Clinical effectiveness of laser acupuncture in the treatment of temporomandibular joint disorder

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Received 20 May 2012; received in revised form 12 July 2012; accepted 31 July 2012

KEYWORDS
laser acupuncture; temporomandibular joint disorder; treatment

Background/Purpose: Temporomandibular joint disorder (TMD) is a general term for diseases of the temporomandibular joint and orofacial muscles. In this study, we tested whether laser acupuncture was effective for the treatment of TMD.

Methods: Twenty patients with TMD were treated with diode K-Laser (wavelength 800 nm, energy density 100.5 J/cm²) once a week at four acupuncture points including three standard ipsilateral local points (ST6, ST7, Ashi point) and one contralateral distal point (LI4). A 10-cm visual analogue scale (0 no pain and 10 the most severe pain) was used for measuring the pain intensity before and after the treatment.

Results: Seventeen out of 20 patients (85%) showed various degrees of pain relief after laser acupuncture treatment. The average pain score was 6.3 ± 1.6 before treatment and 2.5 ± 2.2 after treatment. Significant pain relief after laser acupuncture treatment was achieved (p = 0.0003, Wilcoxon signed rank test). The 17 patients showed an average pain relief of 63 ± 31%. There were six patients who showed no TMD symptoms after an average of four treatments of laser acupuncture. The other 11 patients showed partial relief of TMD symptoms after treatment. Although the pain was still present, it was less and was acceptable. No side effects were reported in any patients during or after laser acupuncture treatments.

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

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http://dx.doi.org/10.1016/j.jfma.2012.07.039
Introduction

Temporomandibular joint disorder (TMD) is a general term for diseases of the temporomandibular joint (TMJ) and orofacial muscles. The symptoms and signs of TMD include pain in the TMJ and masticatory muscles, joint sounds and crepitus, joint locking, mandibular dysfunction, headache, and otalgia. The etiology of TMD is multifactorial and complex with occlusal, psychological, pathological and traumatic aspects. Epidemiological studies reveal that up to 75% of the adult population have at least one sign of TMJ dysfunction and approximately 30% have more than one symptom, while only 3–7% of the population ask for advice or care.

The treatment for TMD involves dental approaches, such as occlusal splints, occlusal adjustment, jaw exercises and counseling, but other options including low-level laser therapy have been used with good clinical results. Low-level laser therapy is a form of phototherapy that has been employed as a treatment for a variety of conditions, including musculoskeletal and soft tissue injuries and chronic ulceration. It is suggested to have biostimulating and analgesic effects through direct irradiation without causing a thermal response.

Acupuncture is a therapeutic method based on traditional Chinese medicine, which consists of the insertion of small, solid needles that are usually made of stainless steel, into specific body points in order to improve health or modify painful states. It is considered to be capable of stimulating the organism’s regulatory systems from the reflex responses obtained by means of afferent stimuli from the selected acupuncture points, with an energy density of 100.5 J/cm² (0.75 W/cm²) for each point. A 10-cm visual analogue scale (VAS; zero for no pain and 10 for the most severe pain) was used to measure the pain intensity before and after the treatment. All patients were treated a low-level energy diode laser with a wavelength of 800 nm. A straight hand-piece with a slightly curved tip whose end was 6 mm in diameter was used for delivering the laser light. The specific acupuncture points were selected according to their classical function on the basis of traditional Chinese medicine. Three standard ipsilateral local points (ST6, ST7 and one local Ashi tender point) and one contralateral distal point (LI4) were stimulated by the laser light in all patients. Traditionally, ST6 (Jiache, Fig. 1A), ST7 (Xiaguan, Fig. 1B) and the local Ashi point are used for relieving facial pain and LI4 (Hegu, Fig. 1C) is used for relieving pain of the face and neck.

When performing the laser acupuncture, the hand-piece tip was in direct contact with light pressure on the skin of the selected acupuncture points. The laser light output was 1.5 W with 0.025 msec intermittent pulsing and a frequency of 20,000 Hz, which is equivalent to 0.75 W/cm². The laser light was applied for 134 sec to each acupuncture point, with an energy density of 100.5 J/cm² (0.75 W/cm² × 134 sec) for each point. A 10-cm visual analogue scale (VAS; zero for no pain and 10 for the most severe pain) was used to measure the pain intensity before and after the treatment. All patients were treated once a week. The therapeutic course was ended when patients felt that they no longer required the treatment or demonstrated no symptom improvement after three courses of treatment. The VAS pain score at each visit was used for analysis. The duration of pain before initial treatment and the maximum mouth opening (MMO) before and after each treatment were recorded. We also conducted placebo laser acupuncture (i.e. the hand-piece tip was applied on the acupuncture points but no laser light was delivered) in six patients as controls.

Methods

Twenty patients with TMD were recruited from the Oral Medicine Clinic at the Oral Medicine Center, Chung Shan Medical University Hospital in Taichung, Taiwan, during the period from January 2011 to October 2011. All patients received panoramic and bilateral TMJ radiographies to exclude any bony abnormalities of the jaws. The inclusion criterion for the patients was a diagnosis of TMD associated with muscle tenderness on palpation. Bilateral muscles including the masseter, pterygoid, temporalis and sternocleidomastoid muscles were palpated. Exclusion criteria were patients who had arthropathy of the TMJ, rheumatoid arthritis, recent trauma to the jaws, ongoing treatment of TMD, psychological illness, major systemic diseases (such as diabetes mellitus) and current pregnancy.

After informed consent was obtained, all patients were treated with a low-level energy diode laser with a wavelength of 800 nm. A straight hand-piece with a slightly curved tip whose end was 6 mm in diameter was used for delivering the laser light. The specific acupuncture points were selected according to their classical function on the basis of traditional Chinese medicine. Three standard ipsilateral local points (ST6, ST7 and one local Ashi tender point) and one contralateral distal point (LI4) were stimulated by the laser light in all patients. Traditionally, ST6 (Jiache, Fig. 1A), ST7 (Xiaguan, Fig. 1B) and the local Ashi point are used for relieving facial pain and LI4 (Hegu, Fig. 1C) is used for relieving pain of the face and neck.

When performing the laser acupuncture, the hand-piece tip was in direct contact with light pressure on the skin of the selected acupuncture points. The laser light output was 1.5 W with 0.025 msec intermittent pulsing and a frequency of 20,000 Hz, which is equivalent to 0.75 W/cm². The laser light was applied for 134 sec to each acupuncture point, with an energy density of 100.5 J/cm² (0.75 W/cm² × 134 sec) for each point. A 10-cm visual analogue scale (VAS; zero for no pain and 10 for the most severe pain) was used to measure the pain intensity before and after the treatment. All patients were treated once a week. The therapeutic course was ended when patients felt that they no longer required the treatment or demonstrated no symptom improvement after three courses of treatment. The VAS pain score at each visit was used for analysis. The duration of pain before initial treatment and the maximum mouth opening (MMO) before and after each treatment were recorded. We also conducted placebo laser acupuncture (i.e. the hand-piece tip was applied on the acupuncture points but no laser light was delivered) in six patients as controls.

The difference in VAS pain score before and after laser acupuncture treatment was assessed for statistical significance using the Wilcoxon signed rank test. The mean duration of pain in different patient groups was compared by Student’s t-test. A p-value of less than 0.05 was considered statistically significant.

Results

Seventeen out of the 20 patients (85%) showed various degrees of pain relief after laser acupuncture treatment.
Figure 1  The acupuncture points that were used in this study: (A) ST6, Jiache; (B) ST7, Xiaguan; and (C) LI4, Hegu.

Table 1  Demographic data, treatment number and pain scores before and after treatment, and clinical outcomes of the 17 temporomandibular joint disorder patients with improvement after laser acupuncture treatment.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (y)</th>
<th>Sex</th>
<th>Treatment number</th>
<th>Pain score before treatment</th>
<th>Final pain score after treatment*</th>
<th>Percentage pain relief</th>
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<tbody>
<tr>
<td>1</td>
<td>17</td>
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<td>7</td>
<td>4.9</td>
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<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>47</td>
<td>Female</td>
<td>4</td>
<td>7.2</td>
<td>0.0</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>49</td>
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<td>4</td>
<td>7.4</td>
<td>0.0</td>
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<tr>
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<td>4.9</td>
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<td>100%</td>
</tr>
<tr>
<td>5</td>
<td>54</td>
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<td>2.5</td>
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</tr>
<tr>
<td>6</td>
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<td>3</td>
<td>5.2</td>
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</tr>
<tr>
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<tr>
<td>8</td>
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<td>7.2</td>
<td>5.5</td>
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<tr>
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<td>7.8</td>
<td>2.3</td>
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<td>4.0</td>
<td>2.1</td>
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</tr>
<tr>
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<tr>
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<tr>
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<tr>
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<td>4.5</td>
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<tr>
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<td>6.7</td>
<td>3.5</td>
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</tr>
<tr>
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<td>Female</td>
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<td>5.4</td>
<td>3.4</td>
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</tbody>
</table>

*Statistical analysis by Wilcoxon signed rank test demonstrated significant pain relief after laser acupuncture treatment (p = 0.0003).
The demographic data, treatment number, pain scores before and after treatment, and clinical outcomes of the 17 symptom-improved TMD patients are listed in Table 1. There were five male and 12 female patients (aged 13–56 years, mean age 34 ± 14 years). The average number of treatments that the 17 patients received was 2.5 ± 1.7 (range, 1–7). The average pain score was 6.3 ± 1.6 (range, 2.5–8.5) before treatment and 2.5 ± 2.2 (range, 0.0–5.8) after treatment. Statistical analysis by Wilcoxon signed rank test demonstrated significant pain relief after laser acupuncture treatment (p = 0.0003). The 17 patients showed an average pain relief of 63 ± 31% (range, 23–100%). Mean MMO of the 17 patients was 38.9 ± 6.3 mm (range, 32.0–53.0 mm) at baseline and 40.1 ± 5.7 mm (range, 32.0–53.0 mm) after the last treatment.

There were six patients who showed no TMD symptoms after an average of four (range, two to seven) laser acupuncture treatments. There was no recurrence of TMD in these six patients after a follow-up period of seven to nine (mean, 8.3) months. The other 11 patients showed partial relief of the TMD symptoms after treatment. Although the pain was still present, it was less and was at an acceptable level. No side effects were reported in any patients during or after laser acupuncture treatments. The remaining three patients showed no response to the laser acupuncture treatment and the six control patients receiving placebo laser acupuncture had not improvement in symptoms. These nine patients were further treated by medication or other appropriate therapy (data not shown).

Seventeen patients responded well to laser acupuncture therapy had mean pain duration of 5 ± 5 weeks (range, 2 days to 16 weeks). However, those three patients without pain relief after laser acupuncture therapy had mean pain duration of 6 ± 6 weeks (range, 2–12 weeks). No significant difference in the mean pain duration was found between the two groups (p = 0.759, Student’s t-test).

Discussion

This study demonstrated that laser acupuncture was effective for the treatment of TMD. Clinically, patients with TMD may receive physical therapy or medication with an analgesic or corticosteroid drugs, which may induce deleterious adverse effects. As an alternative therapy, the low-level laser has been shown to be effective for reducing pain and muscular tension1,25 and for the treatment of burning mouth syndrome.26 The physiological effects of infrared laser therapy may include biostimulation, improvement of blood circulation, vasodilation, analgesia, anti-inflammatory and anti-edematous effects, and an acceleration of wound healing.14,15

The wavelength, power output, energy intensity and the duration of application of low-level laser therapy are important parameters when determining the success of therapy. The most important parameter is the energy intensity in J/cm².12 Pinheiro et al used low-level laser therapy with wavelengths of 632.8 nm, 670 nm and 830 nm and an average dose of 1.8 J/cm² to treat 24 TMD patients. They found significant recovery from pain and clicking in treated patients.11 By using a gallium arsenide or GaAs laser with 904 nm wavelength and a light dose of 3 J/cm²,2 Kulecioglu and colleagues treated 35 TMD patients and showed a significant reduction in pain.2 A double-blind study conducted by Venancioire et al demonstrated that TMD patients treated with low-level laser therapy with a wavelength of 780 nm and a light dose of 6.3 J/cm² had a significant reduction in pain compared to those in the placebo group.13 Mazzetto et al used an infrared laser (780 nm, 89.7 J/cm²) to treat 48 TMD patients. They found a decrease in the level of pain experienced by patients they had treated.1 By using low-level laser therapy (980 nm at 2 J over the TMJ and 1.5 J at three pain trigger points), Lassemi and colleagues treated 48 TMD patients and showed a significant reduction in pain and clicking.15 Kat-soulis et al used laser acupuncture (690 nm, 40–60 J/cm²) for the treatment of seven patients with myofascial pain of the masticatory muscles. They showed a pain reduction in six out of seven patients.24 This study used a much higher light dose (100.5 J/cm²) at each acupuncture point than those described in the aforementioned studies. We suggest that the higher light dose may provide more effective stimulation on the acupuncture points, enhancing the clinical effect of pain relief. Under treatment with this higher light dose, most patients showed partial or total relief of pain without experiencing significant side effects. Rosted reviewed the studies using acupuncture for the treatment of TMD, he concluded that when conducting the acupuncture the needles should be manipulated manually to achieve the De-qui sensation and left in situ for 30 minutes.27 “De-qui” is an important sensation for needling to achieve an effective clinical outcome, according to ancient Chinese experience. Since laser acupuncture is a non-invasive therapy and cannot achieve the De-qui sensation as the needle acupuncture does, a relatively higher light dose may be needed to ensure sufficient stimulation for each acupuncture point.

In this study, the duration of pain that patients had experienced before treatment showed no significant correlation with the clinical outcomes of laser acupuncture therapy. We also found that laser acupuncture therapy did not significantly improve the MMO of the patients after treatment. Further studies need to be performed to elucidate why laser acupuncture therapy does not have effects on the MMO of the patients.

Needle acupuncture has been proven to be effective for the treatment of TMD.21 However, it is invasive and may cause pneumothorax, endocarditis and hepatitis if practitioners ignore basic anatomy or do not apply aseptic procedures.28,29 In addition, most dentists are not well-trained in acupuncture and may be prohibited by law from using acupuncture in some countries. In contrast, laser acupuncture is more generally available for dentists and is non-invasive, safe, painless and easy to use. By stimulating the four easily identified acupuncture points, this study found that laser acupuncture was an effective treatment modality for TMD.

Needle acupuncture can activate small myelinated nerve fibers in the muscle, which in turn send impulses to the spinal cord and then activate the midbrain and pituitary–hypothalamus to produce an effect. Enkephalin, β-endorphin, dynorphin, serotonin, noradrenaline and adenosine have been shown to be involved in this process.29,30 For low-level laser therapy, the analgesic effect may be obtained through increasing the production of β-endorphins,
the pain threshold, and the lymphatic flow and local microcirculation leading to a reduction in edema. Moreover, the analgesic effect may be achieved by negatively affecting neurotransmission, decreasing the production of bradykinin, altering the noradrenaline—adrenaline balance and promoting the muscle relaxation. It is still not clear why laser acupuncture is effective in the treatment of TMD. Further studies should be carried out to elucidate the mechanism of action of laser acupuncture.

Conclusion

This study demonstrated that approximately 85% of the TMD patients treated with the laser acupuncture exhibited an average pain relief of 63% after treatment. Six out of 17 patients showed no symptoms after an average of four treatments. The small sample size of this study means that we may need further studies to draw a solid conclusion regarding the effect of laser acupuncture on the treatment of TMD. However, we suggest that laser acupuncture may be an alternative treatment modality for TMD because it is non-invasive, results in partial or total relief of pain, and has no side effects.

References