Efficacy of Laser on Acupuncture Points in Knee Osteoarthritis

YASMIN A. ABDEL HALEM, B.Sc.*; RAGIA M. KAMEL, Ph.D.**; RANIA R. ALI, Ph.D.** and HUSSEIN A. HUSSEIN, Ph.D.***
The Department of Physical Therapy, El-Monira Hospital*, The Department of Basic Sciences, Faculty of Physical Therapy, Cairo University** and The Department of Orthopedics, Ahmed Maher Teaching Hospital***, Cairo

Abstract

Background: Knee osteoarthritis is reported to be a major health problem worldwide and a main source of disability and handicap, which leads to considerable socioeconomic costs.

Purpose: The study conducted to investigate the efficacy of laser on acupuncture points in management of knee osteoarthritis.

Methodology: Thirty patients with moderate knee osteoarthritis from both genders were assigned, aged between 40-60 years old were divided randomly into two equal groups. Group (A) 15 patients received low level laser on acupuncture points and conventional exercises. Group (B) 15 patients received placebo laser and conventional exercises. Treatment was done 3 times a week for 4 weeks. Pain level, range of motion and functional performance were measured before and after treatment by visual analogue scale, digital goniometer and WOMAC questionnaire respectively.

Results: There were significant statistical differences within the two groups before and after treatment. Active laser Group (A) demonstrated high significant improvement in pain, knee ROM and function ability compared with Placebo laser Group (B).

Conclusion: Low level laser on acupuncture points was effective modality in for managing chronic knee osteoarthritis.

Key Words: Knee osteoarthritis – Low level laser – Acupuncture points.

Introduction

OSTEOARTHRITIS (OA) is a painful and disabling inflammatory disease of the joints and is the most prevalent form of arthritis. It is caused by multiple factors (e.g., joint injury or overuse, obesity and heredity) and dramatically increases in prevalence with age [1]. Autopsies indicate evidence of OA in weight-bearing joints of almost all persons by the age of 45 years [2]. Knee osteoarthritis is the most common multiple bone and joint disease of the elderly, accounting for approximately 40% of all types of arthritis [3]. Previous studies have shown the incidence rate of people over 65 years is nearly 100 percent. The pathological features of knee osteoarthritis are joint cartilage deformation and destruction and osteophyte formation. The main clinical manifestations include knee swelling, pain and stiffness and dysfunction [4].

The objectives of management of knee osteoarthritis are to relieve pain and to maintain or improve function. Different modalities in physiotherapy have been suggested to improve the clinical course of knee osteoarthritis, with potentially fewer adverse effects than medical treatment [5].

Acupuncture traditionally involves the insertion of fine needles into specific points of the body. According to the ancient philosophy of traditional Chinese acupuncture, energy circulates in 12 ‘meridians’ located throughout the body. Pain or ill health will result if the meridian energy circulation is blocked. Stimulating the appropriate combination of meridian acupuncture points in the body can restore energy circulation, health and balance [6].

Laser Acupuncture (LA) is a noninvasive and noninfectious method that can avoid pain and psychological fear promoted by the insertion of needles [7]. Indeed, LA is a form of phototherapy at acupoint similar to needle acupuncture, differing in the type of stimulus [8].

Purpose of the study:

To determine the effect of laser on acupuncture points on pain, range of motion and functional activities in patients with knee osteoarthritis.
Design of the study:

Pre-post test design was used in this study.

Patients and Methodology

They were selected randomly and referred by the Orthopedist from the clinic of Orthopaedic in El-Monira Hospital and they were operated in the Department of Physical Therapy at El-Monira Hospital one of the Egyptian Health Ministry Hospitals in Cairo. The study was conducted from February 2016 to June 2016. Patients weight and height allowed them to be considered below (30kg/m²), according to Body Mass Index (BMI) equation BMI= Weight (Kg) + Height (m²) [9]. Thirty patients of both genders with moderate knee osteoarthritis (grade 3) according to Kellgren-Lawrence Radiographic Grading System for Knee Osteoarthritis were randomly divided into two groups; each group consisted of fifteen patients. The first received low level laser therapy on five acupuncture points and conventional exercises (Group A) and the second group (Group B) that received placebo laser and the same conventional exercise program as (Group A), all groups was under their medical treatment prescribed by the physician all patients were diagnosed as chronic knee osteoarthritis. Their inclusion criteria were as follow: Age from 40-60 years, body mass index (<30kg/m²), moderate knee osteoarthritis, not be treated with analgescics or any medication which may cause misleading results. Any patient had systemic arthritic condition, knee arthroplasty, wait-listed for any knee surgery was excluded from the study, any condition affecting lower limb function (eg trauma, malignancy, neurological condition), structure discrepancy (eg leg length discrepancy), any knee surgery in previous six months, any knee injection in past six months was excluded from the study.

Patients were assessed before and after 12 sessions of treatment. Pain assessed by visual analogue scale, knee range of motion assessed by Absolute + AxisTM digital goniometer and functional disability assessed by Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

Instrumentation:

A- For treatment:

Gallium aluminium arsenide laser device (Endolaser 476, Enraf Nonius, Botterdam, Netherland) with 30mW diode probe, producing infra-red laser with a wavelength of 830nm and an irradiation area of 0.28cm².

B- For assessment:

- Weight and height scale to evaluate the height, weight and calculate BMI.
- Visual analogue scale to assess pain.
- Absolute + AxisTM digital goniometer to assess knee range of motion.
- Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) to assess functional disability.

Procedure:

A- Evaluation session:

Prior to participation, informed consent form was signed from all subjects participated in this study. Weight and height were recording and BMI was calculated and obtained by this equation according to BMI = Weight (Kg) + Height (m²). The study protocol was explained in details for every patient before starting the initial assessment.

B- Low level laser procedure:

A 30mW, continuous wave Gallium-Aluminum-Arsenide (GaAlAs) laser with wavelength 830nm probe was used to irradiation area of 0.28cm². Laser beam irradiated five points (ST-35, Ex-31, Ex.32, G.B.-34, U.B-40) which were frequently used for treating knee osteoarthritis by acupuncturists in clinical and research settings [10,11], each point for 50 seconds with a dose of 1.5J per point and 7.5J per session for each patient [12,13]. The energy density was 5J/cm² [14].

The therapist and patients wore protective goggles to shield their eyes from active laser radiation. On the affected knee, the laser probe was placed sequentially and perpendicularly in full contact with the skin [15]. Patients received treatment in a supine position, with the affected knee slightly flexed and supported by a rolled towel [15]. Then for U.B-40 point to be irradiated patients turned prone position with a supporting roll or pillow placed under the ankles to relax the popliteal crease [16]. The same procedures were applied to patients in the placebo laser group, but the device was inactive and only produced visible red light.

C- Exercise program:

- Stretching of the hamstring and calf muscle from supine position passively done by the therapist. The stretching force sustained 30 seconds for 3 times for each muscle.
- Strengthening exercises of the quadriiceps from crock lying position in form of muscle straight
leg raising exercises, patient asked to contract the quadriceps muscle and elevate the limb to 45 degree and hold for 6 seconds, slowly lower the limb then relax for 6 seconds, 3 sets of 10 repetitions were done. Then in the form of straight leg raising exercise with lifting 2kg (sandbag) 3 sets of 6 repetitions. The isometric contractions were repeated at multiple knee angles (30-60-90) degree respectively, each set of contractions at each knee angled was followed by 10 seconds rest period.

Statistical analysis:

Descriptive statistics and t-test were conducted for comparison of the mean age and BMI between both groups. Unpaired t-test was conducted for comparison of pre and post-treatment mean values of knee ROM between groups. Paired t-test was conducted for comparison between pre and post-treatment mean values of knee ROM in each group. Mann-Whitney U-test was conducted for comparison of VAS and WOMAC between both groups. Wilcoxon signed ranks test was conducted for comparison of VAS and WOMAC between pre and post-treatment in each group.

Results

Subject characteristics:

Group A fifteen patients (11 females and 4 males) their mean ± SD age and BMI were 53.33 ± 5.66 years and 28.2± 1.33kg/m² respectively. Group B fifteen patients (9 females and 6 males) in group (B) their mean ± SD age and BMI were 53±4.89 years and 28.4±0.96kg/m² respectively. Comparing the general characteristics of the subjects of both groups revealed that there was no significance difference between both groups in the mean age and BMI (p>0.05).

Pre and post-treatment median values of VAS of Group A:

There was a significant decrease in the median values of VAS in Group A post-treatment compared with pre-treatment (p=0.001).

Table (1): Wilcoxon signed ranks test for comparison between pre and post-treatment median values of VAS of Group A.

<table>
<thead>
<tr>
<th>VAS</th>
<th>Z-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>6</td>
<td>3.47</td>
<td>0.001</td>
</tr>
<tr>
<td>Post</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Z-value : Wilcoxon signed ranks test value.

Pre and post-treatment median values of VAS of Group B:

There was a significant decrease in the median values of VAS in Group B post-treatment compared with pre-treatment (p=0.001).

Table (2): Wilcoxon signed ranks test for comparison between pre and post-treatment median values of VAS of Group B.

<table>
<thead>
<tr>
<th>VAS</th>
<th>Z-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>7</td>
<td>3.27</td>
<td>0.001</td>
</tr>
<tr>
<td>Post</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Z-value : Wilcoxon signed ranks test value.
p-value : Probability level.

Pre and post-treatment median values of VAS of both Groups (A and B):

There was a significant decrease in the median values of VAS of Group A compared with Group B post-treatment (p=0.003).

Table (3): Mann-Whitney U-test for comparison between post-treatment median values of VAS of Group A and B.

<table>
<thead>
<tr>
<th>VAS</th>
<th>U-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>3</td>
<td>42</td>
<td>0.003</td>
</tr>
<tr>
<td>Group B</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

U-value : Mann-Whitney test value.
p-value : Probability level.

Pre and post-treatment median values of WOMAC of Group A:

There was a significant decrease in the median values of WOMAC in Group A post-treatment compared with pre-treatment (p=0.001).

Table (4): Wilcoxon signed ranks test for comparison between pre and post-treatment median values of WOMAC of Group A.

<table>
<thead>
<tr>
<th>WOMAC</th>
<th>Z-value</th>
<th>p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>50</td>
<td>3.41</td>
<td>0.001</td>
</tr>
<tr>
<td>Post</td>
<td>30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Z-value : Wilcoxon signed ranks test value.
p-value : Probability level.

Pre and post-treatment median values of WOMAC of Group B:

There was a significant decrease in the median values of WOMAC in Group B post-treatment compared with pre-treatment (p=0.001).
Post-treatment median values of WOMAC of both Groups (A and B):

There was a significant decrease in the median values of WOMAC of Group A compared with Group B post-treatment ($p=0.001$).

Table (6): Mann-Whitney U-test for comparison between post-treatment median values of WOMAC of Group A and B.

<table>
<thead>
<tr>
<th>WOMAC Median</th>
<th>U-value</th>
<th>$p$-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>30</td>
<td>32.5</td>
<td>0.001</td>
</tr>
<tr>
<td>Group B</td>
<td>35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

U-value: Mann-Whitney test value.
$p$-value: Probability level.
S: Significant.

Pre and post-treatment mean values of knee ROM of Group A:

The mean ± SD knee ROM pre-treatment of Group A was $116.33±7.89$ degrees and that post-treatment was $131±5.07$ degrees. The mean difference between pre and post-treatment was $–14.67$ degrees and the percent of change was $12.61\%$. There was a significant increase in the knee ROM in Group A post-treatment compared with pre-treatment ($p=0.0001$).

Table (7): Paired $t$-test for comparison between pre and post-treatment mean values of knee ROM of Group A.

<table>
<thead>
<tr>
<th>Knee ROM (degrees)</th>
<th>MD</th>
<th>$t$-value</th>
<th>$p$-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>$116.33±7.89$</td>
<td>$131±5.07$</td>
<td>$–8.29$</td>
<td>$0.0001$</td>
</tr>
</tbody>
</table>

$X$: Mean.
$SD$: Standard Deviation.
$MD$: Mean Difference.
$t$-value: Paired $t$-value.
$p$-value: Probability value.
S: Significant.

Post-treatment mean values of knee ROM level of both Groups (A and B):

The mean ± SD knee ROM post-treatment of Group A was $131±5.07$ degrees and that of Group B was $122±5.27$ degrees. The mean difference between both groups was $9$ degrees. There was a significant increase in the knee ROM in Group A compared with Group B post-treatment ($p=0.0001$).

Table (8): Paired $t$-test for comparison between pre and post-treatment mean values of knee ROM of Group B.

<table>
<thead>
<tr>
<th>Knee ROM (degrees)</th>
<th>MD</th>
<th>$t$-value</th>
<th>$p$-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>$116±6.6$</td>
<td>$122±5.27$</td>
<td>$–14.67$</td>
<td>$0.0001$</td>
</tr>
</tbody>
</table>

$X$: Mean.
$SD$: Standard Deviation.
$MD$: Mean Difference.
$t$-value: Paired $t$-value.
$p$-value: Probability value.
S: Significant.

Discussion

The study was conducted to investigate effect of laser on acupuncture points on pain, knee range of motion and functional activities in patients with knee osteoarthritis.

Thirty patients of both sexes (20 females-10 males) complaining from moderate knee osteoarthritis, aged 40 to 60 years, were assigned randomly into two groups. (Group A) received who received low level laser on acupuncture points in addition to conventional exercises for knee osteoarthritis; and (Group B) who received placebo laser and same conventional exercises as Group A. All patients received 3 sessions per week for successive 12 weeks.
All patients in both groups of the current study exercised regularly which played a role in the improvement seen in participants of both group. Patients with KOA have a significant decrease in knee muscle strength, especially the quadriceps muscle, which increases knee pain; and there is strong evidence suggesting that exercises can reduce pain and improve function in patients with OA [17]. Therefore, exercise is a core recommendation in all international guidelines as a first-line management method for patients suffering KOA [18].

The analgesic effect of laser explained by Brosseau et al., [19], stated that the reduction in pain through using LLLT might be due to mechanisms such as physiological effects mediated by photochemical actions at cellular level in animal or human tissue, and through increased levels of the neurotransmitters implicated in pain modulation, such as serotonin. And Hegedus et al., [20], stated that through LLLT, there is an improvement in local circulation, which leads to reduced edema and improved tissue oxygenation, which consequently may result in pain alleviation. Also, Jia and Guo [14]. Concluded that LLLT has an effect on joint cartilage regeneration, achieved through proliferation of chondrocytes and synthesis and secretion of extracellular matrix. These results come in agreement with Shen et al., [21], who conducted RDBCT, to assess the efficacy and safety of two combined types of laser irradiation in patients with KOA when AP Dubi (ST35) is irradiated. Forty patients with OA were randomly allocated to an active laser group or to a placebo laser group (20 per group). They either received active or placebo laser treatment at acupoint Dubi (ST35) in a total of 12 sessions. Patients were treated by a 650nm semiconductor laser and 10.6 µm CO2 laser in a total of 12 sessions, with irradiation time of 20 minutes for each patient in each session. The study showed statistically significant improvement in pain, stiffness, and function of patients in the laser group when compared with the placebo group.

These results were in agreement with the findings of Schuller and Neugebauer [22], who evaluated the evidence for laser acupuncture for the selected orthopedic diseases (medial and lateral epicondylitis, myofascial pain syndrome of the neck, back and shoulder and osteoarthritis), a positive effects can be assumed in myofascial pain syndromes of the neck, back and shoulder and laser acupuncture was advantageous in terms of side effects compared to classical acupuncture techniques.

Many other studies had been conducted to investigate the efficacy of LLLT on patients with KOA when applied to different areas, rather than on APs. These results were agreement with the findings of Hegedus et al., [20], who conducted a RDBCT to investigate the effect of LLLT in pain and possible microcirculatory changes in patients with KOA. Treatments were delivered twice a week over a period of 4wk with a diode laser (wavelength 830nm, continuous wave, power 50mW) in skin contact at a dose of 6J/point. The study showed a significant reduction in VAS scores in the active laser group, as compared with the placebo group (p<0.05).

Pallotta et al., [23], conducted a RCT to investigate the effect of LLLT (infrared, 810nm, 100mW output power, 0.028cm2 spot size area, power density of 5W/cm2, and the irradiation was performed with skin contact) in experimentally induced rat knee inflammation. Thirty male wistar rats were used for the study. According to the results of the study, the authors concluded that laser radiation could be acting to modulate the inflammatory process and possibly stimulating the production of anti-inflammatory mediators.

In contrast to Yurtkuran et al., [24], who conducted a RDBCT, to investigate the efficacy of LLLT. Group I (n=27) received 904-nm low-level laser irradiation with 4mW output power to the acupuncture point Sp9. Group II (n=25) received placebo-laser therapy at the same place on the same point. Patients in both of the groups had treatment 5 days per week for two weeks. The outcome measures: Pain on movement (pVAS), 50-foot walking time (50 foot w), Knee Circumference (KC), Medial Tenderness Score (MTS), Western Ontario and McMaster Universities osteoarthritis index (WOMAC), and Nottingham Health Profile (NHP). When groups were compared with each other, the improvement observed in KC was superior in Group I at the 2 (nd) weeks. Laser acupuncture was found to be effective only in reducing periarticular swelling when compared with placebo laser. These results were in disagreement with Tascioglu et al., [25], who conducted a RSBCT to investigate the analgesic efficacy of LLLT in patients with KOA. They suggested that LLLT has no effect on pain in patients with KOA.

**Conclusion:**

We concluded that low level laser on acupuncture points was effective modality for managing chronic knee osteoarthritis as there were highly significant differences in pain level, knee ROM and functional ability after treatment.
References


فعالية الليزر على نقاط وخص الأطر الصينية في خشونة الركبة

الخلاصة: إن خشونة مفصل الركبة من أكثر أمراض المفاصل إنتشاراً، وهي تسبب نسبة كبيرة من سكان العالم وتعد من أهم مسببات الإعاقة وعدم القدرة على الإستمرار في العمل مما يؤثر بشدة على العمل والتنشيط الاجتماعي والاقتصادي.

الغرض: بحث فعالية الليزر على نقاط وخص الأطر الصينية في علاج خشونة مفصل الركبة.

لقد تم اختيار ثلاثين مريضاً بخشونة الركبة من الدرجة المتوسطة من الجنسين تتراوح أعمارهم بين (٤-١٠) وكان قد تم تقسيم المرضى عشوائياً إلى مجموعتين متساويتين. المجموعة (أ) (١٥ مريضاً تلقى الليزر المنخفض الشدة على نقاط وخص الأطر الصينية والتمريضات التقليدية) والمجموعة (ب) (١٥ مريضاً تلقى الليزر الوهمي مع التمريضات التقليدية) وكانت الجلسات تتم بمعدل ثلاث جلسات أسبوعياً لمدة أربعة أسابيع.

وقد تم قياس نسبة الألم وقياس مدى حركة الركبة والحالة الوظيفية للمريض في بداية ونهاية الثلاثة عشرة جلسة باستخدام مقياس الألم البصري والنقل الإلكتروني لقياس الالتواء وقياس (وماك) على التوالي.

النتائج: وقد أوضحت النتائج وجود فروق ذات دلالة إحصائية في المجموعتين قبل وبعد العلاج مع وجود تحسن ملحوظ في المجموعة (أ).

الخلاصة: يجب أن يتم علاج المرضى الذين يعانون من خشونة مفصل الركبة على استخدام الليزر على نقاط وخص الأطر الصينية.