Review Article

Low Level Laser Therapy (LLLT) for Orofacial Pain

Seyyed Amir Seyyedi [1], Pooya Olyaee [2], Zohreh Dalirsani [3], Farnaz Falaki [3]

[1]Department of Oral Medicine, Faculty of Dentistry, Urmia University of Medical Sciences, Urmia, Iran
[2]Department of Orthodontics, Faculty of Dentistry, Urmia University of Medical Sciences, Urmia, Iran
[3]Oral and Maxillofacial Diseases Research Center, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

Abstract:

Low-power lasers are a group of lasers with a power less than 500 mW and unlike high-power lasers they have no effect on tissue temperature; they produce light-dependent chemical reactions in tissues. The purpose of this study was to review the clinical applications of these lasers and their success rate in different studies in orofacial pains. The articles with the key word “low level laser therapy” were extracted from pubmed. Clinical trials, meta-analysis, randomized clinical trials, and review articles were selected. Related articles to orofacial region were gathered and selected from the search results and carefully reviewed. Laser therapy may affect many cellular and sub-cellular processes, although exact mechanism has not been well-defined yet. Articles had different points of views as mentioned in the context of this article. Low level laser therapy was effective in orofacial pain relief in most studies, but the use of laser remains controversial. These lasers have analgesic features, and it is according to these features they have been used in the treatment of orofacial pain, including myofacial pain, mucositis, facial myalgia, temporomandibular joint disorders and neuralgia. It seems that laser therapy can be considered as an alternative physical modality in treatment of orofacial pain.

Keywords: orofacial pain; low level laser therapy; mucositis; neuralgia

Please cite this article as follows:
Seyyedi SA, Olyaee P, Dalirsani Z, Falaki F.Low Level Laser Therapy for Orofacial Pain. J Lasers Med Sci 2011; 3(3):97-101

***Corresponding Author:** Seyyedi Seyyed Amir, DDS, MSc; Department of Oral Medicine, Urmia Faculty of Dentistry, Urmia University of Medical Sciences, Iran. Tel: +98-9143408762; Fax: +98-4413470517;Email: seyyediamir@yahoo.com

Introduction

Low-power lasers (soft, cold) have no thermal effect on tissues and produce a reaction in cells through light, called photobiostimulation or photobiochemical reaction. Output power of these lasers is less than 500 mW. The critical point that differentiates low-power lasers from high-power ones is photochemical reactions with or without heat. The most important factor to achieve this feature in lasers is not their power but the power density per cm^2. If the density is lower than $670mW/cm^2$, it can mimic stimulatory effect of low-power lasers without any thermal effects (1).

Orofacial pains usually are difficult conditions to treat, but the introduction of low level laser therapy (LLLT) now provides a good treatment modality for our patients to experience less pain. LLLT can be applied in conditions such as acute and chronic muscular pain, neuralgia, inflammation of joints, constrained mobility, cervical pain, and etc. It is believed that empirical evidence gathered proves that the LLLT is a useful modality for acceleration of the healing process and pain attenuation. This is further supported by the absence of harmful side effects of this therapy, reasonable equipment and operating cost, and the fact that there are few effective alternative treatments for many conditions. The absorption of low intensity laser light by biological systems is of a purely non-coherent (i.e.,photobiological) nature at the cellular level, biological responses are determined by the absorption of light photo acceptor molecules(2).

In this article we reviewed the English manuscripts about effect of low level laser therapy on orofacial pain published in pubmed from 1988 to 2012.

Mechanisms of Action

Stimulation of any point of the body creates neural impulses that are transmitted to upper nervous centers by neurons that have different features. These impulses finally reach the CNS. Low-power lasers can leave their effects in different parts of the body (3). Laser radiation may alter cell and tissue function and decrease patients' pain.

Currently the following analgesic effects are recognized: - Anti-inflammatory**.** LLLT reduces oxidative stress: Mitochondria in stressed or ischemic tissues produce nitric oxide (mtNO) that binds to cytochrome oxidase competitively displacing oxygen leading to oxidative stress and reduced ATP production. Light of suitable wavelength, sufficient irradiance and time when applied to injuries is absorbed by cytochrome oxidase displacing mtNO thereby reducing oxidative stress and increasing ATP production. A cascade of downstream metabolic effects lead to a reduction in inflammatory markers including prostaglandin E2, interleukin 1β and tumor necrosis factor α (3).- Analgesia. LLLT creating a nerve block. Higher energy can induce an analgesic effect by disrupting fast axonal transport in small diameter fibers, in particular nociceptors. This temporary (reversible) inhibition of A-delta and C fiber transmission reduces tonic peripheral nociceptive afferent input and facilitates reorganisation of the modulation of synaptic connections. Repeated treatments lead to a reduction in central sensitization (3).

Bjordal in a systematic review of possible mechanisms of action and clinical effects in randomized placebo-controlled trials, found that there was strong evidence that LLLT can modulate inflammatory pain by reducing levels of biochemical markers (PGE_2, mRNA Cox 2, IL-1β, TNFα), neutrophil cell influx, oxidative stress, and formation of edema and hemorrhage in a dose-dependent manner (median dose 7.5 J/cm^2, range 0.3–19 J/cm^2). Compared with non-steroidal anti-inflammatory drugs (NSAIDs) in animal studies, they found optimal doses of LLLT and NSAIDs to be equally effective. It was concluded that LLLT can modulate inflammatory processes in a dose-dependent manner and can be titrated to significantly reduce acute inflammatory pain in clinical settings (4).

Clinical Applications of Laser in Orofacial pain

Management of Myofacial Pain

Myofacial pain dysfunction syndrome (MPDS) is the most common reason for pain and limited function of the masticatory system. The effects of low-level lasers (LLLs) for controlling the discomfort of patients are investigated frequently. Several studies have shown that use of 830-nm wavelength laser in several appointments can reduce or eliminate myofacial pain (5, 6).

Some authors (Ilbuldu, Irnich) have reported significant pain reduction in a number of conditions such as myofascial pain syndrome, chronic neck pain after laser application (7, 8).

In a study by Kulekcioglu, semi-conductive (diodic) gallium arsenide(GaAs) laser (wavelength: 904 nanometers, mean output power: 17 mW) was used in treatment of temporomandibular disorder. The patients were treated with fifteen sessions of low-level laser concurrent with daily exercise program. Active and passive maximum mouth opening, lateral motion and number of tender points were significantly improved in patients who undertaken laser therapy compared with placebo group, although pain relief was observed in both groups (9).

Altafini et al. reported no pain in their patients up to 3 months after laser therapy. Furthermore, effectiveness of laser acupuncture has been confirmed in decreasing myofacial pain (10).

Shirani et al. evaluated the efficacy of a LLLT producing 660 nm and 890 nm wavelengths that was recommended to reduce the pain in the masticatory muscles. This was a double-blind and placebo-controlled trial. Treatment was given twice a week for 3 weeks. In each group the reduction of pain before and after the treatment was meaningful, but, between the two groups, low-level laser therapy (LLLT) was more effective (P=0.03). According to their study, LLLT was an effective treatment for pain reduction in MPDS patients (11).

Oz et al. compared the effects of low-level laser with occlusal splints in patients with signs and symptoms of myofacial pain (MP) dysfunction syndrome. Vertical movements showed statistically significant improvements after the treatments in both groups, but when the groups were compared with each other, there were no significant difference between the groups. In both groups, tenderness to palpation of the muscles decreased significantly. Pressure pain threshold evaluations and visual analog scale scores revealed similar results, too. That particular type of low-level laser therapy (820 nm, 3 J/cm^2, 300 mW output power) was as effective as occlusal splint in pain release and mandibular movement improvement in MP (12).

Effect of Low-Level Laser on Temporomandibular Joint Disorder Pain

Kulokciglu et al, showed decrease in pain related to temporomandibular joint disorders in 35 patients (9). In another study pain decreased significantly in patients suffering from temporomandibular joint disorders, and exposed to 785 nm laser compared to the placebo group. They also had no pain during the 6 month follow-up period (13).

Emshoff et al, assessed the effectiveness of low-level laser therapy (LLLT) in the management of temporomandibular joint (TMJ) pain in a random and double-blind research design. TMJ pain patients received active LLLT (Helium Neon, 632.8 nm, 30 mW) or sham LLLT. At the 8 week point, within-group improvements of TMJ pain were present for TMJ pain during function, for both the active and sham LLLT groups. Between-group differences were not highly evident. They concluded that LLLT was not better than placebo at reducing TMJ pain during function (14).

Da Cunha et al, evaluated the effectiveness of low-level laser therapy (LLLT) in patients presenting with temporomandibular disorder (TMD) in a random and placebo-controlled research design. The treatment was done with an infrared laser (830nm, 500mW, 20s, 4J/point) at the painful points. Baseline and post-therapy values of pain and craniomandibular index were compared in the therapy groups, yet no significant differences were observed regarding visual analogue scale and craniomandibular index. They suggested that after either placebo or laser therapy, pain and temporomandibular symptoms were significantly lower, although there was no significant difference between groups. The low-level laser therapy was not effective in the treatment of TMD, when compared to the placebo (15).

Determination of Possible Anti-inflammatory LLLT dose for Patients with Temporomandibular Disorder

At target location in in-vitro trials, LLLT has been reported to suppress inflammation by a reduction of PGE2 in ligament cell cultures (16). This effect was reported within a range between 0.4 and 19 J and a power density of 5-21.2 mW/cm^2 (17). The lower range limits for PGE2 reduction were identified because data showed no effect below this threshold. Upper range limits could not be identified, as there were no data available to show when or if this effect would level off. However, it has been shown that power densities above 20mW/cm^2 temporarily inhibit fibroblast metabolism, and numerous fibroblast cells are found in the joint capsule (18). It has been assumed doses of 0.4-19 J and power density of 5-21 mW/cm^2 would be capable of reducing inflammation at the target joint capsule without compromising fibroblast metabolism (16). Some researchers postulate that energy loss due to the skin barrier for continuous HeNe (632nm) laser is 90%, for continuous GaAlAs (820nm) and NdYAG IR lasers, 80% and for GaAs (904 nm) infrared pulse laser, 50%. Further energy loss is, according to the porcine penetration model, postulated to be linear at 5% per mm of tissue for infrared lasers. For red HeNe laser further energy loss is 10% per mm of tissue (17,18).

Effect of Low-Level Laser on Trigeminal Neuralgic Pain

Eckerdal and Bastian, designed a doubleblind, placebo controlled study to determine whether low reactive-level laser therapy (LLLT) is effective for the treatment of trigeminal neuralgia. Two groups of patients (19) were treated with two probes. Each patient was radiated with laser for 5 weeks (830 nm, 30 mW). The results demonstrate that of 16 patients treated with the laser probe, 10 were free from pain after completing treatment and 2 had noticeably less pain, while in 4 there was little or no change. After a one year follow-up, 6 patients were still entirely free from pain. In the group treated with the placebo system, i.e. the non-laser probe, one was free from pain. Results confirmed the fact that LLLT is effective in the treatment of trigeminal neuralgia. It is concluded that the present study clearly shows that LLLT treatment, given as described, is an effective method and an excellent supplement to conventional therapies used in the treatment of trigeminal neuralgia (19).

Moore et al. designed a double blind assessment of the efficacy of low level laser therapy in the relief of the pain of post herpetic neuralgia with patients acting as their own controls. Admission to the trial was limited to patients with established post herpetic neuralgia of at least six months duration and who had shown little or no response to conventional methods of treatment. The patients were treated with a Ga-Al-As diode laser (830 nm: 60mW.) The results demonstrate a significant reduction in the pain intensity and distribution following a course of low level laser therapy (20).

Effect of Low-Level Laser on Mucositis Pain

Maiya and Fernandes showed that in patients who had oral mucositis because of radiotherapy of neck and head region, exposure to 632.5 nm wavelength decreased pain more than that in those who received oral analgesics or topical anesthesia (21). Mucositis pain following chemotherapy can also be reduced by low-level laser with a wavelength of 650 nm. In addition, it has been shown that low-level lasers have prophylactic effect on mucositis following chemotherapy (22).

Bjordal et al. performed a systematic review and meta-analysis of randomized placebo-controlled trials of LLLT performed during chemotherapy or radiation therapy in head and neck cancer patients. The relative risk (RR) for developing oral mucositis (OM) was significantly reduced after LLLT compared with placebo LLLT. This preventive effect of LLLT improved to RR=2.72 when only trials with adequate doses above 1 J were included. For treatment of OM ulcers, the number of days with OM grade 2 or worse was significantly reduced after LLLT to 4.38 days less than placebo LLLT. Oral mucositis severity was also reduced after LLLT with a standardised mean difference of 1.33 over placebo LLLT. All studies registered possible side-effects, but they were not significantly different from placebo LLLT. It was concluded that there was consistent evidence from small high-quality studies that red and infrared LLLT can partly prevent development of cancer therapy-induced OM. LLLT also significantly reduced pain, severity and duration of symptoms in patients with cancer therapy-induced OM (23).

Conclusion

LLLT is a helpful and non-invasive treatment modality in various clinical conditions, such as trigeminal neuralgia, myofacial pain syndrome, temporomandibular disorders, and etc. Proper application of laser can improve our clinal performance.

References

1. Khalighi HR, Anbari F, Taheri JB, Bakhtiari S, Namazi Z, Pouralibaba F. Effect of Low-power Laser on Treatment of Orofacial Pain. J Dent Res Dent Clin Dent Prospect 2010; 4(3):75-8.
2. Al-sharify AA. The Biological Effects of Low Level Laser Therapy with Static Magnetic Field on Acute and Chronic Pain. Eng. & Tech 2007; 25(10):1154-61.
3. Chow RT, Johnson MI, Lopes-Martins RA, Bjordal JM. Efficacy of Low-Level Laser Therapy in the management of neck pain: a systematic review and meta-analysis of randomised placebo or active-treatment controlled trials. Lancet 2009; 374(9705):1897-908.
4. Bjordal JM, Johnson MI, Iversen V, Aimbire F, Lopes-Martins RA. Low-Level Laser Therapy in acute pain: a systematic review of possible mechanisms of action and clinical effects in randomized placebo-controlled trials. Photomed Laser Surg 2006; 24(2): 158-68.
5. Dundar U, Evicke D, Samli F, Pusak H, Kavuncu V. The effect of Gallium laser therapy in the management of myofacial pain syndrome. Clin Rheumathol 2007 Jun;26(6):930-4.
6. Bradly P, Heller G. The effect of 830 nm laser on chronic myofacial pain. Pain 2006; 124:201-10.
7. Ilbuldu E, Cakmak A, Disci R, Aydin R. Comparison of laser, dry needling, and placebo laser treatments in myofascial pain syndrome. Photomed Laser Surg 2004; 22(4):306-11.
8. Irnich D, Behrens N, Gleditsch JM, Stor W, Schreiber MA, Schops P, et al. Immediate effects of dry needling and acupuncture at distant points in chronic neck pain: results of a randomized, double-blind, sham-controlled crossover trial. Pain 2002; 99(1-2):83-9.
9. Kulekcioglu S, Sivrioglu K, Ozcan O, Parlak M. Effectiveness of low-level laser therapy in temporomandibular disorder. Scand J Rheumatol 2003;32(2):114-8.
10. Altafini, Catro G, Ambrosio F. Diode laser in myofacial pain. Clin J Pain. 1998; 5:301-4.
11. Shirani AM, Gutknecht N, Taghizadeh M, Mir M. Low-level laser therapy and myofacial pain dysfunction syndrome: a randomized controlled clinical trial. Lasers Med Sci 2009;24(5):715-20.
12. Öz S; Gökçen-Röhlig B, Saruhanoglu A, Tuncer EB. Management of myofascial pain: low level laser therapy versus occlusal splints. J Craniofac Surg 2010. 21(6):1722-8.
13. Ribeiro Ms. Clinical evaluation of the low intensity laser antalgic action of Ga Al As in the treatment of the temporomandibular disorder. Laser Med Surg 2002; 18:205-7.
14. Emshoff R, Bosch R, Pumpel E, Schoning H, Strobl H. Low-level laser therapy for treatment of temporomandibular joint pain: a double-blind and placebo-controlled trial. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008; 105(4); 452-6.

15. da Cunha LA, Firoozmand LM, da Silva AP, Camargo SE, Oliveira W. Efficacy of low-level laser therapy in the treatment of temporomandibular disorder. Int Dent J 2008; 58(4):213-7.
16. Sakurai Y, Yamaguchi M, Abiko Y. Inhibitory effect of low-level laser irradiation on LPS-stimulated prostaglandin E2 production and cyclooxygenase-2 in human gingival fibroblasts. Eur J Oral Sci 2000; 108(1): 29-34.
17. Bjordal JM, Couppé C, Chow RT, Tunér J and Ljunggren EA. A systematic review of low level laser therapy with location-specific doses for pain from chronic joint disorders. Aust J Physiother 2003; 49(2): 107-16.
18. Van Breugel HH, Bar PR. Power density and exposure time of HeNe laser irradiation are more important than total energy dose in photobiomodulation of human fibroblasts in vitro. Lasers Med Surg 1992;12(5): 528-37.
19. Eckerdal A, Bastin L. Can low reactive-level laser therapy be used in treatment of neurogenic facial pain? A double blind placebo controlled investigation of patients with trigeminal neuralgia. Laser Therapy 1996; 247-52.
20. Moore KC, Kramer P, Jayakumar C, Double blind crossover trial of low level laser therapy in the treatment of post herpetic neuralgia Neuropathic pain. Laser Therapy 1988; 1: 7.
21. Arun Maiya G, Sagar MS, Fernandes D. Effect of low level helium-neon laser therapy in the prevention and treatment of radiation induced mucositis in head and neck cancer patients. Indian J Med Res 2006; 124:399-402.
22. Schubert MM, Eduardo FP, Guthrie KA, Franquin JC, Bensadoun RJ, Migliorati CA, et al. A phase III randomized double-blind placebo-controlled clinical trial to determine the efficacy of low level laser therapy for the prevention of oral mucositis in patients undergoing hematopoietic cell transplantation. Support Care Cancer 2007; 15(10):1145-54.
23. Bjordal JM, Bensadoun RJ, Tunèr J, Frigo L, Gjerde K, Lopes-Martins RA. A systematic review with meta-analysis of the effect of low-level laser therapy (LLLT) in cancer therapy-induced oral mucositis. Support Care Cancer 2011; 19(8):1069-77.