

# Diode-laser assisted vital pulp therapy

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## Introduction

The preservation of pulp vitality is one of the most challenging approaches in endodontics. In Vital Pulp Therapy (VPT), after pulp exposure due to extensive dental caries, tooth injuries and iatrogenic events, the intact portion and uninflamed dental pulp is preserved with a suitable dressing at the exposure area. The dressing materials are biocompatible or bioactive.<sup>1-3</sup> At the moment, different methods for VPT are used, including: (1) direct pulp capping, (2) indirect pulp capping, (3) partial pulpotomy and (4) full pulpotomy. Pulp dressing in these methods is performed using mineral trioxide aggregate (MTA), calcium-enriched material (CEM), calcium hydroxide and biodentin.<sup>4-6</sup> Bleeding control and pain reduction are the most common complications in partial or full pulpotomy.<sup>7</sup> Lasers have several benefits in endodontic treatment, for example: (1) pulp diagnosis, (2) dental hypersensitivity reduction, (3) pulp capping, (4) pulpotomy, (5) disinfection of root canals, (6) root canal shaping, (7) root canal obturation, (8) apicectomy and (9) root canal photodynamic therapy.<sup>8</sup> Dental lasers are either Class 3B (< 500 mW) or Class 4 (< 500 to 5,000 mW). The former lasers are used for biostimulation (Low Level Laser Therapy—LLLT), whereas the latter are used for evaporation, coagulation, cutting, etc. Most lasers in both groups are based on diodes, but the 500+ mW lasers are often called "diode

lasers". Although particularly used for such procedures, they can also be set at their lowest output and be used as biostimulators in a defocused mode. In the current case, a Class 4 laser in defocused mode was used for biostimulatory purposes in a case of VPT.<sup>8-9</sup>

## Case report

An 18-year-old female patient with complaints due to a right permanent molar tooth with deep caries was referred for treatment.

### Medical history

The patient's medical history showed neither systemic medical problems nor any allergic reaction, pharmaceuticals or history of past surgical procedures. Thus, the patient did not need to be referred for medical consultation.

### Dental history

Oral and maxillofacial examination of the patient revealed no TMJ or myofascial disturbances, no functional or parafunctional habits, Class I occlusion, but a relatively poor oral hygiene.

### Clinical findings

Intermittent pain during the last 24 hours, binding of explorer at the occlusal surface was obvious, thermal and cold vitality pulp tests were positive.

**Fig. 1:** Immediately after pulpotomy with high-speed handpiece and good coagulation with diode laser and then LLLT treatment.

**Fig. 2:** After CEM cement placement.

**Fig. 3:** Immediately after interim restorative treatment (IRT) with Glass ionomer cement (GC Fuji IX).





Fig. 4a



Fig. 4b

**Figs. 4a & b:** X-ray examination immediately after VPT.

### X-ray examination

X-ray examination showed a radiolucent lesion near the dental pulp.

### Diagnosis

A reversible pulpitis was diagnosed.

### Laser-assisted VPT procedure

#### Treatment delivery sequence

After fulfillment of the consent form, the operation area was anaesthetised by infiltration method and 2% lidocaine with Epi 1:80,000, 1.8 ml (Darou Paksh, Tehran, Iran). The controlled area and proper placing of the laser warning signs were defined to secure the operating room. The protective goggles for patient, operator and assistant were checked. Furthermore, the patient's information (examination sheet and X-ray, consent form, etc.) was reviewed.

Mouth rinsing was done by 0.2% chlorhexidine oral rinse (Shahre Daru, Tehran, Iran) for one minute and then the surface of the tooth was cleaned by a swab wetted by the same chlorhexidine solution.

Cavity preparation was performed by fissure diamond burs and then round stainless-steel burs. After caries removal, the pulpal bleeding was obvious and a partial pulpotomy was indicated.

Partial pulpotomy was started with sterile round diamond bur on a high-speed handpiece to remove the inflamed pulp tissue gently via normal saline irrigation. Haemostasis was obtained by cotton pellet soaked in normal saline for five minutes and then followed by diode laser irradiation.

CEM cement dressing was applied with a base of 2 mm CEM cement paste according to the manufacturer's instruction (Biunique Dent, Tehran, Iran) using a sterile plastic instrument and then the dry sterile cotton pellet was used for more adaptation of CEM cement to the cavity wall (Fig. 2).

Interim restorative treatment (IRT) was applied with Glass Ionomer GC Fuji IX according to the manufacturer's instruction without finger pressure (Fig. 3). Permanent filing was postponed for one month.

### Laser parameters

The laser parameters were as follows:

- For bleeding control: 980 nm (diode laser, Wuhan Gigaa, Wuhan, China), power 0.8 W, 8 Joule, fibre 400 µm, non-initiated fibre, CW, non-contact mode, 10 seconds in scanning mode (Fig. 1)
- For pain reduction: 980 nm, output power 0.3 W, irradiation time 10 s, 3 Joule, spot size 3 mm, power density 4, 246 W/cm<sup>2</sup> at the end of low-level handpiece. The cavity diameter was 4 mm, irradiation area 0.1256 cm<sup>2</sup>, power density at the target surface 2.388 W/cm<sup>2</sup>, dose 23, 88 J/cm<sup>2</sup>, non-contact (5 mm away from the exposure area), scanning mode, single dose

### Final result

Excellent VPT was observed with no bleeding, no carbonisation and no char. The patient did not experience any discomfort and was satisfied. Radiographic examination was taken in order to follow the result of laser-assisted pulpotomy based on radiographic changes (Figs. 4a & b).

### Follow-up

The first visit after VPT was one day after the procedure. There was no pain, therefore, a second LLLT was not deemed necessary. The next visit was determined two days after the procedure via telephone conversation in order to check on the pain degree based on VAS scaling (Visual Analogue Scale). Since there were no symptoms, the final visit was determined to be one month after the procedure. Finally, after one month follow-up, a successful treatment was observed clinically (positive thermal pulp vitality test) and with radiographic examination (Figs. 5a & b).

**Figs. 5a & b:** X-ray examination five weeks after VPT. A successful treatment was observed clinically (positive thermal pulp vitality test) and with radiographic examination.



## Discussion

Diode laser is extensively used in many dental practices.<sup>9</sup> Laser-tissue interaction with high power diode lasers is based on photothermal effects contrary to LLLT, where there is no photothermal effect, but based on photochemical mechanisms.<sup>10,11</sup> Since LLLT is dose-dependent,<sup>12</sup> the laser parameters have to be respected carefully.<sup>13,14</sup> The precise molecular mechanisms for LLLT are not too clear, but the clinical effects on pain control, inflammation reduction and wound healing are well investigated.<sup>15-17</sup> Gupta et al. reported that laser pulpotomy showed clinical and radiographical results superior to those of electro-surgery and ferric sulfate pulpotomy in human primary molars, using high power diode laser in order to achieve good coagulation.<sup>18</sup> Uloopi et al. applied LLLT in pulpotomy and noted that this treatment modality can be considered for primary teeth pulpotomy and its success was comparable to MTA pulpotomy technique.<sup>19</sup> It is obvious that the use of diode laser application in

pulpotomy can be twofold. In this case, higher power was first used for good coagulation and LLLT was then used in for pain reduction and anti-inflammatory purposes.

## Conclusion

Diode laser based on the protocol applied in this study can successfully be used in Vital Pulp Therapy.

## contact

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## Kurz & bündig

Im Rahmen der VPT (Vital Pulp Therapy) wird der Erhalt der intakten, nicht entzündlichen Pulpa nach Kariesinfektion, Zahntrauma oder iatrogenen Vorfällen durch einen entsprechenden Verband im Expositionsbereich erzielt. Die hierfür verwendeten Materialien sind biokompatibel oder bioaktiv.<sup>1-3</sup> Die aktuellen VPT-Verfahren schließen ein: (1) direkte Überkappung der Pulpa, (2) indirekte Überkappung der Pulpa, (3) teilweise Pulpotomie und (4) vollständige Pulpotomie.

Die Blutungskontrolle sowie die Schmerzlinderung zählen zu den häufigsten Komplikationen der teilweisen oder vollständigen Pulpotomie.<sup>7</sup> In diesem Zusammenhang können sich die Vorteile der Laseranwendung positiv auf das Komplikationsmanagement der Pulpotomie sowie des Erhalts der Pulpa auswirken und kommen bei folgenden Behandlungsabschnitten zum Einsatz: (1) Pulpadiagnose, (2) Reduktion dentaler Hypersensitivität, (3) Überkappung der Pulpa, (4) Pulpotomie, (5) Desinfektion des Wurzelkanals, (6) Wurzelkanalerweiterung, (7) Obturation, (8) Wurzelspitzenresektion und (9) photodynamische Therapie.<sup>8</sup> Diodenlaser können dabei auch als Biostimulatoren fungieren, wenn sie mit geringster Leistung und im nicht fokussierten Modus eingesetzt werden. So wurde im vorliegenden Fall ein Klasse IV-Laser im nicht fokussierten Modus zur Biostimulation im Rahmen der VPT eingesetzt.<sup>8,9</sup>

Die Behandlungsergebnisse zeigten weder Blutung, noch Karbonisation, Vernarbung, Nebenwirkungen, jedoch eine hohe Patientenzufriedenheit. Das Follow-up nach einem Monat bestätigte klinisch (positiver thermaler Pulpa-Vitalitätstest) sowie radiologisch den Behandlungserfolg. Die Autoren fassen daher zusammen, dass der Diodenlaser gemäß dem im Artikel vorgestellten Behandlungsprotokoll erfolgreich im Rahmen der VPT eingesetzt werden kann.

Literature

