Managing Pain with Laser Acupuncture

Szu-Ying Wu, Chun-En Kuo, Yu-Chiang Hung and Wen-Long Hu

Additional information is available at the end of the chapter
http://dx.doi.org/10.5772/62863

Abstract

According to the theory of traditional Chinese medicine, Qi flows through the body along specific paths known as meridians. Any disturbance in Qi evokes a Ying−Yang imbalance in the body, and consequently leads to disease. Pain results from blood stasis and Qi stagnation. Laser acupuncture (LA), first introduced clinically in the 1970s, combines the advantages of traditional acupuncture and modern laser medicine and has been applied for the treatment of various diseases. Here, we investigated studies on the use of LA for pain management according to current evidence. Articles including English keywords related to the use of LA for pain, published between January 2006 and August 2015 were sourced from PubMed, Medline, and Cochrane Library databases. On the basis of these papers, we explored the modern applications, mechanisms, and analgesic effects of LA. LA integrates the positive effects of acupuncture and low-level laser therapy, and is therefore effective in activating blood and in moving Qi. LA relieves pain through both anti-inflammatory and analgesic effects. No adverse effects or complications resulting from LA were reported in the literature. In the hands of an experienced physician, LA can be a useful and safe method for pain management.

Keywords: laser acupuncture, low-level laser therapy, acupuncture, pain, traditional Chinese medicine

1. Introduction

Although written accounts of acupuncture date back over 2000 years, archaeological evidence suggests more than 3000 years of practice. According to the principles of traditional Chinese medicine (TCM), energy (or Qi) flows through the body along specific paths known as meridians. Balanced Qi contributes to the maintenance of good health. On the other hand, any
disturbance in Qi results in an energy imbalance in the body. This imbalance, either an excess or a deficiency, may then result in disease [1]. Both blood stasis and Qi stagnation will lead to pain [2]. In 1996, the World Health Organization (WHO) confirmed 64 indications for acupuncture treatment. Acupuncture treats the underlying diseases by stimulating specific acupuncture points along the meridians. Acupuncture is one of the most common types of alternative treatments for patients who suffer from long-term pain. Moreover, it is a relatively safe procedure with minimal adverse effects [3]. Even though acupuncture has been proven to be effective for many therapeutic applications, metal needling is not widely accepted owing to fear of possible contamination or transcutaneous lesions [4]. Consequently, following the theory of TCM, the use of low-level laser on acupuncture points has been developed as a new therapeutic approach called laser acupuncture (LA) [5, 6].

LA was first introduced clinically in the 1970s [7]. It has been widely studied over several years to turn it into an evidence-based clinical practice. The use of low-intensity and nonthermal laser irradiation stimulation of acupuncture points is an effective alternative to traditional metal needling; it is a safe technique because it is noninvasive and is acceptable to needle-phobic persons. Thus, LA can be used at acupuncture points that require complicated applications of needles [1, 8]. The laser beam is an electromagnetic wave and can stimulate acupuncture points in the human body by depositing energy without causing heating. In contrast to needling, acupuncture points irradiated by a laser beam need to receive sufficient energy to induce a physiological effect at the cellular level based on the principle of “photobiomodulation.” The beam excites the relevant channels and activities, regulates the function of organs, and promotes metabolism. Recently, several papers have reported that the decisive factor in the efficacy of LA is the applied dosage [5, 9–11].

Although the mechanisms underlying LA are not well understood, LA is widely applied clinically. LA is also referred to as low-level laser therapy (LLLT), with 0.1–0.5 J/cm² deposited per acupuncture point, or 1–4 J/cm² per Ashi point [12]. LLLT has an anti-inflammatory function because it can reduce the levels of certain biochemical factors (prostaglandin E2, messenger ribonucleic acid cyclooxygenase-2, interleukin (IL)-1β, and tumor necrosis factor (TNF)-α), neutrophil influx, oxidative stress, edema, and hemorrhaging [13]. Analgesia induced by laser phototherapy is mediated by peripheral opioid receptors [14]. Nevertheless, LA has both local and distant analgesic effects, which may be mediated by different mechanisms. LA combines the advantages of traditional metal-needle acupuncture and LLLT. This chapter on managing pain by LA focuses on how LA may be an alternative method of relieving pain and improving functional outcomes.

2. Review of the clinical literature

Clinical literature in electronic databases—PubMed, Medline, and Cochrane library—was surveyed using the terms “laser acupuncture”, “low level laser therapy”, and “pain”, published from January 2006 to August 2015. All papers had to meet the following criteria: randomized controlled trials (RCTs) that considered a control group (either placebo, sham LA,
nonstandard traditional acupuncture, or other therapeutic equipment) and retrospective/prospective clinical studies in which LA/LLLT was used. Studies cited in review articles were also included. Papers published in languages other than English were excluded. Conference abstracts, single-case studies, and paper for which full text was not available were also excluded.

Among the reviewed literature, most studies targeted myofascial pain, fibromyalgia, tendinopathy, radiculopathy, osteoarthritis (OA), low back pain, temporomandibular joint dysfunction (TMD), and headache. These are discussed below.

2.1. Myofascial pain
Kiralp et al. [15] reported a RCT in which 43 patients with myofascial pain were enrolled, and showed the positive effect of LA as compared to prilocaine injection. Eight other RCTs also showed the pain-relieving effect of LA; some of these focused on myofascial pain over the cervical region [16, 17], masseter [18], masticatory muscles [19, 20], trapezius [21, 22], or trigger points [23]. The consistency of these trials highlighted the efficacy of LA in the treatment of myofascial pain.

2.2. Fibromyalgia
Two RCTs showed different results for LA treatment of fibromyalgia [24, 25]. Both of these studies obtained subjective pain presentation using a visual analog scale (VAS), the Fibromyalgia Impact Questionnaire (FIQ), and other measures. Armagan et al. [24] reported positive results of LA for treating the pain of fibromyalgia. The difference between these studies was the dose and power density. Armagan et al. set the parameters of LA to 830 nm, 2 J/point, and 50 mW. These results suggested that the treatment effect of LA was inconclusive in fibromyalgia or that the power density used should be sufficiently high to manage the pain in this disease group.

2.3. Tendinopathy
Two RCTs showed positive results of LA in pain management of lateral epicondylitis (LE) [26, 27], also known as tennis elbow. Emanet et al. [27] reported that even though LA had no short-term advantage over the placebo in patients with LE, there was a significant long-term improvement, especially in functional parameters. Another RCT reported that LA had a treatment effect equal to that of ultrasound [28]. Moreover, a systemic review revealed that applying LLLT to myofascial trigger points of LE patients was an effective treatment for pain reduction and also led to increase in grip force, range of motion (ROM), and weight test [9]. As for tendomyopathy of the masticatory musculature, the pilot study showed inconclusive results because there were few participants [19].

2.4. Radiculopathy
Konstantinovic et al. [29] performed an RCT that enrolled 60 patients with acute neck pain with cervical radiculopathy. After a 3-week LA treatment, VAS, neck movement, neck
disability index, and quality of life indicated the positive effect of LA. Radiculopathy of other spinal segments was not reported.

2.5. Osteoarthritis

Among the four RCTs on the use of LA in treating the pain of knee OA, two showed a positive result [30, 31], one was inconclusive [32], and the other one reported efficacy after 2 weeks of treatment but not at the 4-week assessment [33]. However, the RCT showed the inconclusive result for only one point, ST35. An inappropriate dose or insufficient irradiation at a point may be the reason for the poor treatment effect.

2.6. Low back pain

Glazov et al. [34] had reported negative result for the use of LA to relieve low back pain in their study, in which LA was applied to local points of three meridians (Bladder, Gallbladder, and Governor vessel) and Ashi points. Subsequently, Glazov [35] reported another RCT, in which 100 patients with low back pain were enrolled, and found a positive result for pain management with LA. However, the parameter settings used for the second RCT were not described. Therefore, we were not able to determine the differences that contributed to the successful treatment. Nevertheless, further two RCTs showed a positive response for low back pain treated with LA [36, 37].

2.7 Temporomandibular joint disorder

In our literature search, all four RCTs suggested a positive treatment effect for LA in treating the pain associated with TMD [4, 38–40]. Occlusal splinting is the nonsurgical standard treatment for this condition in dental clinics. In two RCTs, LA was found to be as effective as occlusal splinting in relieving TMD-associated pain [39, 40]. LA could be an alternative treatment choice to occlusal splinting. Sattayut and Bradley [41] compared low- and high-grade LA and found that high-grade LA, i.e., 820 nm, 107 J/cm², and 300 mW, showed a superior treatment effect. More recently, Hu et al. [42] clearly showed the therapeutic effects of LA in managing treatment-resistant TMD. In our literature review, another two clinical trials revealed the benefit of LA therapy for TMD patients [43, 44].

2.8. Headache

Gottschling et al. [45] reported an RCT in which LA was used to treat headache in children and showed a decrease in the VAS score and monthly hours with headache. Interestingly, the treatment in this study consisted of only four treatment episodes, at a frequency of once a week, yet the improvement of symptoms was excellent. This study also focused on the meridian-based selection of irradiation points. The basic points for patients with frontal headache were LI4 and ST36; for lateral pain, they were TE6 and GB34; for occipital pain, they were SI3 and BL60, and for holocephalic pain, it was GV20. Additional body acupuncture points and ear acupuncture points were chosen individually. The combination of TCM meridian theory with
LA energy treatment seemed to provide a better effect than simply irradiating the tender points.

2.9. Others

Chow et al. [17] reported that chronic neck pain of any etiology could be treated successfully with a program of 14 LA treatments over a period of 7 weeks. Ip and Fu [46] reported a prospective cohort study that proved the treatment efficacy of LA in painful adhesive capsulitis of the shoulder.

3. Conclusions

We have presented evidence supporting the use of LA in the management for various types of pain (Table 1). LA is a noninvasive technique involving the stimulation of traditional acupuncture points with low-intensity laser irradiation. LA has the advantages of being painless and safe as no heat is generated during the procedure, and it is more effective in some medical conditions and requires less time than needle-based acupuncture [47]. No adverse effects or complications resulting from LA have been reported in any study to date. The effectiveness of LA in managing pain depends on the selection of appropriate points and frequencies. Insufficient energy and very few therapeutic sessions will result in ineffective therapy. In conclusion, LA combines the positive effects of traditional Chinese acupuncture and LLLT, and is therefore effective in both activating blood and moving Qi. LA relieves pain through both anti-inflammatory and analgesic effects. As experienced physicians, we should optimize laser parameters, treatment intervals, and long-term follow-up for LA therapy.

| Study                  | Study design | Subjects | Diagnosis                        | Control        | Intervention time | Wavelength | Dose | Power | Irradiation time (s) | Acupoints | Outcome measure | Results                           |
|------------------------|--------------|----------|----------------------------------|----------------|------------------|-------------|------|-------|----------------------|-----------|------------------|------------------------------------|
| Kiralp et al. [15]     | RCT          | 43       | Myofascial pain syndrome         | Prilocaine injection | 4 weeks (12 sessions) | —           | —   | —     | 180                  | Trigger points in the neck, shoulder, and back muscles | VAS, VPS, pressure pain threshold by pressure algometer | Positive in pressure algometer |
| Chow et al. [17]       | RCT          | 90       | Chronic neck pain                | Placebo         | 7 weeks (14 sessions) | 830 nm     | 0.67 W/cm² | 300 mW | 30                  | Tender points | VAS              | Positive                           |
| Armagan et al. [24]    | RCT          | 32       | Fibromyalgia                      | Placebo         | 2 weeks (10 sessions) | 830 nm     | 2.1 J/point | 50 mW  | 60                  | Tender points | VAS              | Positive                           |
| Yurtkuran et al. [30]  | RCT          | 52       | Knee OA                          | Placebo         | 2 weeks (10 sessions) | 904 nm     | 0.48 J    | 10 mW  | 120                 | SP9                  | VAS, VAS, SF-36, FIQ, WOMAC, NHP | Improvement in KC                  |
| Macietto et al. [36]   | RCT          | 48       | TMD                               | Placebo         | 4 weeks (8 sessions) | 706 nm     | 0.7 J/cm² | 70 mW  | 10                  | One point inside the external auditory duct | VAS              | Positive                           |
| Matsuura et al. [29]   | RCT          | 20       | Fibromyalgia                      | Stretching plus LLLT versus no laser | End of intervention | 830 nm     | 0.3 J/cm² | 30 mW  | —                   | —                    | VAS, dolorimetry at tender points, SF-36 | Negative                           |
| Lam and Cheing [26]    | RCT          | 39       | Lateral epicondylitis             | Placebo         | 3 weeks (9 sessions) | 904 nm     | 2.4 J/cm² | 25 mW  | 11                  | Tender points | VAS, DASH questionnaire        | Positive                           |
| Dundar et al. [16]     | RCT          | 64       | Myofascial pain                   | Placebo         | 5 weeks (15 sessions) | 830 nm     | 7 J/point | 58 mW  | 120                 | Trigger points | VAS, VAS, SF-36             | Positive                           |
| Study                  | Study design | Subjects | Diagnosis                          | Control                        | Intervention time | Wavelength | Dose | Power | Irradiation time (s) | Acupoints | Outcome measures | Results                  |
|-----------------------|--------------|----------|------------------------------------|--------------------------------|--------------------|-------------|------|-------|----------------------|------------|-------------------|--------------------------|
| Shen et al. [31]      | RCT          | 48       | Knee OA                           | Combined laser versus red light | 5 times/week for 2 weeks then for 4 weeks | 630 nm         | --   | --    | --                   | ST35       | WOMAC             | Positive but no difference |
| Gottschling et al. [40] | RCT         | 43       | Headache in children             | Placebo                        | 4 weeks (4 sessions) | 820 nm       | 0.9 (point 30 mW) | --    | 30                  | L4, ST36; T5, T6, GBR5, SI1, BL40, CV20 | MVAS; monthly hours with headache | Positive |
| Shirazi et al. [20]   | RCT          | 16       | Myofascial pain of mandibular system | Placebo                        | 5 weeks (6 sessions) | 660 nm; 900 nm | 6.2 [J/cm²] | 1.17 [J/m²] | 9.8 W                  | Tender points | VAS               | Positive                  |
| Shen et al. [32]      | RCT          | 40       | Knee OA                           | Placebo                        | 4 weeks (12 sessions) | 650 nm       | 36 mW | 200 mW | 1200                  | ST35       | WOMAC             | In-conclusive              |
| Garcia et al. [34]    | RCT          | 100      | Chronic non-specific low back pain | Placebo                        | 5–10 sessions        | 830 nm       | 0.2 (point 10 mW) | --    | 20                  | ST5, ST18, SI2, SP6, LI4 | VAS, DQ, DASH–21, PNI–A | Negative |
| Carrasco et al. [23]  | RCT          | 60       | Myofascial pain                   | Placebo                        | 4 weeks (8 sessions) | 780 nm       | 23.40 and -- | 105 [J/cm²] | --                   | Trigger point | --                | Positive                  |
| Zhao et al. [33]      | RCT          | 40       | Knee OA                           | Placebo                        | 4 weeks (12 sessions) | 650 nm       | 36 mW | 280 mW | 1200                  | ST35       | WOMAC             | Positive after 2 weeks treatment, but not at 4 weeks |
| Ör et al. [39]        | RCT          | 40       | Myofascial pain due to TMD        | occlusal split                  | 5 weeks (10 sessions) | 820 nm       | 3 [J/cm²] | 300 mW | --                   | --         | VAS               | As effective               |
| Karuvalis et al. [19] | Pilot study  | 11       | Tendinopathy of rotator musculature | Placebo                        | 3 weeks (6 sessions) | 690 nm       | 40–60 | 40 mW | 900                  | ST5, ST18, SI2, SI4 | VAS               | In-conclusive              |
| Glazov [39]           | RCT          | 100      | Low back pain                     | Placebo                        | 5–10 sessions        | --           | --    | --    | --                   | --         | VAS               | Positive                  |
| Hotta et al. [43]     | Clinical trial 10 | TMD | No treatment                      | Placebo                        | 10 weeks (10 sessions) | 780 nm       | 35 [J/cm²] | 70 mW | 20                  | L4, HT3, SI10, EMG, SI57 | VAS, EMG | Positive |
| Konstantinovic et al. [29] | RCT       | 60       | Acute neck pain with cervical radiculopathy | Placebo                        | 5 weeks (15 sessions) | 905 nm       | 2 [J/cm²] | 12 mW/cm² | 120                  | Lateral to spinous process and the neck disability two next spinal index, quality of life | VAS, neck movement, process and the neck disability two next spinal index, quality of life | Positive |
| Lee and Han [21]      | RCT          | 24       | Myofascial trigger point pain     | Placebo                        | End of intervention  | 830 nm       | 386, 771, 1929 [J/cm²] | 450 mW | 1, 2, 5 min | Trigger points PPT | -- | VAS, tenderness, tenderness questionnaire, PRITE test, pain-free grip strength, NHP | Positive in 5 min |
| Emanet et al. [27]    | RCT          | 50       | Lateral epicondylitis             | Placebo                        | 5 weeks (15 sessions) | 905 nm       | 1 [J/cm²] | --    | 120                  | Two most sensitive points around the lateral epicondyle | VAS, tenderness, tenderness questionnaire, PRITE test, pain-free grip strength, NHP | Positive in long-term evaluation (12 weeks) |
| Skorepska et al. [28] | RCT          | 80       | Tennis-Elbow                      | Ultrasound                      | 10 days with a weekend break (10 sessions) | 820 ± 10 nm   | 1 ± 5 J/cm² | 400 mW | --                   | Trigger points | Algometer, VAS, DASH, questionnaire, and hand grip strength | Equally effective |
| Karman [22]           | RCT          | 45       | Myofascial pain of upper trapezius | Ultrasound                      | 5 days (5 sessions) | 904 nm       | 74 mW/cm² | --    | 30                  | Trigger points | VAS, provocative pain test, active lateral bending of the cervical spine | Positive |
| Batzer and Bradley [40] | RCT       | 30       | Temporomandibular joint disorder | Low-energy-density laser versus high-energy versus placebo | 1 week (3 sessions) | 820 nm       | 21.4 ± 10 [J/cm²] | 60 mW | 300 mW | 5 points around PPT, MOSP, TMD | 5 most tender trigger points | VAS, positive | Positive in higher energy group |
| Lin et al. [36]       | RCT          | 60       | Low back pain                     | Placebo                        | 5 days (5 sessions) | 889 nm       | 15 [J/cm²] | 40 mW | 600                  | BL4, BL5, SI11 | VAS, Ryodoraku | Positive |
| Ferreira et al. [4]   | RCT          | 40       | TMD                               | Placebo                        | 5 months (12 sessions) | 780 nm       | 112.5 [J/cm²] | 30 mW | 90                  | ST6, ST7, GB20, GB36, LI4, LI3, LI5, ST3, ST4, SI3, SI4 | VAS | Positive |
| Lommatz et al. [18]   | RCT          | 21       | Myofascial pain syndrome of masticatory muscles | Anesthetic injection            | 8–12 days (4 sessions) | 790 nm       | Right: 4 [J/cm²] | Left: 8 [J/cm²] | --              | Trigger points | Surface EMG, mouth opening, VAS | Positive |

Salient Points:
- Study design: RCT (Randomized Controlled Trial), Pilot study, Clinical trial.
- Subjects: 21 to 60 participants.
- Diagnosis: Various conditions including Knee OA, Low back pain, Myofascial pain, Temporomandibular joint disorder.
- Control: Placebo, Anesthetic injection, Ultrasound, Laser.
- Intervention: Laser therapy with different wavelengths and power levels.
- Outcome measures: VAS, WOMAC, DASH, PRITE test, pain-free grip strength, neck disability index.
- Results: Positive, negative, or inconclusive findings.
| Study | Study design | Subjects | Diagnosis | Control | Intervention time | Wavelength | Dose | Power | Irradiation time (s) | Acupoints | Outcome measure | Results |
|-------|--------------|----------|-----------|---------|------------------|------------|------|-------|---------------------|-----------|-----------------|---------|
| Huang et al. [44] | Clinical trial 20 | TMD | Placebo | Once a week till symptom relief or 3 weeks of no improvement | 800 nm | 10.5 [cm²]/0.75 W/cm²/134 | ST 6, ST 7, LI 4 and one local Ashi point | VAS | Positive |
| Demirkol et al. [40] | RCT | 30 | Myofascial pain due to TMD | Occlusal splint; 10 days (10 sessions) | 1064 nm | 8 [J/cm²] | 290 mW | 20 | Trigger points | VAS | As effective as occlusal splint |
| Hu et al. [42] | Clinical trial 29 | Treatment-resistant TMD | — | 4 weeks (12 sessions) | 810 nm | 7.5–26.25 [J/cm²] | 5 W/cm² | 5 sec (acupoint); 40 sec (Ashi point) | ST 7, ST 6, LI 4 and Ashi point | VAS, MMO | Positive |
| Shin et al. [37] | RCT | 56 | Low back pain | Sham laser | 1 week (3 sessions) | 660 nm | — | 50 mW | 180 | GVS, GVF, GVS, BL 25, BL 24, BL 23, BL 40, GES | VAS, PPT, PGIC, EQ-5D | Positive |
| Ip and Fu [46] | Prospective cohort study | Painful adhesive capsulitis of shoulder | — | 5 week (24 sessions) | 810 nm | 8.4 [J/point] | 20 mW/cm² | 20–30 | 3 anatomic points; SI 11, SI 12 | Constant Murley shoulder score | Positive |

**DASH**: disabilities of the arm, shoulder, and hand; **DASS-21**: Depression Anxiety Stress Scale; **EMG**: electromyography; **EQ-5D**: Euro-Quality-of-Life Five Dimensions questionnaire; **FIQ**: Fibromyalgia Impact Questionnaire; **FW**: knee circumference; **LA**: laser acupuncture; **LLE**: lateral epicondylitis; **LLLT**: low-level laser therapy; **MOSP**: maximum mouth opening (MMO) without pain; **MTS**: medial tenderness score; **NHP**: Nottingham Health Profile; **NTP**: number of tender points; **ODI**: Oswestry Disability Index; **PGIC**: Patient Global Impression of Change; **PPT**: pressure pain threshold; **PRTEE**: Patient-Related Lateral Epicondylitis Evaluation; **PWI-A**: Personal Wellbeing Index; **SF-36**: 36-item Short-Form Health Survey; **VPS**: verbal pain scale; **VSGI**: global improvement on a verbal scale; **WOMAC**: Western Ontario and McMaster Universities osteoarthritis index.

Table 1. Summary of clinical studies into pain management with laser acupuncture.

**Abbreviations**

**DASH** disabilities of the arm, shoulder and hand  
**DASS-21** Depression Anxiety Stress Scale  
**EMG** electromyography  
**EQ-5D** Euro-Quality-of-Life Five Dimensions questionnaire  
**FIQ** Fibromyalgia Impact Questionnaire  
**KC** knee circumference  
**LA** laser acupuncture  
**LE** lateral epicondylitis  
**LLLT** low-level laser therapy  
**MOSP** maximum mouth opening (MMO) without pain  
**MTS** medial tenderness score  
**NHP** Nottingham Health Profile
NTP  number of tender points
OA  osteoarthritis
ODI  Oswestry Disability Index
PGIC  Patient Global Impression of Change
PPT  pressure pain threshold
PRTEE  Patient-Related Lateral Epicondylitis Evaluation
PWI-A  Personal Wellbeing Index
RCT  randomized controlled trial
ROM  active range of motion
SF-36  36-item Short-Form Health Survey
SSI  symptom severity index
TCM  traditional Chinese medicine
TMD  temporomandibular joint (TMJ) disorder
VAS  visual analogue scale
VPS  verbal pain scale
VSGI  global improvement on a verbal scale
WHO  World Health Organization
WOMAC  Western Ontario and McMaster Universities osteoarthritis index

Author details

Szu-Ying Wu¹, Chun-En Kuo¹, Yu-Chiang Hung¹,² and Wen-Long Hu¹,³,⁴*

*Address all correspondence to: oolonghu@gmail.com

1 Department of Chinese Medicine, Kaohsiung Chang Gung Memorial Hospital and School of Traditional Chinese Medicine, Chang Gung University College of Medicine, Kaohsiung, Taiwan

2 School of Chinese Medicine for Post Baccalaureate, I-Shou University, Kaohsiung, Taiwan

3 Fooyin University College of Nursing, Kaohsiung, Taiwan

4 Kaohsiung Medical University College of Medicine, Kaohsiung, Taiwan
References

[1] Whittaker P. Laser acupuncture: past, present, and future. Lasers in Medical Science. 2004;19(2):69–80.

[2] Bing Z, Hongcai W. Diagnostics of traditional Chinese medicine. 1st ed. London and Philadelphia: Singing Dragon; 2010. 224 p.

[3] Rickards LD. Therapeutic needling in osteopathic practice: An evidence-informed perspective. International Journal of Osteopathic Medicine. 2009;12(1):2–13.

[4] Ferreira LA, de Oliveira RG, Guimarães JP, Carvalho ACP, De Paula MVQ. Laser acupuncture in patients with temporomandibular dysfunction: A randomized controlled trial. Lasers in Medical Science. 2013;28(6):1549–1558.

[5] Baxter GD, Bleakley C, McDonough S. Clinical effectiveness of laser acupuncture: A systematic review. Journal of Acupuncture and Meridian Studies. 2008;1(2):65–82.

[6] Round R, Litscher G, Bahr F. Auricular acupuncture with laser. Evidence-Based Complementary and Alternative Medicine. 2013;2013:984763. doi: 10.1155/2013/984763. 22 pages.

[7] Hill S. Letter: Acupuncture research in the USSR. The American Journal of Chinese Medicine. 1976;4(2):204.

[8] Litscher G. High-tech laser acupuncture is Chinese medicine. Medical Acupuncture. 2008;20(4):245–254.

[9] Chang W-D, Wu J-H, Yang W-J, Jiang J-A. Therapeutic effects of low-level laser on lateral epicondylitis from differential interventions of Chinese-Western medicine: Systematic review. Photomedicine and Laser Surgery. 2010;28(3):327–336.

[10] Peplow PV, Chung T-Y, Baxter GD. Laser photobiomodulation of proliferation of cells in culture: A review of human and animal studies. Photomedicine and Laser Surgery. 2010;28(S1):S3–S40.

[11] Litscher G, Opitz G. Technical parameters for laser acupuncture to elicit peripheral and central effects: State-of-the-art and short guidelines based on results from the Medical University of Graz, the German Academy of Acupuncture, and the scientific literature. Evidence-Based Complementary and Alternative Medicine. 2012;2012:697096. doi: 10.1155/2012/697096. 5 pages.

[12] Wen-Long Hu, Yu-Chiang Hung, I-Ling Hung. Explore Laser Acupuncture’s Role. In: Lucy L. Chen, Tsung O. Cheng, editors. Acupuncture in Modern Medicine. 1st ed. Rijeka: InTech; 2013. p. 205-220. ch9.

[13] Bjordal JM, Johnson MI, Iversen V, Aimbire F, Lopes-Martins RAB. Low-level laser therapy in acute pain: A systematic review of possible mechanisms of action and clinical
effects in randomized placebo-controlled trials. Photomedicine and Laser Therapy. 2006;24(2):158–168.

[14] Serra AP, Ashmawi HA. Influence of naloxone and methysergide on the analgesic effects of low-level laser in an experimental pain model. Brazilian Journal of Anesthesiology. 2010;60(3):302–310.

[15] Kiralp MZ, Ari H, Karabekir I, Dursun H. Comparison of low intensity laser therapy and trigger point injection in the management of myofascial pain syndrome. The Pain Clinic. 2006;18(1):63–66.

[16] Dundar U, Evcik D, Samli F, Pusak H, Kavuncu V. The effect of gallium arsenide aluminum laser therapy in the management of cervical myofascial pain syndrome: A double blind, placebo-controlled study. Clinical Rheumatology. 2007;26(6):930–934.

[17] Chow RT, Heller GZ, Barsnley L. The effect of 300mW, 830nm laser on chronic neck pain: A double-blind, randomized, placebo-controlled study. Pain. 2006;124(1):201–210.

[18] Uemoto L, Antonio C Garcia M, Vinicius D Gouvêa C, Vilella OV, Alfaya TA. Laser therapy and needling in myofascial trigger point deactivation. Journal of Oral Science. 2013;55(2):175–181.

[19] Katsoulis J, Ausfeld-Hafter B, Katsoulis K, Blagojevic N, Mericske-Stern R. Laser acupuncture for myofascial pain of the masticatory muscles. A controlled pilot study. Schweiz Monatsschr Zahnmed. 2010;120(3):213-225.

[20] Shirani AM, Gutknecht N, Taghizadeh M, Mir M. Low-level laser therapy and myofascial pain dysfunction syndrome: A randomized controlled clinical trial. Lasers in Medical Science. 2009;24(5):715–720.

[21] Lee JH, Han JT. The dose-dependent effect of an 830-nm, 450-mW low-level laser therapy on the myofacial trigger point of the upper trapezius muscle: A randomized, double-blinded, clinical trial. Journal of Physical Therapy Science. 2011;23(6):933–935.

[22] Kannan P. Management of myofascial pain of upper trapezius: A three group comparison study. Global Journal of Health Science. 2012;4(5): 46-52.

[23] Carrasco TG, Guerisoli LDC, Guerisoli DMZ, Mazzetto MO. Evaluation of low intensity laser therapy in myofascial pain syndrome. CRANIO®. 2009;27(4):243–7.

[24] Armagan O, Tascioglu F, Ekim A, Oner C. Long-term efficacy of low level laser therapy in women with fibromyalgia: A placebo-controlled study. Journal of Back and Musculoskeletal Rehabilitation. 2006;19(4):135–140.

[25] Matsutani L, Marques A, Ferreira E, Assumpção A, Lage L, Casarotto R, et al. Effectiveness of muscle stretching exercises with and without laser therapy at tender points for patients with fibromyalgia. Clinical and Experimental Rheumatology. 2007;25(3):410–415.
[26] Lam LKY, Cheing GLY. Effects of 904-nm low-level laser therapy in the management of lateral epicondylitis: A randomized controlled trial. Photomedicine and Laser Surgery. 2007;25(2):65–71.

[27] Emanet SK, Altan Lİ, Yurtkuran M. Investigation of the effect of GaAs laser therapy on lateral epicondylitis. Photomedicine and Laser Surgery. 2010;28(3):397–403.

[28] Skorupska E, Lisinski P, Samborski W. The effectiveness of the conservative versus myofascial pain physiotherapy in tennis elbow patients: Double-blind randomized trial of 80 patients. Journal of Musculoskeletal Pain. 2011;20(1):41–50.

[29] Konstantinovic LM, Cutovic MR, Milovanovic AN, Jovic SJ, Dragan AS, Letic MD, et al. Low-level laser therapy for acute neck pain with radiculopathy: a double-blind placebo-controlled randomized study. Pain Medicine. 2010;11(8):1169–1178.

[30] Yurtkuran M, Alp A, Konur S, Özçakir S, Bingol U. Laser acupuncture in knee osteoarthritis: A double-blind, randomized controlled study. Photomedicine and Laser Therapy. 2007;25(1):14–20.

[31] Shen X-Y, Ding G-H, Wu F, Wang L-Z, Zhao L, Wang M, et al. Effects of 650 nm-10.6 μm combined laser acupuncture-moxibustion on knee osteoarthritis: A randomized, double-blinded and placebo-controlled clinical trial. Journal of Acupuncture and Tuina Science. 2008;6:315–317.

[32] Shen X, Zhao L, Ding G, Tan M, Gao J, Wang L, et al. Effect of combined laser acupuncture on knee osteoarthritis: A pilot study. Lasers in Medical Science. 2009;24(2):129–136.

[33] Zhao L, Shen X, Cheng K, Deng H, Ding G, Tan M, et al. Validating a nonacupoint sham control for laser treatment of knee osteoarthritis. Photomedicine and Laser Surgery. 2010;28(3):351–356.

[34] Glazov G, Schattner P, Lopez D, Shandley K. Laser acupuncture for chronic nonspecific low back pain: A controlled clinical trial. Acupuncture in Medicine. 2009;27(3):94–100.

[35] Glazov G. The influence of baseline characteristics on response to a laser acupuncture intervention: An exploratory analysis. Acupuncture in Medicine. 2010;28(1):6–11.

[36] Lin M-L, Wu H-C, Hsieh Y-H, Su C-T, Shih Y-S, Lin C-W, et al. Evaluation of the effect of laser acupuncture and cupping with ryodoraku and visual analog scale on low back pain. Evidence-Based Complementary and Alternative Medicine. 2012;2012:521612. doi: 10.1155/2012/521612. 7 pages.

[37] Shin J-Y, Ku B, Kim JU, Lee YJ, Kang JH, Heo H, et al. Short-Term effect of laser acupuncture on lower back pain: A Randomized, Placebo-Controlled, Double-Blind Trial. Evidence-Based Complementary and Alternative Medicine. 2015;2015:808425. doi: 10.1155/2015/808425. 8 pages.
[38] Mazzetto MO, Carrasco TG, Bidinelo EF, de Andrade Pizzo RC, Mazzetto RG. Low intensity laser application in temporomandibular disorders: A phase I double-blind study. CRANIO®. 2007;25(3):186–92.

[39] Öz S, Gökçen-Röhlig B, Saruhanoglu A, Tuncer EB. Management of myofascial pain: Low-level laser therapy versus occlusal splints. Journal of Craniofacial Surgery. 2010;21(6):1722–1728.

[40] Demirkol N, Sari F, Bulbul M, Demirkol M, Simsek I, Usumez A. Effectiveness of occlusal splints and low-level laser therapy on myofascial pain. Lasers in Medical Science. 2014;30(3):1007–1012.

[41] Sattayut S, Bradley P. A study of the influence of low intensity laser therapy on painful temporomandibular disorder patients. Laser Therapy. 2012;21(3):183–192.

[42] Hu W-L, Chang C-H, Hung Y-C, Tseng Y-J, Hung I-L, Hsu S-F. Laser acupuncture therapy in patients with treatment-resistant temporomandibular disorders. PLoS One. 2014;9(10):e110528.

[43] Hotta PT, Hotta TH, Bataglion C, Bataglion SA, de Souza Coronatto EA, Siéssere S, et al. Emg analysis after laser acupuncture in patients with temporomandibular dysfunction (TMD). Implications for practice. Complementary Therapies in Clinical Practice. 2010;16(3):158–160.

[44] Huang Y-F, Lin J-C, Yang H-W, Lee Y-H, Yu C-H. Clinical effectiveness of laser acupuncture in the treatment of temporomandibular joint disorder. Journal of the Formosan Medical Association. 2014;113(8):535–539.

[45] Gottschling S, Meyer S, Gribova I, Distler L, Berrang J, Gortner L, et al. Laser acupuncture in children with headache: A double-blind, randomized, bicenter, placebo-controlled trial. Pain. 2008;137(2):405–412.

[46] Ip D, Fu N-Y. Two-year follow-up of low-level laser therapy for elderly with painful adhesive capsulitis of the shoulder. Journal of Pain Research. 2015;8:247–252.

[47] Hu W-L, Chang C-H, Hung Y-C. Clinical observations on laser acupuncture in simple obesity therapy. The American Journal of Chinese Medicine. 2010;38(05):861–867.