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Diode Laser Irradiation in the Management of a Cutaneous Sinus Tract Related to an Infected Mandibular Molar: A Case Report

Soheila Darmiani [1], * Aida Tavakoli Roodi [1]

[1] Department of Endodontics, Faculty of Dentistry, Birjand University of Medical Sciences, Birjand, Iran.

Abstract

An odontogenic cutaneous sinus tract (OCST) is a complication of pulp necrosis and chronic periapical (PA) infection. It spreads to the skin surface through a sinus tract, creating diagnostic and therapeutic challenges for dentists and dermatologists. In pediatric patients, due to the thinner bone cortex, it may appear more rapidly and can lead to significant complications if left untreated. This case explains the management of a chronic cutaneous sinus tract. The tract was associated with pulp necrosis of the mandibular first molar and was treated via non-surgical root canal treatment (RCT) assisted with laser irradiation. Follow-up appointments confirmed the complete resolution of the sinus tract and the radiographic lesion.

Key Words: Cutaneous sinus tract, Diode laser, Mandibular molar, Pediatric endodontics, Root canal treatment.

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Corresponding Author:

Aida Tavakoli Roodi; Department of Endodontics, Faculty of Dentistry, Birjand University of Medical Sciences, Birjand, Iran.Tel: +989155733255; E-mail: aida_tavakkoli_1376@yahoo.com

1- INTRODUCTION

An odontogenic cutaneous sinus tract (OCST) is a rare but challenging case that originates from chronic periapical (PA) dental infections. This lesion creates an epithelialized or granulation tissue-lined pathway that drains pus from the PA abscess to the skin surface. In the pediatric population, bone metabolism is faster, and the bone cortex is thinner, especially in the mandible. Consequently, the extension of infection and formation of a cutaneous sinus tract can occur more rapidly (1, 2).

The appearance of this lesion is often non-specific and may be misdiagnosed for a long time as a primary skin problem. Misdiagnoses can include local bacterial infections (furuncles), epidermoid cysts, or other granulomatous lesions, which delays treating the responsible tooth (3-5). As noted in the report by Kaučikaitė et al. (2024), a palpable cord-like tract during intraoral examination is a critical diagnostic clue that connects the skin lesion to the infected tooth, helping differentiate this condition from primary skin diseases (2). In the mandible, infection from the first molars often spreads to the submandibular space. This is because the cortical bone is closer to the fascial planes (2, 6). The standard treatment approach is to remove the source of infection. This is achieved through root canal treatment (RCT) or extraction if the tooth is non-restorable (1, 7). However, in modern pediatric dentistry, the emphasis is on preserving the tooth and performing conservative, minimally invasive treatments. This preserves the integrity of the dental arch and its normal function (7). Technological advancements have introduced the use of lasers, particularly diode lasers, as an adjunct for root canal disinfection. The laser's mechanism of action is based on photothermal and photochemical effects. The laser beam has a bactericidal effect, especially in areas where access with traditional mechanical methods is limited. Low level laser therapy (LLLT) through biological stimulation of tissues accelerates the repair of PA tissues and helps reduce inflammation and edema (8, 9). This makes it an effective approach in treating cutaneous sinus tracts of dental origin (7). This case report describes the treatment of an OCST secondary to an infection of a mandibular first molar in an 8-year-old girl. It highlights the role of laser irradiation in achieving microbial reduction, stimulating faster bone regeneration, and lesion resolution.

2- CASE PRESENTATION

In March 2024, an otherwise healthy 8_yeard_old girl with no significant past medical history or systemic diseases (including no history of diabetes, immunodeficiency, or chronic medication use) was referred to the endodontic clinic by her general physician. She had a chronic, painless skin lesion with intermittent discharge in the right submandibular region (Figure 1.A). The lesion showed mild erythema and was approximately 1.5 cm in diameter. No laboratory tests were performed as there were no signs of systemic involvement or fever. Intraoral examination revealed deep occlusal caries in the mandibular right first molar (tooth #46). Pulp sensibility tests (thermal tests and electric pulp test from SybronEndo. CA, USA) were negative, indicating pulp necrosis. The tooth was asymptomatic and not tender to percussion or palpation. Periodontal probing depths were within normal limits (≤3 mm) except in the buccal aspect where a 7 mm pocket was detected.

A PA radiograph revealed a well-defined radiolucent lesion approximately 10 × 8 mm in size at the apices of the mesial and distal roots of tooth #46, with discontinuity of the buccal cortical plate suggesting the pathway of the sinus tract (Figure 1.B). No other teeth showed PA pathology . Probing of the soft tissue traced the sinus tract intraorally to the gingival sulcus near the

molar, suggesting a dental origin. After discussing treatment options and explaining the procedure, informed consent was obtained from the parents. Non-surgical RCT was initiated.

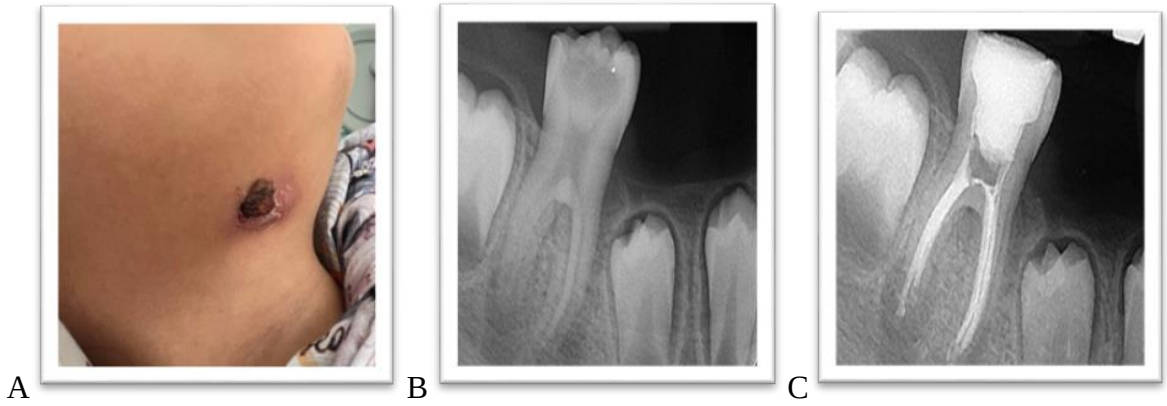


Figure-1: (A) Clinical appearance of the draining cutaneous lesion with mild erythema. (B) PA radiograph of the right mandibular first molar showing deep occlusal caries and a radiolucent lesion in the PA area .(C) PA radiograph after obturation.

2-1.Treatment Method

During the first appointment an inferior alveolar nerve block was administered using 2% lidocaine with 1:100,000 epinephrine to achieve deep anesthesia. Isolation was achieved with a rubber dam. After removing caries, a direct access cavity was prepared. Working lengths were established with an electronic apex locator (Propex IQ, Dentsply) and confirmed radiographically. Mechanical preparation of the canals was performed with Protaper Universal rotary file system (Dentsply, Sirona) in the sequence Sx, S1, S2, F1, and F2. For the distal root, preparation was continued up to an F3 file. During this process, the canals were irrigated with a total of 10 mL of 5.25% sodium hypochlorite (NaOCl) (Chloraxid, Cerkamed, Stalowa Wola, Poland) solution using a 30-gauge needle (Guangxi EhallMedical Technology Co,Ltd., Germany). Calcium hydroxide (Ca(OH)2) paste (Golchadent, Golchai, Iran) was placed as an intracanal medicament The access was temporarily sealed with Cavit (3M ESPE). The occlusion was checked to prevent premature contacts. Antibiotics were not prescribed.

Ten days after the first visit, the sinus tract was closed. After achieving anesthesia, under rubber dam isolation, the temporary restoration was removed. The canals were irrigated with 1.5% NaOCl to remove the calcium hydroxide. An XP-Endo Finisher file (FKG Dentaire, La-Chaux-de-Fonds, Switzerland) was used as an adjunctive technique for efficient cleaning. The smear layer was removed with 17% EDTA for 1 minute, followed by saline irrigation. The canals were dried with paper points. A high-power diode laser was irradiated inside the canals (Table 1). Due to the open root apices, a 4 mm Mineral Trioxide Aggregate (MTA) plug (Angelus) was placed in the apical third of the canals to create an apical seal. Obturation of the canals was performed with gutta-percha and AH 26 sealer (Dentsply, Konstanz, Germany) using cold lateral compaction. The final coronal restoration was placed. The OCST was irradiated using LLLT three times a week for two weeks (Table 2).

At the 1-month follow-up, the intermittent pus discharge from the lesion had resolved. After one year follow up, the patient was asymptomatic (Figure 2.A) and the coronal integrity was maintained. A radiographic evaluation confirmed

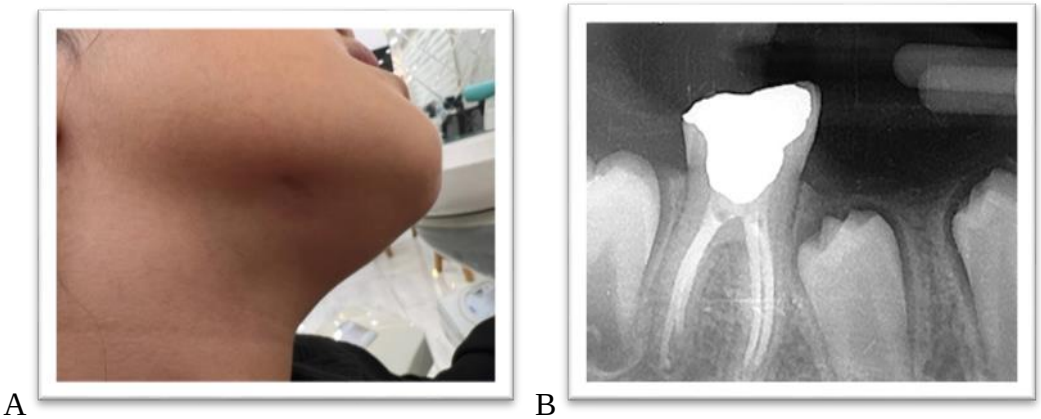
complete healing, with the intact MTA plug (Figure 2.B).

Table-1. Device information about the high-power laser.

Features	Information
Manufacturer	Simpler Doctor Smile
Model identifier	Class IV Dental Diode Laser
Type of laser	High power
Operation mode	Continuous wave
Wavelength	980 nm
Power	1 Watt
Exposure duration	1 s per 2 mm root canal length × 4 times (10 s between applications)
Number of points irradiated	Entire root canal length
Beam spot size on target	Endodontic fiber-optic tip(200µm)
Application technique	Spiral apico-coronal sweeping motion

Table-2. Information about the LLLT parameters.

Features	Information
Manufacturer	Simpler Doctor Smile
Type of laser	Low level
Delivery system	Fiber optic
Operation Mode	Short Pulse
Wavelength	980 nm
Exposure duration	30 s per point
Number of points irradiated	4
Total Energy	60 J
Power	500 mJ
Energy Density	20 J/cm^2
Application technique	contact



A B

Figure-2: Clinical appearance (A) and PA radiograph (B) after one year follow up.

3- DISCUSSION

This case report highlights the diagnostic and therapeutic challenges of cutaneous sinus tracts with dental origins in the pediatric population. Due to a thinner bone cortex and different immune responses, symptoms may appear more rapidly and complicate treatment (1). Partially erupted teeth in children are closer to the external cortex and situated within the developing alveolar bone, facilitating the spread of infection to the

skin surface (2). The lesion's non-specific appearance often leads to misdiagnosis as a primary skin condition (3), resulting in delayed correct treatment (4, 5). A thorough review of differential skin diagnoses similar to a cutaneous sinus tract is crucial. This lesion can be confused with pyogenic granuloma (lacking a dental connection) (3), bacterial skin infections like furuncles (10), epidermoid/dermoid cysts (often congenital) (11), deep fungal infections in immunocompromised patients (12), and rarely, skin malignancies (13). Congenital fistulas like branchial clefts should also be considered (6). Differentiating these conditions is possible based on history, physical examination, radiography, and biopsy if necessary (14, 15). Kaučikaitė et al. (2024) also emphasize that OCSTs are often misdiagnosed as common skin lesions like furuncles, acne cysts, or even sebaceous cysts, leading to significant delays in proper treatment (2).

Beyond common conditions like pyogenic granuloma (3) and furunculosis (10), a broader range of lesions should be considered. Congenital cysts like branchial or thyroglossal cysts may present as draining fistulas in the midline or lateral neck. These cysts are usually present from birth or early childhood and are not associated with an infected tooth (6, 14). In immunocompromised patients, deep fungal infections can have similar skin manifestations (12). In very rare cases, skin malignancies such as metastatic squamous cell carcinoma or primary basal cell carcinoma may appear as ulcerated or nodular draining lesions. Therefore, careful evaluation and even biopsy are necessary for treatment-resistant cases (13, 15). Imaging techniques play an important role in this differentiation. Panoramic or PA radiographs are essential for identifying the causative tooth and associated bone lesion (1, 6).

The complex anatomy of mandibular first molars makes them susceptible to harboring microorganisms. In such cases, using adjunctive cleaning methods like laser irradiation plays a key role. The use of the high-power diode laser in this case offered several advantages for more effective root canal disinfection. The strong antimicrobial effect of the laser stems from the absorption of light energy by bacterial pigments and the production of reactive oxygen species leading to bacterial cell wall destruction and reduced microbial load (9). This effect is particularly valuable in immature teeth with open apices and complex anatomical root areas where mechanical cleaning and irrigation alone may be insufficient (16). Furthermore, the laser's biomodulatory effect can reduce inflammation and stimulate the healing of PA tissues, contributing to faster lesion resolution and bone regeneration. This approach enhances the success of conservative treatments like apexification with MTA (17,18). According to the study by Nasrabadi et al. (2024), ultrasound-activated Photodynamic Therapy (PDT) in one case of endodontic sinus tract led to complete treatment success without surgical intervention.After laser application, the pulp and surrounding tissues fully healed after 6 months of follow-up. This case report indicates that combining PDT and photobiomodulation (PBM) can serve as a suitable alternative to invasive treatments, offering a high success rate in tooth preservation. This approach not only reduces inflammation but also promotes natural regeneration by stimulating tissue repair via PBM, making it highly suitable for treating patients with resistant infections (19). Despite the successful outcome, limitations exist, such as the focus on a single case and the high cost of laser equipment (20). However, this case demonstrates that non-surgical RCT assisted with high-power laser and LLLT is a minimally invasive and effective

option for treating these infections. In summary, this case report emphasizes that an OCST should be considered in the differential diagnosis of any chronic, draining lesion in the face and neck region, especially in children. A thorough intraoral examination, coupled with the judicious use of appropriate imaging techniques, is key to a correct diagnosis. Treatment should focus on eliminating the source of infection through conservative endodontic therapy. Employing adjunctive technologies like high-power diode lasers and LLLT can significantly enhance disinfection efficacy, accelerate healing, reduce edema, and modulate inflammation (7, 9).

4- CONCLUSION

This case demonstrated successful non-surgical management of an external sinus tract related to a necrotic mandibular first molar. By combining conventional RCT with laser irradiation healing of OCST and PA lesion was achieved without the need for surgery.

5- COMPETING INTERESTS

The authors declare that they have no conflicts of interest.

6- ETHICAL APPROVAL

This case was approved by the Research Ethics Committee of Birjand University of Medical Sciences(IR.BUMS.REC.1404.207). In this clinical case, the highest ethical standards in medical care were ensured.

7- FUNDING

No funding was received for this case study.

8- PATIENT'S CONSENT

The patient provided written informed consent voluntarily.

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