
Mohamed Fattouh
*Department of Fixed Prosthodontics, Faculty of Dentistry, Cairo University, Cairo, Egypt; Department of Oral and Maxillofacial Surgery, Faculty of Dental Medicine, Umm Al-Qura University, Makkah, Saudi Arabia,* mohamed.fattouh@dentistry.cu.edu.eg

Manal Mohammed Aljuaid
*Faculty of Dental Medicine, Umm Al-Qura University, Makkah, Saudi Arabia,* manal101219@gmail.com

Nada Ali AbdelAleem
*Department of Conservative and Restorative Dentistry, Faculty of Dental Medicine, Umm Al-Qura University, Makkah, Saudi Arabia,* naabalhameed@uqu.edu.sa

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CASE REPORT


Mohamed Fattouh¹,²*, Manal Mohammed Aljuaid³, Nada Ali AbdelAleem⁴

¹Department of Fixed Prosthodontics, Faculty of Dentistry, Cairo University, Cairo, Egypt
²Department of Oral and Maxillofacial Surgery, Faculty of Dental Medicine, Umm Al-Qura University, Makkah, Saudi Arabia
³Faculty of Dental Medicine, Umm Al-Qura University, Makkah, Saudi Arabia
⁴Department of Conservative and Restorative Dentistry, Faculty of Dental Medicine, Umm Al-Qura University, Makkah, Saudi Arabia

*Correspondence e-mail to: mohamed.fattouh@dentistry.cu.edu.eg

ABSTRACT

Tooth hypersensitivity is a common clinical complaint after dental treatment. **Objective:** This study presents a case report of the use of a diode laser for treating tooth hypersensitivity in a patient with a cantilever fixed partial denture abutment. **Case Report:** A 23-year-old female patient presented to the Faculty of Dentistry, Umm Al-Qura University in Makkah, with the chief complaint of pain in a deeply carious maxillary right first premolar. The tooth was extracted, and a cantilever fixed partial denture was placed using the second premolar as an abutment. One year later, the patient experienced tooth hypersensitivity under the bridge. Low-level laser therapy (LLLT) was implemented to treat cervical hypersensitivity using a novel protocol with a total application time of 2.5 minutes across two visits. LLLT effectively relieved the pain. **Conclusion:** Diode laser is a valid method for treating tooth hypersensitivity in fixed partial denture patients.

Key words: cantilever fixed partial denture, diode laser, low-level laser therapy, tooth hypersensitivity


INTRODUCTION

A cantilever fixed partial denture (FPD) is defined as a fixed restoration with one or more abutments at one end while the other is unsupported.¹ Dentists have used cantilever FPDs for many years with success; however, caution must be taken regarding the abutment crown length, crown-to-root ratio, periodontal support, and occlusion.² A systematic review of cantilever fixed partial dentures stated that the failure rate after 10 years was 18.2 %, whereas that for conventional fixed partial dentures is 10.9%.³

Tooth hypersensitivity is a common clinical complaint defined as sharp dental pain of short duration in response to chemical, thermal, osmotic, or tactile stimuli.⁴ The incidence of tooth hypersensitivity is between 4 and 74% among the population.⁵⁻⁹ Tooth hypersensitivity may be caused by a combination of several factors, such as bad oral hygiene, incorrect brushing techniques with consequent gingival recessions, acidic foods and beverages, dental bleaching, trauma, periodontal pathologies, or removal of orthodontic fixed appliances.¹⁰ Tooth hypersensitivity is usually treated using desensitizing topical fluoride pastes and sealants. Aesthetic restorations for eroded or exposed dental necks appear to be a good solution for pain reduction.

Recently, these measures have been reinforced by a laser-supported treatment. LASER is the acronym for Light Amplification by Stimulated Emission of Radiation and was introduced in dentistry in 1960 by Theodore Maiman; however, it was only in 1989 that CO₂ laser and Nd:YAG laser therapy became available in the dental market.¹¹ The emitted light is coherent, collimated, and monochromatic.¹² The essential components of a laser machine are a sounding box in which a dynamic medium is stimulated by a pumping procedure in a population inversion and suitable
geometry for optical feedback elements. Depending on the active medium (solid, liquid, or gas), laser radiation can be in the infrared, visible, or ultraviolet region of the electrophotometer spectrum. The early results of laser treatment were rather unsatisfactory; however, the advance of scientific knowledge and technologies has enhanced instrumentation and produced new lasers with suitable wavelengths for treatment. Lasers are classified as soft or hard, not according to the type of tissue exposed, but the interaction between the laser and the tissue. Laser–tissue interaction depends on laser power and wavelength, tissue type, and time. When the outcome is ablative (mainly photothermal), direct, or primary, lasers are classified as hard; when tissue effects are non-direct and occur through secondary (mainly bio-stimulatory) intermediate action, they are classified as soft. Soft lasers are used for low-level laser therapy (LLLT), low-power laser therapy (LPLT), photobiomodulation, and photomedicine and are also referred to as biostimulation, bioregulation, healing, medical, therapeutic, low-intensity, low-level, low-reactive or nonthermal lasers. Laser phototherapy is the latest development of soft laser therapy and has been widely accepted. The use of LLLT was initiated by Endre Master in Hungary and Fredrich Plog in Canada. LLLT has been a motivating but not distinct field among the dental, medical, veterinarian and physiotherapy professions. LLLT is more biocompatible than hard laser therapy; it is a non-ionizing light-based conservative treatment, uses photons of a specified wavelength (650 nm and 1000 nm), and penetrates tissues to provide low rays and doses to the targeted area.

CASE REPORT

A 23-year-old female patient presented to the female comprehensive care clinic Faculty of Dentistry at Umm Al-Qura University in Makkah, Saudi Arabia, with the chief complaint of pain in a deeply carious maxillary right first premolar (tooth # 14) (Figure 1). She had no significant medical history and was not taking any medication. A dental examination revealed that her tooth was non-restorable due to severe caries extension; hence, the tooth was extracted. Immediate temporization was not used. Healing progressed as expected, without any complications. The soft tissue showed normal contours after three weeks. A clinical examination was conducted one month later to design a proper treatment plan. The patient was given the choice of a fixed partial denture (FPD), an implant-supported prosthesis (ISP), or a removable partial denture (RPD). The detailed steps of each treatment option (including consequences and recall visits) were thoroughly described to the patient. The patient did not choose the RPD as she preferred a fixed option and was uncertain about the ISP as she was concerned about the surgical procedure and the extended time required for this.

TREATMENT PROCEDURES

Preliminary impressions were made using hydrocolloid impression material (Kromopan 100, Lascod, Italy); and poured to primary casts. A face bow record was used to mount the maxillary diagnostic cast on a semi-adjustable articulator (Denar Mark II, Whip Mix co., USA). The patient’s bite was recorded using a bite registration paste (Imprint Bite VPS, 3M co., USA) that was used to mount the mandibular cast. A silicon index (Express, 3M co., USA) was made for the abutment tooth before it was prepared. Abutment preparation was performed following the guiding principles of metal–ceramic restorations using a tapered stone with flat end (TF12, Mani co., Japan). The axial wall reduction was 1 mm, and the occlusal reduction was 1.5 mm. The finish line was located supra-gingival, and all internal line angles were rounded (Figure 2). Provisional crown material (ProTemp 4,3M ESPE co., USA) was injected into the silicone index, and a provisional crown was fabricated.

A final impression was made with polyether impression material (Impergum L duoSoft, 3M co., USA). After casting, the metal framework was checked on the die, and the procedure was conducted on the patient. The
proper shade was selected using VITA shade guide (Vitapan 3D Master, Vita Zahnfabrik, Bad Säckingen, Germany). Porcelain was fired over the metal, then the bridge was cemented using glass ionomer cement (Riva self cure, SDI co., Australia) (Figure 3). The patient was recalled one week after cementation for any necessary adjustments and then after six months, during which a radiograph was taken. However, the patient visited after one year complaining of pain with cold drinks. A clinical examination revealed gingival recession and cementum exposure, while a radiographic examination showed proper restoration adaptation and an adequate margin seal (Figure 4). The patient was diagnosed with tooth hypersensitivity and LLLT for management.

After obtaining informed consent from the patient, ethical approval was obtained from the Biomedical Research Ethics Committee of Umm Al-Qura University (Approval No.:HAPO-02-K-012-2023-01-1397). LLLT was carried out using a diode laser machine (LaserHF, Hager & Werken GmbH, Duisburg, Germany) according to the following specified protocol. The LLLT laser tip was applied at approximately 1 mm and perpendicular to the tooth surface (Figure 5), operating in continuous mode with a power of 90 mW and a 660–900 nm wavelength. Neither pre-drug application nor cooling is required for this laser.

Tooth sensitivity was recorded before and after laser application using two methods: Visual Analogue Scale (VAS) from zero (representing no pain) to ten and Electric Pulp Tester (EPT). When the tooth was stimulated with an air-water stream immediately before laser application, the VAS score was 10 and the EPT reading was 18. However, a one-minute laser application reduced tooth sensitivity; the VAS score decreased to seven, and the EPT reading increased to 25. The laser was applied for another minute, after which the VAS score decreased to five, and the EPT reading reached 31.

The patient was recalled one week later, and the abutment was stimulated again by an air-water stream. There was a noticeable delay of pain, and the VAS score decreased considerably to three, while the EPT reading reached 40. After another round of laser application for 30 seconds, the patient felt no pain, with a VAS score of zero and an EPT reading of 47. The patient was followed-up for one, three, six and nine months after the last laser application visit and reported no sensitivity.

DISCUSSION

The use of cantilever FPD designs to replace a missing tooth necessitates a careful physiologic assessment. The patient should have a satisfactory clinical condition, including adequate root length and shape, adequate crown length, good alveolar support, favourable masticatory forces, and favourable occlusion.

In the current case, the intraoral examination revealed an anterior open bite in centric and eccentric occlusion; when the patient occluded her teeth, substantial space remained between the maxillary and mandibular teeth, which favoured using a cantilever FPD. Tooth sensitivity may arise from several factors, such as hypo-mineralization, enamel loss resulting from abrasive components in toothpaste (measured in terms of relative dentin abrasivity (RDA)), the use of a hard toothbrush, an aggressive brushing method, poor oral hygiene resulting in plaque accumulation, periodontal...
Several authors have studied the most understood mechanism for hypersensitivity is the hydro-dynamic theory described by Brännström. Pain is triggered by abrupt fluid displacement inward or outward through the dentinal tubules due to osmotic, thermal, chemical, mechanical, or evaporative stimuli. This fluid movement through dentinal tubules stimulates the nerve endings at the dentin/pulp interface and is diffused as a painful sensation.

Many treatment modalities are available for managing tooth hypersensitivity, such as adding potassium nitrate, strontium, arginine and calcium carbonate or calcium sodium phosphor-silicate to toothpaste. Other methods include the application of desensitizers such as fluoride, hydroxyethyl methacrylate, glutaraldehyde oxalate and bonding agent, and the use of laser therapy.

Many authors recommended using He-Ne, Nd:YAP, Nd:YAG, CO2, and Er:YAG lasers to treat tooth hypersensitivity by occluding the dentinal tubules without affecting the tooth and neighbouring structures. Several authors have studied the effectiveness of diode lasers in the treatment of hypersensitivity. Matsumoto et al. reported ~85% success in laser-irradiated teeth; Aun et al. described great success in 98% of laser-treated teeth. Yamaguchi et al. showed an effective progress index of 60% in the group treated with laser versus 22.2% in the non-lasered control group. Kumazaki et al. reported a success rate of 69.2% in the laser-treated group and 20% in the placebo group.

LLLT has recently been used to treat tooth hypersensitivity. The LLLT system comprises a laser device, a controller, and a delivery system. All available LLLT systems use semi-conductor diode lasers. These are mostly variants of either gallium-aluminium-arsenide (GaAlAs), which emits in the infra-red spectrum range (wavelength: 700–940 nm), or indium-gallium-arsenide-phosphorus (InGaAsP) devices that emit in the red portion of the visible spectrum range (wavelength: 600–680 nm). The power outputs are classically 10–50 mW when measured at the level of the diode laser itself; however, the definitive working output coming from the handpiece is usually lower due to losses in the delivery system. Therefore, frequent calibration of the laser system using an external power meter is essential for quality assurance measures.

It has been anticipated that laser therapy offers a placebo outcome on pain perception; this may be due to obtaining advanced treatment from a high-technology device and a decent relationship between the clinician and the patient. The choice of appropriate laser parameters is crucial for achieving acceptable results. Many parameters should be considered, such as wavelength, irradiation frequency, dose, energy, mode of application (scanning movement versus stationary), and the time between treatment visits. In our case, the stationary laser mode was applied to the cervical part of the root in multiple applications across two sessions. Energy and energy density are critical parameters to encourage biological effects. We planned laser therapy with an energy of eight joules per tooth and an energy density of seven J/cm².

In the presented case, 100% improvement was observed in the sensitivity of the affected tooth after two sessions of LLLT with a total application time of two minutes and thirty seconds. This may be attributed to the direct effect of LLLT on the neural networks inside the pulp due to its anti-inflammatory, bio-stimulatory, and analgesic properties. Moreover, LLLT potentially exerts effects by altering cellular metabolism. The exact action at the cellular level is unknown but may be due to the inhibition of nociceptive signals radiating from peripheral nerves, as explained in a previous study. The effect of this type of laser is mainly related to changes in pulp nerve transmission and blocking of the depolarization of sensory C fibers. Another theory that may cause a continued desensitizing effect is the promotion of tertiary dentin production at the dentin/pulp interface by stimulating the differentiation and proliferation of odontoblasts cells.

Similarly, Sgolastra et al. showed that the efficacy rate of GaAlAs laser therapy at the one-month follow-up ranged from 53.3 to 94.2%. They pointed out that a hypersensitive tooth that does not react to four to six Joules per root after 2 or 3 sessions is indicated for root canal treatment. The use of LLLT in the current case successfully treated tooth hypersensitivity, consistent with the findings of other studies.

**CONCLUSION**

LLLT effectively treated tooth hypersensitivity after two visits, with complete pain alleviation. The forthcoming applications of LLLT are promising. Efforts should focus on exploring the exact dosimetry needed to achieve therapeutic laser effects. More in vivo studies should be conducted to establish a standardized treatment protocol.

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CONFLICT OF INTEREST

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