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Case Report

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Non-surgical Management of a Large Endodontic Lesion Using Diode Laser-Assisted Decompression and Photobiomodulation Therapy: A Case Report

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Abstract

Introduction: Endodontic periapical (PA) lesions are common sequelae of pulpal infections and often require root canal therapy (RCT) for resolution. Large lesions near vital anatomical structures are more important. A minimally invasive approach involving both diode laser-assisted disinfection and photobiomodulation therapy (PBMT) might be more suitable as both are less invasive while suppressing deep infection and promoting tissue healing.

Case Report: A 58-year-old female patient presented with a mandibular radicular cyst that extended from teeth #25 to #28 with a complicated buccal cortical perforation and proximity to the mental foramen. Treatment consisted of multi-visit root canal therapy with diode laser disinfection in the canals (980 nm, 200-µm fiber, 1 W, 1 second. for every 2 mm canal length, 4 passes) and PBMT (0.5 W, 30 seconds per point, 6 points; 7 sessions over 4 weeks) for the canals.

Conclusion: This case demonstrates that a large PA lesion was resolved through a distinctive diode-laser and PBMT, achieving significant healing in 10 months.

Keywords: Diode laser; Healing; Low-level laser therapy; Radicular cyst.

Introduction

Endodontic PA lesions, including granulomas, abscesses and cysts, arise as a consequence of microbial invasion of the pulp and subsequent periapical (PA) inflammation.[1] These lesions represent a significant challenge when they are large or involve adjacent anatomical structures such as the maxillary sinus or mandibular canal.[2] Conventional root canal therapy (RCT) aims to eradicate infection and promote PA healing; however, large cystic lesions often require surgical intervention when nonsurgical methods fail or when anatomical complications arise.[3,4]

Resolution of an infection requires removal of the source of infection and drainage of exudates. Drainage from a swelling decreases the number of microorganisms and their by-products. Surgical management, including apicoectomy or cyst enucleation, although effective, is invasive and associated with increased morbidity, postoperative discomfort, and potential complications. Therefore, minimally invasive alternatives that can enhance nonsurgical treatment outcomes are desirable.[5]

In recent years, the integration of laser technology into endodontic practice has revolutionized the management of persistent PA pathologies.[6] Diode laser is particularly effective in bacterial reduction and has been shown to accelerate the healing of PA lesions.[7] These lasers, with their compact design and ease of use, offer several advantages over traditional methods. They not only enhance root canal disinfection by targeting bacteria within dentinal tubules and inaccessible canal irregularities but also stimulate PA tissue healing through PBM.

Moreover, diode laser-assisted decompression presents a minimally invasive approach for managing large cystic lesions, potentially reducing the need for surgery and its associated risks.[8] Clinical studies have demonstrated that adjunctive laser therapy can lead to faster resolution of PA radiolucency, improved bone regeneration, and reduced postoperative symptoms.[9-12] Despite these promising outcomes, further research is needed to establish long-term efficacy.[8,13] Photobiomodulation therapy (PBMT) applied with a low-level laser therapy (LLLT) has shown good results in the acceleration of healing.

This case report describes the nonsurgical management of a large PA lesion near the mental foramen using high power diode laser irradiation and PBMT combined with conventional RCT. The clinical, radiographic, and histopathological findings are discussed, along with the treatment protocol and recall outcomes.

Case Presentation

Patient Information

In November 2023, a 58-year-old female patient presented to the endodontic clinic with a chief complaint of a persistent swelling on the gingiva adjacent to the mandibular anterior teeth. The patient reported mild

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discomfort but no pain. There was no history of dental trauma. Her medical history was non-contributory, with no systemic diseases or medications affecting healing.

Clinical Findings

Extraoral examination revealed no facial asymmetry or lymphadenopathy. Intraoral inspection showed a localized gingival swelling with a sinus tract near teeth #25 and #26. The mucosa was otherwise healthy, with no signs of generalized inflammation. Pulp sensibility tests indicated non-vital status in teeth #25, #26, and #28 (unresponsive to thermal tests such as cold spray, gutta-percha, and electrical pulpal test). The pulpal status of tooth #27 was previously treated. There was no tooth mobility and abnormal pocket depth. Teeth #25, #26, #27, and #28 were tender to percussion.

Radiology Findings

The initial panoramic radiography demonstrates a roughly oval-shaped lesion (Figure 1). The cone beam computed tomography (CBCT) scan showed a mixed radiolucent-radiopaque lesion with well-defined borders, extending from the distal aspect of tooth #24 to the mesial aspect of tooth #28 involving the mental foramen (Figure 2). Buccal cortical perforation was observed. Additionally, the lesion was in close proximity to the right mental foramen, raising concerns about potential neurovascular involvement. Differential diagnoses included granuloma, radicular cyst, central giant cell granuloma, odontogenic keratocyst, and unicystic ameloblastoma. These findings emphasize the importance of careful evaluation of lesion margins, cortical integrity, and anatomical relationships for accurate diagnosis and treatment planning.

Histopathological Examination

A biopsy specimen obtained during incision and drainage (I & D) was sent for histopathological analysis. The macroscopic description indicated a $1.5 \times 1 \times 1$ cm soft tissue fragment. Microscopic examination revealed a cystic lesion lined by non-keratinized stratified squamous epithelium with a fibrous connective tissue wall infiltrated by chronic inflammatory cells, consistent with a radicular cyst diagnosis.

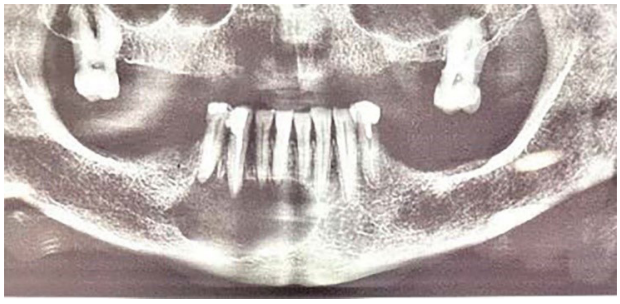

Figure 1. Pre-treatment Panoramic Radiograph Revealing a Large, Well-Corticated Radiolucency Along the Roots of Mandibular Anterior Teeth

Diagnosis

Based on clinical presentation and radiographic findings, a diagnosis of a large radicular cyst was confirmed.

Treatment Procedure

Prior to commencing the treatment, the patient was thoroughly informed about the proposed plan, including its benefits, risks, and available alternatives, and she provided written informed consent**.** The treatment plan included RCT combined with high-power diode laser therapy. At the first appointment, the patient's oral cavity was disinfected with 0.2% chlorhexidine mouthrinse for one minute. Inferior alveolar and mental nerve blocks were induced with persocaine-E (lidocaine HCL 2%/ Epinephrine 1:80000). Access cavity was established in the four teeth selected for endodontic treatment, and the root canals were located. All subsequent steps were done under rubber dam isolation. In tooth #27, gutta-percha in the third coronal root canal was removed passively by using Gates Glidden. Afterward, the rest of the canal fillings were removed by M Two retreatment files (VDW GmbH, Munich, Germany) and chloroform solution (Supelco, Merck KGaA, Germany). The patency of the canals was established by K file# 10 (Mani, Japan). The canals were prepared by the use of the crown-down technique using Profa rotary files (Sx, S1, S2, F1 and F2). Each rotary file was used for the instrumentation of four canals. The working length (WL) of the canal was defined by the apex finder (Propex IQ, Dentsply) and confirmed by a digital radiograph. After each use of the files, the canals were irrigated with 1 mL of 2.5% sodium hypochlorite (NaOCl) (Chloraxid, Cerkamed, Stalowa Wola, Poland) by using a 30-gauge needle (Guangxi Ehall Medical Technology Co, Ltd., Germany) inserted deeply and passively. Creamy calcium hydroxide ($Ca(OH)_2$) (Gholchadent, Golchai, Iran) was applied as an intracanal dressing for 10 days, and the cavity was filled with a temporary material (Coltosol, Coltene). I & D were performed to manage the associated swelling. A stab incision through the periosteum was made at the most dependent site on the swelling. The lesion was irrigated with warm normal saline. A hemostat was used for blunt dissection to allow drainage of any accumulated exudate. In the second appointment, the $Ca(OH)_2$ paste from the canals was removed with 5 mL NaOCl 2.5% and by using a Hedstrom file (Mani, Japan) corresponding to the master apical file. The smear layer was removed by 2 mL of 17% ethylene diamine tetraacetic acid (EDTA), followed by 2 mL of 5.25% NaOCl. After final rinsing with distilled water, the canal of tooth #27 was dried with paper points, the fiber was introduced 1 mm short of the WL, and a power output of 1 W was applied for 1 second for every 2 mm of canal length (Table 1).[10] During the laser irradiation, the endodontists, the patient, and the assistant wore protective eyewear. The root canal of

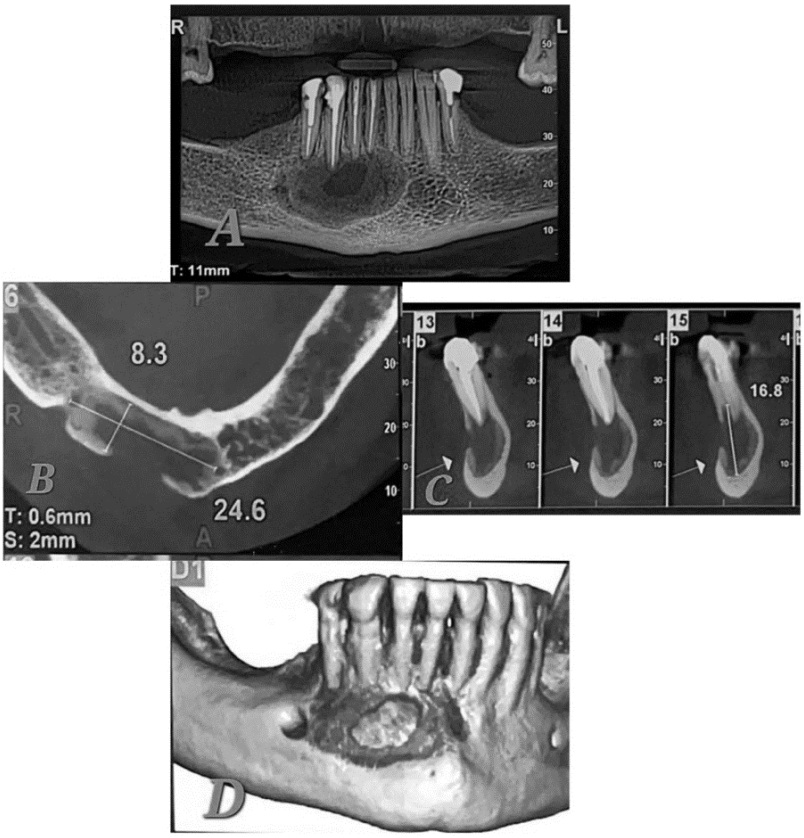

Figure 2. CBCT Images of the Clinical Case. (A) Panoramic reformation shows a large PA osseous radiolucency with a well-defined, corticated border involving the PA tissues of all teeth in between. (B) The axial view demonstrates the buccal cortical perforation and the extent of the lesion. (C) Sagittal views. (D) Three-dimensional reconstruction of the lesion

Table 1. Information About the High-Power Laser Device

Features	Information
Manufacturer	Simpler doctor smile
Model identifier	Class IV dental diode laser
Type of laser	High-power
Emitter type	Diode laser technology
Number of emitters	1
Operation mode	CW
Center wavelength	980 nm
Exposure duration	1 sec per 2 mm root canal length × 4 times (10 s between applications)
Power	1 W
Number of points irradiated	Entire root canal length
Beam spot size on target	Endodontic fiber tip (200 µm)
Application technique	Spiral apico-coronal sweeping motion

CW, Continuous Wave

Table 2. Device Information and Irradiation/Treatment Parameters

Features	Information
Manufacturer	Simpler Doctor Smile
Type of laser	Low-level
Delivery system	Fiber optic
Emitter type	Diode laser technology
Operation mode	SP
Center wavelength	980 nm
Exposure duration	30 sec per point
Energy density	30 J/cm²
Number of points irradiated	6
Total energy	90 J
Power	0.5 W
Application technique	contact
Beam divergence	No

SP, Short Pulse

tooth #27 was obturated using the lateral condensation technique with gutta-percha and AH 26 (Dentsply, Konstanz, Germany) sealer. PBMT was then applied with a low-power handpiece using a total energy of 90 J in an area of 3 cm^2 as described in Table 2.[14] The root canals of teeth # 25, 26 and 28 were not dried, and serous liquid was discharged, so after accurate chemical debridement, the $Ca(OH)_2$ was applied again. The third session was carried out 10 days later. The root canals of teeth # 25, 26 and 28 were dried, and the same protocol of disinfection, irrigation and obturation was applied. Seven days after obturation, composite fillings were placed to restore the teeth. During the first week after the completion of the RCT, one PBMT session was applied, followed by two

in the second week and one each in the third and fourth weeks, making a total of seven applications, all using the same protocol as described previously.

Follow-up and Outcomes

At the 10-month follow-up, the extraoral sinus tract was healed, swelling was absent, and radiography confirmed bone regeneration and lesion resolution (Figure 3).

Discussion

The management of large PA lesions traditionally involves surgical intervention. Therefore, nonsurgical alternatives that can effectively disinfect the root canal system and promote healing are highly desirable.[5] In the present case, the radicular cyst was successfully managed with a conservative, nonsurgical RCT supplemented by diode laser disinfection and PBMT. This approach resulted in the reduction of cystic volume and clinical resolution in a shorter period of time.[15] Unlike this report, in the study of Lewusz-Butkiewicz et al., endodontic surgical treatment was done after failed nonsurgical endodontic treatment. [4] Diode lasers have gained attention in endodontics for their antimicrobial properties and ability to stimulate tissue repair. The 980 nm wavelength diode laser penetrates dentinal tubules effectively, reducing the bacterial load beyond the reach of conventional irrigants. Additionally, PBM promotes fibroblast proliferation, collagen synthesis, and angiogenesis, accelerating PA tissue regeneration.[13,16] Because of these properties of laser irradiation, the signs and symptoms of the patient resolved very soon. A 200-µm fiber tip was used in contact mode, positioned 1 mm short of the WL, and activated for one second per 2 mm of canal length in four passes. This protocol was designed to maximize bacterial reduction while minimizing thermal risk.[17,18]

The lateral condensation obturation technique was chosen for its reliability in achieving a dense apical seal, critical for preventing reinfection. A 10-day interval between treatment sessions allowed inflammation to subside and enabled the assessment of healing. Chemomechanical debridement combined with I & D provided effective decompression and bioburden reduction. Systemic antibiotics were not prescribed, as the patient was otherwise healthy and presented with a draining sinus tract of endodontic origin. Irrigation of the lesion with warm saline further reduced cystic volume. This conservative method, together with laser therapy, was sufficient to promote healing.[19] Therefore, in this case, drainage was performed, and the defect was irrigated with warm saline. The radiographic follow-up revealed progressive bone regeneration. The absence of postoperative complications and complete resolution of symptoms further support the effectiveness of this protocol. The favorable outcomes observed over a 10-month follow-up period suggest promising results. These findings highlight the potential of diode laser–assisted endodontic therapy as a minimally invasive approach for managing large PA lesions. However, limitations of this report include that baseline intraoral clinical photographs could not be obtained because the patient did not provide consent for photography. Future randomized controlled trials with larger cohorts are needed to establish standardized protocols and confirm the long-term effectiveness of this approach.

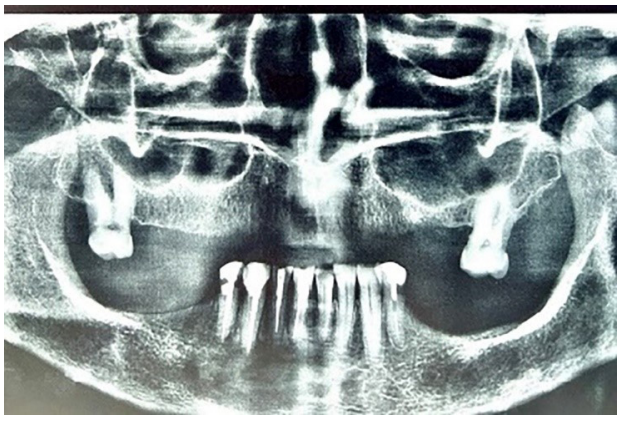

Figure 3. Panoramic Radiography: Post-treatment view after 10 months, indicating marked bone healing and osseous formation

Conclusion

This case indicates that a large radicular cyst was resolved through a distinctive diode laser and PBM protocol, achieving substantial healing in a shorter period of time. The approach provided effective disinfection, promoted accelerated healing, and avoided the morbidity associated with surgical intervention. Diode laser therapy represents a valuable tool in modern endodontics, offering minimally invasive treatment options for PA lesions.

Author's Contribution

Conceptualization: Soheila Darmiani.
Investigation: Soheila Darmiani.
Methodology: Soheila Darmiani.
Project administration: Soheila Darmiani.
Resources: Soheila Darmiani, Soroush Saleh Jahromi.
Supervision: Soheila Darmiani.
Visualization: Soheila Darmiani.
Writing-original draft: Soroush Saleh Jahromi.
Writing-review & editing: Soheila Darmiani, Soroush Saleh Jahromi.

Competing Interests

The authors declare no conflict of interest.

Ethical Approval

This case was approved by the Research Ethics Committee of Birjand University of Medical Sciences (IR.BUMS.REC.1404.204). In the present clinical case, the highest ethical standards in medical care were ensured.

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Patient's Consent

Written informed consent was obtained from the patient voluntarily.

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