



Effect of an 810 nm Diode Laser on the Healing of a Periapical Abscess

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Abstract

Introduction: The golden standard of the treatment of radicular cysts is mainly root canal therapy or surgical excision with apicectomy. The root canals are usually disinfected by the mechanical and chemical actions of instruments and chemical irrigating solutions respectively. To improve the efficacy of the root canal disinfection process, many techniques have been used and many researchers are still trying to reach the quickest and most convenient way to achieve this goal. Diode lasers have shown antibacterial activity on dentinal tubules, and they can penetrate more than 1000 μm into the dentin.

Case Presentation: Our patient was a 25-year-old female with an infraorbital abscess caused by a non-vital maxillary canine with periapical radiolucency. After completing the conventional treatment, the optical fiber was inserted into the canal according to the working length previously measured. An 810 nm diode laser at the output power of 4 W was used to irradiate the root canals, with a 300 μm fiber. The patient was free of pain within a few days. The lesion was resolved in radiographic follow-ups, 3 and 6 months after the root canal treatment.

Conclusion: A combination of conventional root canal therapy and an 810 nm diode laser is an effective treatment for non-vital teeth with periapical lesions.

Keywords: Diode laser; 810 nm Laser; Laser-assisted root canal therapy; Periapical abscess.



Introduction

Radicular cysts (also called periapical cysts) are the most common odontogenic cystic lesions of inflammatory origin.^{1,2} The golden standard of the treatment is mainly root canal therapy or surgical excision with apicectomy.^{2,3} The elimination of the microorganism from the root canals, their coronal seal and also the host response are the keys to successful endodontic treatment.⁴ The root canals are usually disinfected by the mechanical and chemical actions of instruments and irrigating solutions respectively.⁵ To improve the efficacy of the root canal disinfection process many techniques have been used and lots of researches are still conducted to reach the quickest and most convenient way of achieving this goal.^{6,7} Lasers have been introduced as a promising alternative to conventional chemical irrigation, in endodontics since a long time ago.⁸

Diode lasers have shown antibacterial activity on dentinal tubules, they can penetrate more than 1000 μm into the dentin. So they are able to eliminate bacteria from the dentin.^{9,10} Here we present a case of a periapical cyst

with an acute abscess which was treated by 810nm diode laser assisted root canal therapy.

Case Presentation

The patient was a 25-year-old female complaining of swelling on her face. Overall, she was healthy and her medical history was not contributory. On clinical examination she had an infraorbital abscess. In radiographic examination, there was a radiolucency at the apex of the left maxillary canine root. The clinical diagnosis was a periapical cyst. Local anesthesia was applied (lidocaine + epinephrine 1/80000, 1.8 mL). The abscess was perforated and decompressed by a sterile hollow needle. We used a rubber dam to isolate the tooth and disinfection was performed following the endodontic clinic standard disinfection protocol (Figure 1). First the tooth was disinfected by applying chlorhexidine 0.12%, then all the existing caries were removed by a high-speed drill and the remaining tooth structure was disinfected for the second time.

After measuring the canal length it was instrumented



Figure 1. The Isolated Tooth With an Initial File in Place. The periapical abscess can be seen around the root apex.

manually by endodontic standard files up to number ISO No.30. Then it was prepared and enlarged up to standard file ISO No.40 by the passive step-back technique. The root canal was irrigated by NaOCl 2% between the files during the instrumentation. After final irrigation with NaOCl 2% the smear layer was eliminated by EDTA 17%, then another 5 ml of NaOCl 2% was applied in the canal and the final rinse was carried out by normal saline. After completing the conventional treatment, the canal was completely dried with a sterile paper cone. The optical fiber was inserted into the canal until it reached the working length that was measured previously. A 300 μ m fiber was used to irradiate the root canals with an 810 nm diode laser, at the output power of 4 W (810 nm diode laser, Wuhan Gigaa Optronics Technology Co., Ltd.) (Figure 2).

The optic fiber was then irradiated in slow, circular, spiral movements in the apical to the coronal direction. The procedure was repeated four times with a speed of 2 mm/s. After the laser procedure, the canal was obturated with gutta-percha and AH26 sealer by the lateral condensation technique (Figure 3). The patient was prescribed Ibuprofen 400 mg tablets every 8 hours for 3 days. The patient was free of pain within a few days. The lesion was resolved in radiographic follow-ups, 3 and 6 months after the root canal treatment (Figure 4).

Discussion

The disinfection of the root canal system is critically important in the long-term success of root canal therapy. Due to the lack of ability of current mechanical and chemical ways of canal disinfection to reach the depth

of the dentinal tubules, pathogenic bacteria can survive easily and cause long-term failures and resistant cases of the endodontic treatment.¹¹

Laser technology was introduced to endodontics as an adjunctive therapeutic strategy, with the goal of improving the decontamination of the endodontic system. The development of new endodontic tips and thin flexible fibers led to the increasing application of this technology in the field of endodontic dentistry. Due to an extremely wide range of applications, possessing favorable antibacterial properties, relative safety and also more suitable price, diode lasers are now the most widely used types of laser devices in dentistry.¹²

These lasers have shown to possess good antimicrobial properties so they can be used instead of chemical irrigation procedures in root canal therapy.¹³ Different studies have evaluated various types of wavelengths for disinfection of root canals.¹⁴ The absorption coefficient of diode lasers in water is low ($\mu_a = 0.04-0.05 \text{ cm}^{-1}$) and as a consequence, they have low absorption in dentin.¹² The greater depth of penetration of diode laser irradiation can be the reason for its superior bactericidal effect (more than 1000 μ m into dentinal tubules).^{15,16}

These lasers can interact with pigments (e.g. melanin) of the root canal pathogens directly and exert a great bactericidal effect.^{17,18} They also cause thermal photo disruptive action in the unreachable parts of root canal dentin, resulting in an enhanced bactericidal effect there.^{15,16} In 2018, Martins et al. reported the reduction of the bacterial count in deep layers of the infected root canal wall up to 74% by means of the diode laser (810 nm).¹⁹



Figure 2. An 810 nm Diode Laser, With the Output Power of 4 W.(810 nm diode laser, Wuhan Gigaa Optronics Technology Co., Ltd.)

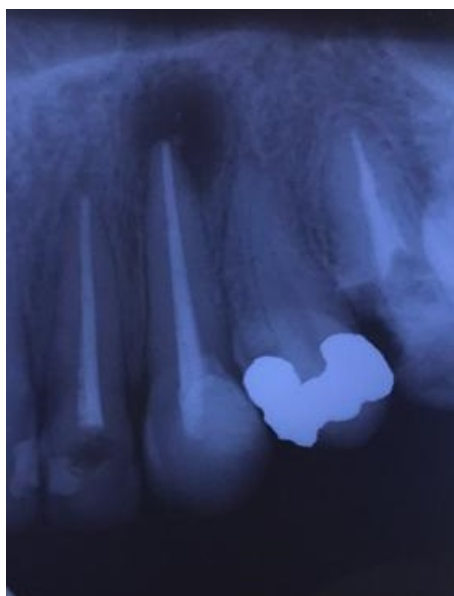


Figure 3. The Final Radiograph After Obturation With Gutta Percha by the Lateral Condensation Technique.



Figure 4. Resolution of the Periapical Lesion 6 Months After the 810 nm Diode Laser Assisted Endodontic Treatment.

In 2018, Tilakchand et al performed an in vivo study in order to evaluate the antibacterial effect of the diode laser on the infected root canal wall. The laser used in this study was EZLASE diode laser (940 nm). The results showed that a combination of irrigation with NaOCl and laser irradiation is more effective than conventional endodontic therapy for a reduction in bacterial flora from the root canal system.⁷

In 2014, Ashofteh et al performed a study on infected root canals to compare the antibacterial effect of intracanal

irrigants and diode lasers. They used an 830 nm diode laser and output power of 1.5 W and a frequency of 20 Hz. They concluded that diode lasers were not as effective as irrigants in disinfecting the root canal but they showed increased disinfection in deep dentin due to deeper penetration.¹³

In 2000, Gutknecht et al showed the capability of an 810 nm diode laser (3w, continuous mode) in the reduction of the bacterial count in the depth of the infected root canal wall dentin.¹⁴

According to another study conducted by Gutknecht et al in 2004, the success rate of root canal treatment increased by the application of a 980-nm diode laser in the root canal wall dentin. It was shown that the elimination of deep-seated bacteria happens due to the bactericidal effect of a 980-nm diode laser.⁶

Mehrvarzfar et al conducted an in vitro study in 2011 to compare the efficacy of diode laser and common irrigants in disinfecting the dental canals. Samples were contaminated with *Enterococcus faecalis*. The absence of growth and complete elimination of *Enterococcus faecalis* happened only in the teeth that received additional laser irradiation (diode 810 nm, 2 W) compared to the teeth that were only rinsed with disinfecting solution.¹⁵

As previously mentioned, there is plenty of literature that supports the use of lasers (both 810 and 940 nm) alone or in conjunction with irrigants to improve the disinfection of root canals.¹³

According to an in vitro study performed by Kafas and Kafas in 2008, the contact application of a diode laser can carbonize a radicular cyst. This case report was performed on the extracted upper left lateral incisor of a Caucasian female patient with swelling of the anterior upper jaw. The tooth with the soft-tissue lesion was decalcified by storing in buffered formalin, and then cut into two portions longitudinally. One portion was used for microscopic evaluation, which confirmed the diagnosis of the radicular cyst. The second portion received laser irradiation. The 808 nm laser settings were 1500 mW, continuous mode. The fiber optic had a diameter of 300 μm . The fiber-optic diode laser was inserted into the radicular cyst through the root and then it was activated. Cyst carbonization was observed in 30 seconds. Diode lasers can be associated with endodontic treatment in this manner and help the rapid healing of peri radicular cysts.¹

The most important concern about the clinical application of lasers is the intense heat produced by its irradiation and also the effect on sound periapical tissues. The diode laser has been reported to result in the least amount of heat among several other common types of lasers tested. Diode laser irradiation can result in the elimination of bacteria without leaving any cytotoxic effects on non-intact periapical tissues.^{20,21}

Conclusion

A combination of conventional root canal therapy and an 810 nm diode laser is an effective treatment for non-vital teeth with periapical lesions.

Ethical Considerations

Informed consent was acquired from the patient for the publication of this report.

Conflict of Interests

The authors declare no conflict of interest.

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