Review Article

Application of Low Level Laser in Temporomandibular Disorders

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Abstract:

Introduction: The American Academy of Orofacial pain defined temporomandibular disorders (TMDs) as"a collective term that embraces a number of clinical problems that involve the masticatory muscles, the TMJ (Temporomandibular Joint), and the associated structures". Pain and dysfunctional symptoms or signs such as limitations in opening, asymmetric jaw movements and TMJ sounds are the most common findings. TMD is a prevalent disease that is most common among 20 to 40 year-olds; not a disease of senility. Researches show that about 75% of the population has one sign of TMD, and approximately 33% has at least one TMD symptom. They reported that 3.6% - 7% of the population has severe TMD problems that cause patients to seek treatment. Low level laser is a conservative treatment method that has been introduced in recent years.The purpose of this article is to review the related investigations and introduce the applications of low level lasers in TMD treatment.
Method: Electronic data bases were searched and hand search of published articles and texts was done.
Result and Conclusion: Laser application can be beneficial in different ways for TMD problems. In many cases occlusal adjustment and taking impression for splint is necessary but the pain prevents conventional treatment. Pain relief can be achieved by irradiating the joint and tender points; musculature will be relaxed, and treatment can begin. It has been revealed in recent clinical experiences and clinical studies that for myogenic conditions rather high doses are needed and that the energy density itself is an important factor. The disagreement in result of older studies may be related to this fact.
Keyword: low level laser therapy; temporomandibular disorders; orofacial pain

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Temporomandibular Disorders (TMDs)

TMJ dysfunction syndrome is a common TMJ disorder which is also referred to as mandibular pain-dysfunction syndrome, arthrosistemporo-mandibularis, TMJ arthrosis, myofacial pain syndrom and Temporomandibular Disorders (TMDs) (1-3). The American Academy of Orofacial painhas defined Temporomandibular disorders (TMDs) as"a collective term that embraces a number of clinical problems that involve the masticatory muscles, the TMJ, and the associated structures" (3-5).

TMDs is a prevalent disease that is most common among 20 to 40 year-olds; not a disease of senility (2,5-8). Researches show that about 75% of the population has one sign of TMD, and approximately 33% has at least one TMD symptom. They reported that 3.6% - 7% of the population has severe TMD problems that cause patients to seek treatment (5,7-9). It is most prevalent among female patients and female patients request treatment more than men (2,5,7,10). Moreover, it is less probable that female patients relieve from TMD symptoms than men (5, 11, 12). Although there are many hypotheses, the underlying reason for this gender difference is not clear (13). The early phase with problems in coordination such as clicking, subluxation and recurrent dislocation is most common in 20 to 30 year-old female patients and the later phase with limitations is most prevalent in 30 to 50 year-olds (2, 10)

Sign and symptoms could be rarely bilateral, but the unilateral onesare common including muscular tenderness, limited motion, and a dull aching pain in the periarticular area often referring to the ear, face, head, neck, and shoulders which exacerbate by function. The first manifestations of the syndrome are usually functional disorders in coordination with the masticatory muscles with symptoms of clicking, without pain, subluxation, or recurrent dislocation. In clinical examination, hyper mobility of the joints, tendency to protrude the mandible or both could be seen during the initial opening movement. In most patientsthese symptoms would be followed by spasms of the masticatory muscles with pain during movement of the joint, particularly during mastication (2, 14). TMDs can lead to further symptoms such as nonotologicotalgia, dizziness, tinnitus, neck pain, and toothache or contribute to migraine and tension headaches, myofacial pain and many other pain complaints (5, 8).

TMD symptoms show fluctuations related to masticatory muscle tensions, tooth clenching, grinding, and other oral parafunctional habits or psychosocial factors such as worriedness, stress, irritation, frustration, and depression (5).

The most common TMD complaints in patients who come to dental offices for treatment, isfunctional disorders of masticatory muscles and pain (15-20). The range of mouth opening in these patients is also decreased, making it difficult to have access to the oral cavity, resulting in complications in the rehabilitative treatment (9, 57, 62).

Thorough 1900s, many different curing methods were identified, and today there exists a large number of conservative therapies, such as anti-inflammatory analgesic medication, occlusal splint, acupuncture, ultrasound, electrotherapy and low level laser to decrease pain in TMD patients (21, 22).

Low Level Laser Therapy (LLLT)

LASER (Light Amplification by Stimulated Emission of Radiation) devices are routinely used in physical therapy (23, 24).

Low level laser therapy (LLLT), also known as low-level therapy, laser biostimulation or soft laser therapy can be used in dentistry for different purposes in soft tissues, hard tissues, and pain reduction.

Although literature for more than thirty years has shown that use of LLLT in health care is beneficial with so many researches on this topic in dentistry, opinions differ because of the different methodologies and doses (25-33-35)

The lasers that are used in these fields, may have visible wavelengths (red), or invisible infrared wavelengths (from 650 to 1,000 nm). Helium-Neon lasers (632.5nm) were used before, but semi-conductor diode types (635 to 650 and 803 to 980 nm) like Gallium-Arsenide (GaAs) lasers and Aluminum-Gallium-Arsenide (AlGaAs) lasers are used nowadays. These near-infrared lasers could be used at high powers for soft tissue surgeries and bactericidal effects, or at low power for effective treatment of pain and reducing of inflammation and tissue repairpromotion with greater tissue penetration than visible lasers (33, 35, 36). Since wavelength is the most important factor in any type of phototherapy, it is crucial to choose the effective wave length with desirable effects in living tissue (35). The typical power output for a low level laser device is between 10 – 500 mW, total irradiances at any point are several joules and the spot area ranges from a few up to 10cm^2. Applications can last from a few seconds up to 15 min, and can be either local or distal. LLLT does not have significant thermal effects on dental tissues and consequent therapeutic effects (23, 24, 35, 37). The penetration of LLL in soft and hard

tissue ranges from 3 mm to up to 15 mm, because the wavelengths which are used for LLLT have poor absorption in water (35).

Low Level Laser Mechanisms of Action

The low level laser therapy has complex mechanisms, but it is essentially related to the absorption of particular visible red and near-infrared wavelength in photoreceptors within sub-cellular components and particularly the electron transport (respiratory) chain within the membranes of mitochondria (35,38,39).

The three main effects of laser light used in LLLT on tissue include: 1- analgesic, 2- biostimulating, 3- anti-inflammatory effects.

Analgesic Effect

LLLT increases metabolism of endorphins, acetylcholine, serotonin, and cortisol, it also changes nerve impulse stimulation and transmission, and reduces stimulation and perception of pain as its result. Laser radiation causes hyperpolarization of the membrane which needs greater stimulation to trigger the cellular action potential. Moreover, the analgesic effect of laser radiation has correlation with the increase ofbeta endorphin in cerebrospinal fluid and normalization of the telethermographic state of the inflamed tissue (dependent on the infrared effect of the 904nm radiation) (33, 40, 41).

Biostimulating Effect

LLLT rises cell activity and adenosine triphosphate (ATP) production. It also causes increased release of growth factors, cytokines, and accelerates replication mechanisms that result in promotion in cell repair processes and declines the oxidative phase. Laser light can also react with beta growth factors and many different oxygenated molecules (33, 42,43). Cellular oxidative state alters these factors; indeed, the effects of photobiostimulationdepend on the pretreatment cell state;and are therefore, unpredictable (33).

Anti-inflammatory Effect

LLLT alters blood flow and induces angiogenesis. Furthermore, it increases lymph drainage and consequently inflammation decreases. In vivo studies on animal models demonstrate both a microcirculation effect that increases production of blood corpuscles, as well as an efficient anti-edemic action that encourages early drainage of the interstitial fluid because of increased lymphatic peristalsis (33,44).Furthermore, the biochemical effect of the laser light can stimulate the production of vascular endothelial growth factor and the conversion of adenosine-monophosphatase into nitric oxide, which improves vessel growth (33,45).

A number of cell systems are involved in the mechanisms possibly underlying the bio-stimulation of damaged tissue, including fibroblast, macrophages, lymphocytes, epithelial cell, and endothelia (33,46,47).The primary mechanisms of laser assisted therapy are mainly attributable to the interaction between photons and cell molecules that transform the photonic light energy into biochemical energy, whereas the secondary mechanisms are attributable to chemical changes induced by the primary effects. The photochemical effect occurs when the laser light is emitted at low power for prolonged periods of time, and is dependentupon the wavelength, dose, and mode of operation (33,40,41,48-51).

Low Level Laser Therapy in TMD

Laser therapy has been used for analgesic and anti-inflammatory purposes and for muscle relaxationin medical and dental fields (52,53).

In dentistry, laser is used in patients with TMDs, mainly for referring pain to the masticatory, neck, and shoulder muscles. The pain may be the result of malocclusion or psychological and emotional disorders (53, 54).

LLLT is a noninvasive, reversible therapy without any known side effects. Thus, it is quite proper for TMD treatment (55-57). Several studies have reported the positive effect of LLLT in TMD (57-59). Kulekcioglu et al. showed that, after 15 sessions of LLLT, the TMD of both myogenic and arthrogenicorigins causes response to therapy with a significant reduction in pain, improvement in mouth opening and lateral movement, and diminished number of trigger points (57,58,60). Results differ from one study to the other, because there are a large range of treatment parameters in therapy (i.e., wavelength, fluence, intensity,

exposure time, total duration of treatment, etc.) (57,61).

In many cases,occlusal adjustment and taking impression for splint is necessary, but the pain prevents the conventional treatment methods.Pain relief can be achieved by irradiating the joint and tender points, musculature will be relaxed, and treatment can begin.

In a research by Hansson, he evaluated the effects of GaAs laser onTMJ arthritis. He emphasizes that lasers are not an alternative to the conventional treatment, but it helps to fasten healing and reduce inflammation more quickly (66). Bezuur and Hansson also treated a group of 27 patients suffering from long-termTMJ problems with a GaAs laser. The treatment was performed over the joint on five consecutive days. 80% of the 15 patients with arthrogenous pain reported total pain relief. The maximum jaw-opening ability increased during the treatment period and continued to increase during the year that the group was monitored. The group suffering from myogenic problems also improved both in terms of pain and jaw opening ability (67). In another study, Kim et al. divided a group of 36 patients with TMJ problem into three therapy groups. The patients were treated either with bite splints, GaAlAs laser or laser acupuncture. The treatment results were compared after two and four weeks with the status of patients before treatment. The following conclusions were drawn. The patients' subjective problems were declined in both the bite splint and laser treatment groups, but improvement in the laser group was much greater than the bite splint group. Clinically noticeable symptoms showed a significant reduction in all groups, but the group treated with laser light responded faster to treatment than the other groups. In this study,laser treatment was more beneficial than bite splints, while laser acupuncture produced the poorest results (69).

It has been revealed in recent clinical experiences and clinical studies that for myogenic conditions rather high doses are needed and that the energy density itself is an important factor. The disagreement in results of older studies may be related to the above fact (63). In cases of trismus, tender points and muscle attachments should be treated. Usually 6 -10 J per point is a good start, but occasionally higher energies are required (64). Even a more peripheral muscle attachment should be palpated and irradiatedduring subsequent treatment. This treatment in TMD patients should not be quitted after pain relief, but should be continued at longer intervals.

Arthritis and arthrosis need lower energies, because they have superficial location. 4-6 J per session is suggested for these problems (63). In a research including 75 cases,Bradly et al. found LLLT as effective as mono-therapy in acute joint pain curing. In more chronic cases, without noticeable bone changes on X-ray, LLLT was used as an adjunct treatment to splints. LLLT is almost as effective as intra-articular steroids for joint pain (65, 68).

Several studies have indicated that additional irradiation of the stellate ganglion in patients with pain is effective and can be recommended for TMD treatment as well (70, 73).

Occlusal adjustment and splint is very helpful in TMD patients. LLLT reduces palpation tenderness and improves microcirculation in the tense muscle. Hence, pain reduction, and consequently increase in mouth opening contributes to impression and occlusal adjustment leading to more rapid success (63).

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