Scand J Rehab Med 19: 135–138, 1987

EFFECT OF LASER VERSUS PLACEBO IN TENNIS ELBOW

T. Lundeberg, E. Haker, and M. Thomas

From the Department of Physiology II, Karolinska Institutet, S-104 01 Stockholm, Sweden

ABSTRACT. The purposes of this study were to compare the pain alleviating effects of laser treatment and placebo in tennis elbow. Also, the effects of laser radiation on the radial sensory nerve conduction, and the temperature changes in the tissue surrounding the treated radial nerve were studied. The results show that laser treatment *is not* significantly better than placebo in treating tennis elbow. Furthermore, no significant change was noted in the evoked sensory potential as well as subcutaneous temperatures in either experimental or control groups as a result of the applications of the laser radiation treatment.

Key words: tennis elbow, laser, placebo.

Laser radiation is currently being used by doctors and physical therapists for the alleviation of pain (1, 2, 5, 6, 9, 10, 11). In spite of that, the lack of controlled studies have cast doubt on its pain alleviating effect. Walker, however, using a control group, showed that repeated irradiation with a low-power Helium–Neon laser produced relief in subjects with chronic pain (14). Also, Kreczi & Klingler reported that laser treatment was superior to placebo in radicular and pseudoradicular pain syndromes (12).

The purpose of this study was to investigate the effects of placebo versus laser on tennis elbow and to determine the effect of laser on sensory nerve conduction in man, and on temperature changes surrounding this nerve.

PATIENTS AND METHODS

Eighty-two patients suffering from tennis elbow (8) of at least three months duration were treated with laser or placebo. Patients with pain or point tenderness over the lateral epicondyle of the humerus were included. Also, the patients included reported aggravation of pain by: dorsiflexion of the wrist against manual resistance with extended elbow, dorsal elevation of the middle finger with the elbow extended and resisted isometric extension of the forearm. Patients with local arthritis of the elbow, generalised polyarthritis, or neurological abnormality in the affected arm were excluded, as were those with symptoms in neck or thorax, or who had had steroid injections within the last 6 months.

Sixty-two patients (76%) attributed symptoms to sport, 18 (22%) to housework and 2 (2%) followed trauma to the elbow.

Clinical trial

Out of the 82 patients, 57 were allocated to the clinical trial. The patients (31 men and 26 women) ranged in age from 25–62 years (mean 43 years). The patients were randomly placed in three groups. Group A ($n=19$) received placebo laser treatment. Group B ($n=19$) received infrared Gallium–Arsenide (Ga–As) laser radiation. Group C ($n=19$) received Helium–Neon (He–Ne) radiation.

Procedure

The two laser machines used were standardised initially and then every month. Output was also checked before each treatment session on a simple radiation balance constructed for this purpose. An on/off key introduced into the transducer circuit allowed mock radiation to be given to a placebo group without affecting the normal output when the key was turned on.

The laser wand was held 1 mm from the patient's skin. The separation distance between the skin and the laser wand was maintained by a piece of plastic 5×3 mm fixed to the wand. The He–Ne laser was a continuous-wave laser with a wavelength of 632.8 nm and a maximum output of 1.56 mW. The Ga–As laser was a pulse laser, with a wavelength of 904 nm; the measured power output was 0.07 mW at the frequency of 73 Hz.

During treatment the following acupuncture points were stimulated: Li 10, Li 11, Li 12, Sj 5, Sj 10, Si 4, Si 8, H 3, H 4, P 3. The wand of the laser was held stationary at a right angle to the surface of the skin for 60 sec/acupuncture point.

Ten treatments were given (two per week) over five to six weeks. A therapist not involved in the treatments arranged a schedule allocating patients at random to either placebo or clinical treatment. She was responsible for setting the apparatus at sessions so that the grouping remained unknown to patients, therapists and the medical assessor alike.

Patients were reviewed fortnightly during treatment. Follow-up continued for at least another three months before patients were discharged or, if symptomatic, offered alternative treatment.

At each visit clinical assessment included: (A) determining a pain score using a 10 cm horizontal analogue scale; (B) noting pain (0–3), and diminished power, assessed manually and compared against the normal wrist,

induced by resisted wrist dorsiflexion (0 = no pain, 1 = mild pain but normal power, 2 = moderate pain and reduced power, 3 = severe pain and absent power); (C) a weight test to assess ability to lift weights of 3, 2, and 1 kg with elbow extended and forearm pronated; (D) a test of grip strength using a 300 mmHg spring coil gauge attached to a rubber bag preset to 25 mmHg, made with the elbow extended and using an average of 3 estimations. After completing treatment follow-up patients were asked to assess the results of their treatment. The medical assessor also judged the outcome.

Full functional recovery with only minor ache or slight tenderness was considered a satisfactory outcome. At the end of the study the patients either withdrew, were discharged or had alternative treatment.

Experimental trial

Out of the 82 patients 25 were allocated to the experimental trial. The patients (14 men and 11 women) ranged in age from 23 to 48 years (mean 39 years).

The patients were randomly placed in three groups. Group 1 ($n=5$) served as a control and did not receive any laser radiation but was measured for sensory nerve conduction characteristics similar to the other groups. Group 2 ($n=10$) received infrared (Ga–As) laser radiation for 60 sec to each of five 1-cm^2 segments of the skin overlying the superficial radial nerve. Group 3 ($n=10$) received He–Ne radiation for 60 sec to each of five 1-cm^2 segments of the skin overlying the superficial radial nerve.

Procedure

All patients lay comfortably on a treatment table. The ambient temperature was maintained at 23°C. The stimulating and recording electrodes were placed along the right superficial radial nerve (4). All electrode sites were cleansed with alcohol, and the conducting medium applied. The ground electrode was secured to the palm of the hand. The negative recording electrode was placed over the branch of the radial nerve where it crosses the tendon of the extensor pollicis longus muscle. The positive recording electrode was placed over the proximal portion of the first dorsal interosseous. The recording electrodes had silver–silver chloride surfaces, 4 mm in diameter. The stimulating electrodes were also two 4 mm silver–silver chloride discs on a 2 cm plastic bar. The negative stimulating electrode was placed overlying the nerve along the crest of the radius at a point 12 cm proximal to the negative recording electrode, and the bar was moved medially or laterally until a maximum amplitude action potential was obtained. Positioning of the recording and stimulating electrodes as described permitted antidromic conduction which produces more consistent high amplitude responses than orthodromic conduction. The stimulus was a monophasic pulse of 0.1 msec duration, delivered once a second. The frequency response of the amplifier was 16 to 1.5 kHz.

The area of skin chosen for application of the Ga–As or He–Ne laser radiation corresponded to the course of the superficial radial nerve determined by the nerve-conduction technique. The skin, 2 cm distal to the bar-stimulating negative electrode, was marked with ink for five 1-cm^2 segments. A sterile, hypodermic probe was inserted percutaneously near the course of the superficial radial nerve. The tip of the needle probe was placed in the area where the laser radiation would be applied to record accurately any temperature changes by the treatment. The needle probe was connected in series with a scanning telethermometer and was accurate to ±0.05°C.

After all recording equipment was secured on the subject, initial nerve conduction latency and subcutaneous temperature were recorded. Nerve conduction latencies and amplitudes were reproduced on a fiberoptic printout. The latency of the evoked sensory response was measured from the start of the stimulus artifact to the peak of the negative portion of the nerve action potential. The amplitude of the evoked sensory response was measured from peak to peak of the nerve action potential. A supramaximal stimulus intensity was used to produce each evoked sensory response.

The treatment of laser radiation was applied in the following manner. The laser was held 1 mm from the subject's skin along the course overlying the superficial radial nerve beginning 2 cm distal to the bar-stimulating negative electrode. The separation distance between the skin and the laser wand was maintained by a plastic wedge, 5×3 mm fixed to the wand. The wand was held stationary at right angles to the surface of the skin for the time determined for each segment (60 sec/cm^2). The five skin segments were treated in turn without pause.

At the completion of the laser radiation to the last segment, the superficial radial nerve was stimulated and the latency and amplitude of the evoked sensory response were recorded following the same procedure as the pretest measurements. Subcutaneous temperatures were again recorded for each subject. The superficial radial nerve stimulation and subsequent conduction and temperature recordings were repeated at intervals of 5, 10, and 15 min post-treatment.

Statistics

The χ^2 test with Yates's correction and the Wilcoxon rank sum test were used to analyse the objective outcome and the rate of recovery.

An analysis of variance (ANOVA) with repeated measures over time was calculated for latency, amplitude, and temperature with a computer program. The Newman-Keuls post hoc analysis was used to evaluate significant differences between means.

RESULTS

Thirteen patients treated with laser (6 He–Ne, 7 Ga–As) and six who had received placebo showed a satisfactory outcome on objective testing both at the end of treatment and during further follow-up. Contingency table analysis showed that the difference between the groups *was not* significant.

Four patients (2 given laser treatment and 2 given placebo) reported the outcome immediately after completing treatment to be satisfactory despite per-

Table I. *Mean improvement and standard deviations after 3 months in the pain score (VAS), pain on resisted wrist dorsiflexion (WD), pain on weight test (WT), and the improvement in grip strength in extension (GS) in the three treatment groups*

P = Placebo, He–Ne = Helium–Neon, Ga–As = Gallium–Arsenide

	VAS	WD	WT	GS
P	2.2±0.2	0.8±0.05	0.3±0.03	38.2±2.3
He–Ne	2.4±0.2	0.9±0.04	0.3±0.04	39.3±3.1
Ga–As	2.6±0.2	0.8±0.05	0.4±0.03	41.5±2.5

sistent disability on objective assessment. Review three months later confirmed an unsatisfactory result in all these patients.

The three treatment groups showed no significant difference in the mean severity of any of the clinical variables on presentation. Comparisons of the rate of recovery from time 0 to each follow-up visit (Wilcoxon's rank sum tests), showed no significant advantage for either laser mode over the placebo group. Table I shows the reduction in the pain score, pain on resisted wrist dorsiflexion, pain on weight test, and the improvement in grip strength in extension in the three groups. The duration of symptoms, dominance of the affected arm, and treatment given before referral did not influence the outcome, but patients who responded to mock radiation had less severe symptoms on presentation than those responding to laser.

All the patients were re-examined or completed a postal questionnaire at six months. No difference in incidence of recurrence of severe pain was noted in the patients. Minor or intermittent pain in the elbow was still present in 60% of the patients.

Table II presents the means and standard deviations for the latency and amplitude of the evoked sensory response and temperature of the subcutaneous tissue for each group. No significant difference between groups was found for latency and amplitude of the evoked sensory responses. Furthermore, the difference in temperature of the subcutaneous tissue of the treated areas was not significant between groups.

The results show that there was a difference in temperature measurement against time. Generally five minutes after laser radiation application the temperature decreased. Post hoc analysis revealed a significant difference ($p < 0.05$) between means at the immediate, and at 15 min post-treatment temperature.

We also found a significant difference for mean latency of the evoked sensory response with time lapse. The latency of the evoked response subsequently increased 15 min after the laser application. Post hoc analysis revealed a difference between mean latency at the 15 min post-treatment interval and those of other time periods. Time made no significant difference to the amplitude of the evoked sensory response.

DISCUSSION

Modalities of treatment such as ultrasound, laser irradiation and short-wave diathermy, by increasing the temperature of tissues surrounding the nerve, increase peripheral nerve conduction velocity in man (3). Further, in vitro and in vivo studies have confirmed the direct effect of temperature changes on nerve conduction.

Laser radiation at clinical intensities, and of 60 sec duration, does not cause thermal changes in human tissues (7).

Results of the present study show that the two different modes of laser over the skin do not significantly affect sensory nerve conduction latency or the amplitude of an evoked action potential. Nei-

Table II. *Means of latency, amplitude and temperature*

	Placebo (n=5)	He–Ne (n=10)	Ga–As (n=10)
Latency (msec)			
Pretreatment	2.7±0.3	2.6±0.3	2.6±0.3
Post-treatment	2.7±0.3	2.6±0.3	2.7±0.3
5 min	2.6±0.3	2.7±0.3	2.7±0.3
10 min	2.7±0.3	2.7±0.3	2.8±0.3
15 min	2.7±0.3	2.7±0.3	2.8±0.3
Amplitude (V)			
Pretreatment	32±2.1	33±2.0	35±2.1
Post-treatment	32±2.0	33±1.9	35±2.1
5 min	32±2.1	33±1.9	35±2.0
10 min	31±2.1	33±2.1	35±1.9
15 min	32±2.0	33±2.0	35±2.0
Temperature (°C)			
Pretreatment	30.9±1.0	31.3±1.3	29.9±1.4
Post-treatment	30.9±1.0	31.3±1.2	29.9±1.3
5 min	30.9±1.0	31.2±1.4	29.9±1.4
10 min	30.8±1.0	31.2±1.2	29.8±1.3
15 min	30.8±1.2	31.1±1.3	29.7±1.4

ther did laser application alter subcutaneous temperatures below the area of its application.

Generally, 10 min after the application of placebo or laser, the temperature of the subcutaneous tissue decreased. Subsequently, 15 min after the application, the mean latent period of evoked sensory response increased. The limb was then, as a result of the experiment, in a state of inactivity for about 10 min. Takebe et al. have demonstrated decreases in limb temperature and subsequent slowing of nerve conduction velocity in the limbs of hemiplegic patients (13).

The result of our study shows no beneficial effects from laser (Ga–As or He–Ne) radiation on tennis elbow. Further, the laser radiation designed for clinical use has no effect on conduction velocity in sensory nerves, nor does it have a thermal effect on subcutaneous tissue after 60 sec of application.

ACKNOWLEDGMENTS

This work was supported by grants from The Royal Swedish Academy of Sciences and Stiftelsen Clas Groschinskys minnesfond. The assistance of dr P. Bousfield in recording the evoked sensory potential and subcutaneous temperature is greatly acknowledged.

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Address for offprints:

T. Lundeberg
Department of Physiology II
Karolinska Institutet
S-104 01 Stockholm
Sweden