Immediate Effect of an 808-909 nm Ga-Al-Ar High Laser Therapy on Visual Analog Scale and Functional Ability in Individuals with Lateral Elbow Pain

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Abstract

Lateral elbow pain or lateral epicondylitis is the pain over lateral epicondyle area and radiate to forearm. The prevalence of lateral epicondylitis is 6.9% in working population with high repetitive hand task. Currently, the most appropriate treatment for individuals with lateral epicondylitis is still limited. Recently, High power laser therapy is widely used in musculoskeletal problems due to a non-invasive method and less pain. Thus, the purpose is to investigate the effect of an 808-909 of Ga-Al-Ar high laser therapy on visual analog scale and functional ability in individuals with lateral elbow pain. **Methods:** Individuals with lateral elbow pain were randomly devided into 2 groups; laser therapy group and placebo. Participants in high laser therapy group were received an 808-909 of Ga-Al-Ar high laser therapy. Both groups received eccentric-concentric-isometric contraction of wrist extensor muscle exercise. Outcome parameters consist of visual analog scale and functional ability which were measured before and after intervention. Mann-Whitney U test was used to evaluate the differences between high laser therapy group and placebo. Wilcoxon sign rank test was used for measure between before and after intervention. The *p-value* < 0.05. **Results:** this study showed no significant different between laser group and placebo on visual analog scale and functional ability. **Conclusion:** the result suggested there is no immediate effect different between laser treatment and placebo. However, eccentric-concentric-isometric contraction exercise should be considered to rehabilitation. High laser therapy may be considered as an additional treatment for lateral elbow pain.

Keywords: High laser therapy, Laser treatment, Lateral elbow pain, Tennis elbow, Lateral epicondylitis

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Introduction

Lateral elbow pain is a common symptom usually presented in tennis players and working population (Thomas, 2007). Lateral epicondylitis or tennis elbow is a medical term to describe this symptom. The symptom is basically related to work and/or activity. The prevalence of lateral elbow pain is reported as 3 percents in general population and up to 6.9 percents in working population (Descatha Alexis, 2016). Lateral elbow pain leads to pain symptom over lareral epicondyle of the elbow and radiate into forearm. The common cause is related to high repetitive work or overuse of forearm muscle. Pathophysiology is explained as a result of inflammatory response of fiber tissue microtear and degenerative process of tissue. Both pathophysiology responses show higher amount of inflammatory immune cells such as neutrophil, macropharge, substant P etc. over lateral epicondyle and common wrist extensor origin area (Ahmad, 2013).

Individuals with lateral epicondylitis are reported to interfere with pain symptom. This pain directly related to work capacity both qualitive and quantitive term. Hence, it is important to decrease pain and gain muscle strength and endurance in order to minimize the adverse effect to activity in daily life and working ability. The main concept of lateral elbow pain treatment is to decrease pain and improve function as soon as possible. Currently, the treatments of lateral elbow pain included medicine, exercise, ultrasound therapy, laser therapy and other modalities. However, the effectiveness of interventions for lateral elbow pain was insufficient for clinical application.

The previous studies show effectiveness of low laser therapy on lateral epicondylitis. The result suggested low level laser therapy is able to decrease pain significantly (Dimitrios, 2005). Whereas, a previous study showed no significant different between receiving laser and non-laser treatment (Trudel, 2004). According to no inclusive result of low level laser therapy, there is a technology of high laser therapy which produce more power and is expected to increase more physhiological change than low level laser therapy. The physiological effect of high power laser is described as a result of photochemical, photothermal and photomechanical effect. The photochemical effect base on cellular reaction response to the laser light such as increasing DNA/RNA production or mitochrondial function. The photothermal effect is explained by the result of increasing temperature is able to improve blood circulation to pathology area. The photomechanical effect base on the believe that intercellular responses lead to micromovement of lymphatic drain and waste product. A previous study had evaluated effectiveness of high power laser therapy in lateral epicondylitis and suggested a group of high laser therapy showed greater result on pain and function improvement comparing to ultrasound therapy (Santamato, 2009). According to physiological response to laser treatment, we hypothesized that laser group will show greater improvement on pain and function than placebo.

Objectives

The purpose of this study is to investigate immediate effect of an 808-909 of Ga-Al-Ar high laser therapy on visual analog scale and functional ability in individuals with lateral elbow pain.

Research Methodology

Study design

A double-blinded randomized controlled trial study, Participants who met the inclusion and exclusion criteria were enrolled into this study. Participants were randomed into 2 groups; laser therapy and placebo. The data were collected before and after intervention immediately. Before participation, all participants will receive information about this study and signed informed content which be approved by Mahidol University Central Institutional Review Board (MU-CIRB).

Participants

Participants were 6 men and 10 women with a diagnosis of lateral epicondylitis. Participants were enrolled following inclusion criteria; presented pain at lateral epicondyle, the pain was evoked by wrist extension/middle finger extension test and passive wrist flexion test. The symptom occurred within the past three months before enrolled into this study. Participants were excluded following; bilateral lateral epicondylitis, experienced of corticosteroid injection at pathology area, Rheumatoid arthritis, Carpal tunnel syndrome, Cubital tunnel syndrome, Cervical radiculopathy and/or contraindication for laser therapy such as bleeding, related cancer and/or abnormal sensation

Instruments

Multiwavelocked system (MLS) laser device (MLS®, ASA Srl, Vicenza, Italy). The MLS laser combined of 2 wavelengths consisted of a pulsed 905 nm diode with peak optical power 25 W and a continuous or pulsed 808 nm diode with peak power 1.1 W. The probe applicator is 2 cm in diameter.

Data collection

Participants who had followed inclusion and exclusion criteria were enrolled into the study. Participants were received information concerning experimental procedure and signed informed content which approved by Mahidol University Central Institutional review board (MU-CIRB). Participants were instructed to avoid pain relieved or anti-inflammatory drugs within 24 hours before study. The data was collected before and after intervention immediately. Participants and assesser were blinded about the group. The laser treatment was performed by a physical therapist who has approved the high laser therapy certification.

Outcome measurement

Visual analog scale (VAS) for pain was measured in term of at rest, during isometric contraction and at worst movement. The VAS is a 100 mm linear horizontal line with initial and terminal end point. The initial point is defined as “no pain” and terminal point is definded as “the worst pain imaginable”. The higher score was described as higher pain feeling. Particaipants were asked to mark the point on the horizontal line at rest, during isometric contraction and at worst movement respectively before and after intervention. Moreover, during marking the isometric contraction pain, participants are not allowed to compare with the others including at rest and/or worst movement.

Functional ability was assessed by using the Quick disability of shoulder, arm, hand questionnaire (Quick-DASH). The Quick-DASH qiestionaire was devided into 2 parts related to activities and work. The activity related part consists of 11 items about how hard to do physical function of upper limbs such as these following questions; open a tight or new jar, do heavy household chores, carry a shopping bag or briefcase, wash your back, use a knife to cut food, recreational activities in which you take some force or impact through your arm, shoulder or hand, during the past week. The work related part consists of 4 items about quality and quantity of work including these questions; using your usual technique for your work, doing your usual work because of arm, shoulder or hand pain, doing your work as well as you would like and spending your usual amount of time doing your work. The score is calculated as 100 percent of disability level. The higher score showed more disability level. This questionnaire has translated into Thai version by Dr. Jeeranan Rapipong et al. in 2006, Department of Rehabilitation Medicine, Faculty of Medicine, Chiang Mai University, Thailand.

Intervention

The intervention consists of eccentric-concentric-isometric contraction of wrist extensor muscle and high laser treatment. Starting position was sitting with forearm rest at the couch. Firstly, both groups received the eccentric-concentric-isometric contraction exercise. The exercise protocol consists of 3 types of muscle contraction. Participants started with full wrist extension then slowly move wrist to flexion position counting to 30 seconds. Then participants actively contracted wrist into full extension position and hold this position with isometric contraction counting to 45 seconds. This exercise was performed 15 times. In case that pain level is increased vigorously during exercise, participants were able to stop the exercise immediately. Secondly, a group of laser therapy was treated with an 808-909 nm laser therapy and another group receive sham laser. The placebo group was perceived the similar sound of laser machince working and both groups were instructed to wear laser light protection glassess. Participants in the laser group received the 808-905 nm Ga-Al-Ar laser emission which produced from MLS laser device

(MLS®, ASA Srl, Vicenza, Italy). The probe applicator is 2 cm in diameter. The protocol was applied into 2 phases consist of trigger point and scanning phase. The trigger point phase was set with 100 Hz, 25% intensity for 20 seconds each point which applied over lateral epicondyle and common wrist extensor musculotendinous junction. The scanning phase was set with 300 Hz, 25% intensity which applied over wrist extensor muscle for 4 minutes.

Statistical analysis

The data was calculated by SPSS for windows version 23. Shaprio-Wilk test was used for data distribution testing. The demographic data of participants were described by mean and standard deviations. Mann-Whitney U test was used to evaluate the difference of visual analog scale and functional ability between high laser therapy group and placebo. Wilcoxon sign rank test was used for measure between before and after intervention. The significant value was set as *p-value* < 0.05.

Results

Table 1 Demographic characteristics of participant

Characteristic	Laser group (N=8)	Placebo (N=8)
	(Mean ± SD)	
Age (Years)	43.38 ± 19.37	45.75 ± 12.37
Gender (Male, Female)	2, 6	3, 5
Duration of symptom (Days)	32.25 ± 20.74	23.25 ± 17.14
Side of symptoms (Right, Left)	6, 2	5, 3

participants (5 men and 11 women) with present lateral elbow pain were enrolled into the study. The duration of symptom was 32.25 ± 20.74 and 23.25 ± 17.14 days in laser group and placebo as respectively. There are no statistical significant between group in participant's characteristics.

Table 2 Visual analog scale between laser group and placebo

Visual analog scale	Laser group (Median)	Placebo (Median)	*P-value*
Pre-intervention			
At rest	3.25	5.05	*0.13*
Isometric contration	5.7	5.2	*0.38*
Worst movement	6.6	7.1	*0.57*
Post-intervention			
At rest	1.45	3.2	*0.57*
Isometric contration	3.0	2.25	*0.51*
Worst movement	5.3	5.2	*0.65*
***P-value** within group*			
At rest	0.036*	0.035*	
Isometric contration	0.017*	0.05*	
Worst movement	0.017*	0.079	

** p < 0.05 tested by Wilcoxon signed-rank test*

Table 2 shows median value of visual analog scale at rest, during isometric contraction and at worst movement between before and after intervention. The result shows no statistically significant between groups. Both group show trend of decreasing in pain after intervention. For the laser group, pre-intervention median of pain at rest, during isometric contraction and at worst movement were 3.25, 5.7 and 6.6 as respectively. And post-intervention median was 1.45, 3.0 and 5.3 for laser group. Whereas, the placebo group shows 5.05, 5.2 and 7.1 at pre-intervention for pain at rest, during isometric contraction and at worst movement. And post-intervention median was 3.2, 2.25 and 5.2 for placebo group. As the results, there are significant different between pre and post intervention for pain at rest p=0.036, 0.035 for laser and placebo group, pain during isometric contraction in laser group and placebo as p=0.017, 0.05. And pain at worst movement p=0.017 for laser group

Table 3 The Quick-DASH questionnaire between laser group and placebo

Functional ability	Laser group (Median)	Placebo (Median)	*P-value*
Pre-intervention			
Disability/Symptom Score	39.77	43.18	*0.38*
Work related score	37.50	50.00	*0.51*
Post-intervention			
Disability/Symptom Score	21.59	31.82	*0.51*
Work related score	25.00	31.25	*0.57*
***P-value** within group*			
Disability/Symptom Score	0.63	0.18	
Work related score	0.78	0.18	

Table 3 shows median value of disability level score between before and after intervention. The result shows no statistical signifincant difference between groups. The score of disability level seems to decrease in both groups. For the laser group disability score decreases from 39.77 to 21.59 percent and work-related score decreases from 37.50 to 25.00 percent of disability. For the placebo group disability score trends to decrease from 43.18 to 31.82 percent and worked related score decreases from 50.00 to 31.25 percent of disability. There are no significant different between pre and post intervention for disability score in placebo p=0.18, for work related score p=0.18. For laser group, p=0.63 and 0.78 in disability and work related domain as respectively.

Discussion

The main finding of this study showed no significant different between laser group and placebo on visual analog scale and functional ability. However, both groups showed significant different on functional abitlity and visual analog scale at worst movement between pre and post intervention. The laser group showed significant different on visual analog scale during isometric contraction. The placebo showed significant different on visual analog scale at rest between pre and post intervention.

Low level laser therapy has been used in clinical treatment for decades due to a noninvasive and painless method. A previous study investigated effects of low level laser therapy combinded with exercise. The results suggested that the combination of laser with plyometric exercises was more effective treatment than placebo laser with the same plyometric exercises at the end of the treatment as well as

at the follow-up (Stergioulas, 2007). However, a systemic review of low level laser therapy of tendinopathy suggested there were conflicting findings of the effectiveness. Some studies declared improvement after receiving low level laser therapy and some studies showed no effects of low level laser therapy (Tumilty, 2010). Currently, high laser therapy is wildly used in musculoskeletal condition. Low level laser device produces lower energy. Thus, the ability of alter cellular response is technically less than high intensity.

According to the previous study of high laser therapy in lateral elbow pain, the founding suggested high intensity laser therapy is a reliable, safe, and effective treatment for lateral elbow pain pateints. The study of long term effect of high intensity laser therapy in lateral epicondylitis patients conducted total 37 elbows of lateral elbow pain. Effectiveness of high laser therapy resulted in improvement of pain symptom including physical and mental health significantly after treatment and prolong to 6 months after treatment. The study applied only high laser therapy without comparable group. The result shows improvement trend in long term after 10 treatment sessions (Akkurt Ekrem, 2016). Conversly to the result of this study, the results found no significant different between high laser therapy and placebo. However, a study compared effect of high laser therapy to splinting in lateral epicondylitis. The comparison of the percentage changes of the parameters after treatment relative to before treatment values did not show a significant difference between high laser therapy group and splinting group. Both groups seem to improve symptoms after intervention (Umit, 2015). Hence, the effectiveness of high laser therapy may not superior to other treatments for lateral elbow pain. The inclusive result is still unable to conclude. Futhermore, additional parameters should be investigated to develop evidences.

The intervention of this study provided eccentric-concentric-isometric contraction of wrist extensor muscle exercise for both high laser therapy group and placebo. The effect of exercise may be included in the result of this study. A previous study of effectiveness of eccentric-concentric-isometric exercise for wrist extensor muscle showed impressive results. The study confirmed that eccentric-concentric-isometric exercise is greater than eccentric training or eccentric-concentric training only (Stasinopoulos, 2017). Moreover, the findings support the inclusion of eccentric exercise as part of a rehabilitation program for improved outcomes in patients with lateral elbow pain. The inclusive result of eccentric exercise reported decreased pain, improved function and grip strength after intervention (Cullinane, 2013). The exercise should be added into treatment program. The low speed eccentric exercises were performed because this allows tissue healing (Kraushaar, 1999). However, the underlying mechanism of eccentric training reduced pain or reverse pathology remains uncertain as there is lack of good quality evidences to confirm physiological effects of eccentric training translate into clinically meaningful outcomes.

It has been suggested that laser therapy combined with eccentric exercise is able to reduce pain and improve symptoms in lateral elbow pain pateints. A study suggested exercise is more effective when inflammation is able to be controlled well (Bjordal, 2008). Thus, exercises combination with high laser therapy should be considered as a treatment for lateral epicondylitis patients.

Limittation of the study included the study provided only subjective outcome measurement. Objective parameters should be added into investigation. At the baseline characteristic, visual analog scale for pain of placebo group trend to be higher than laser therapy group even not significant different. The higher score of visual analog scale remains sensitivity of the symptom. Thus, changing score could be wilder range than laser therapy group. Moreover, according to the protocol suggestion of high laser therapy proposed 10 treatment sessions continuously for effectiveness. A single treatment session of treatment may insufficient for treatment effect. Underlying mechanism of high laser therapy is unexplained in this study.

Suggestion

an 808-909 nm Ga-Al-Ar high laser therapy combinded with eccentric-concentric-isometric contraction exercise has no significant different from eccentric-concentric-isometric contraction exercise with sham laser. However, both groups showed the trend of improvement on visual analog scale. The result of this study suggested high laser therapy and eccentric-concentric-isometric contraction exercise may be considered as additional treatment for later elbow pain. Further study needs to be investigated long term effect of high laser therapy and provide evidence for laser treatment protocol in order to apply in clinical study. A number of sample size should be added in order to improve effect size of the study. According to the outcome measurements of this study are subjective pain assessment and subjective functional assessment, the objective outcome measurements should be considered as parameters.

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