dentin and extending into at least the coronal third of the root. ICR class 4 is characterized by an extensive invasive resorptive process developed beyond the coronal third of the root canal [1].

The literature recommends different approaches for ICRs, both surgical and nonsurgical. Surgical methods include a flap procedure to allow access to the defect to remove the resorptive tissue and the placement of dentin bonded or glass ionomer cement [6]. Typically, nonsurgical approaches require the mechanical or chemical removal of the resorptive tissue during root canal treatment [7].

This case describes using aPDT as an adjunctive therapy during root canal retreatment in a patient presented with severe ICR class 4. The surgical approach was not successfully achieved due to the severity of root canal resorption and probably persistent microorganisms located in the resorption area.

The CBCT exam showed that the resorption was located in the cervical and middle third of the root. This area can contain several interconnections with the periodontal ligament (PDL). The histological image of the portal of entry, located in the cementum below the gingival epithelial attachment of tooth #9 with ICR, revealed osteoid tissue.

One stimulating factor that has been suggested for the continuity of ICR includes persistent bacteria [8, 9]. In the current case, aPDT was performed because it has proved to be an effective approach in endodontic treatment for both in vitro and in vivo studies [4, 5, 10, 11]. It consists of the application of a PS in the root canal and a light source resonant with the emission peak of the PS that generates local singlet oxygen and free oxygen radicals. This approach was expected to reduce persistent microorganisms in the root canal space, dentinal tubules, and ICR beyond a critical threshold [4]. There have been no published studies using aPDT for class 4 ICR treatment to the best of our knowledge.

5. Conclusion

In conclusion, this case report illustrated that using aPDT as an adjunct therapy in nonsurgical endodontic retreatment with class 4 ICR promoted sufficient microbial reduction corroborating clinical, radiographic, and tomographic success after five years of follow-up.

Acknowledgments

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior Brasil (CAPES) — Finance Code 001.

Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Pró-Reitoria de Pesquisa da UFMG.

The authors are grateful for the postgraduate program at the School of Dentistry of UFMG.

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Figure Legends

Figure 1. A – Clinical aspect and cone-beam computed tomography (CBCT) of the invasive cervical resorption of tooth #9. B – Incision using a blade 15C. C – Exposure of the resorption area. D – Image showing the extensive resorption area. E, F – Histopathologic exam confirming the presence of osteoid tissue. G – Restoration with glass ionomer.

Figure 2A, B. Radiographic and clinical aspect of the sinus tract. C, D – CBCT showing incomplete sealing of the resorption area. E – Canal filled with 0.005% methylene blue. F – A 300-µm light diffusor was inserted into the root canal. G, H – Calcium hydroxide intracanal placed. I – Buccal view of tooth #9 after completion of treatment (note the healing of the sinus tract). J, K, L – Periapical radiograph, CBCT, and clinical image after five years of follow-up.