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Research Article

LASER ACUPUNCTURE VERSUS ULTRASOUND IN TREATMENT OF DISCOGENIC SCIATICA

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ABSTRACT

The aim of the study is to compare the effect of laser acupuncture treatment and ultrasound therapy in patients with sciatica caused by a herniated disc. we recruited 30 patients (17 male and 13 female) with symptoms of discogenic sciatica and they were distributed into two equal groups (A \ B), in the group (A) we used laser acupuncture, infrared and therapeutic exercises and in group (B) we used ultrasound, infrared and therapeutic exercise , we used visual analogue scale (VAS) to assess pain level, modified oswestry disability questionnaire (MODQ) to assess functional disability, straight leg raising test (SLR)to assess range of motionand speed test (ST) to assess walking performance.We found that there were statistically significant differences in measurements before and after treatment within both groups, alsothere were statistically significant difference in measurements after treatment between both groups. So we could conclude that the physical therapy program is an effective program to achieve good results in cases of discogenic sciatica also laser acupuncture therapy and ultrasound therapy in patients with discogenic sciatica giving a marked improvement in the patient's status, but laser acupuncture treatment gives a more noticeable effect.

INTRODUCTION

Sciatica is defined as unilateral, well-localized leg pain which approximates to the dermatomal distribution of sciatic nerve and normally radiates to the foot or toes. It is often associated with numbness or paraesthesia in the same distribution. It is a common condition that is associated with significant pain and disability. The lifetime prevalence is at least 5.3% in men and 3.7% in women, representing 6% of total work disability. Sciatica has traditionally been regarded as a self-limiting condition with a good prognosis for complete recovery; however, 30% of patients still have a significant symptom at 1 year, with 20% out of work and 5-15% requiring surgery (Arden *et al*., 2005). Laser acupuncture is the stimulation of traditional acupuncture points with low-intensity, non-thermal laser irradiation (Siedentopf *et al*., 2002). Ultrasound is series of mechanical compressions and refractions in the direction of travel of the wave (Feril and Kondo, 2004).

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The aim of the study is to investigate and compare the effect of laser acupuncture and ultrasonic on pain level, functional outcome, ROM and walking performance in treatment of patients with discogenic sciatica

MATERIALS AND METHODS

Participants and design

This study was conducted in outpatient clinic of Al- Qasr Al Aini hospital, Cairo University to compare the effect of laser acupuncture therapy against ultrasonic therapy in treatment of patients of discogenic sciatica.

It is conducted between Oct.2012 and May 2013

It is a comparative study between two groups of patients. Thirty patients of both sexes complaining of low back pain radiating to one lower limb will participate in this study and will be randomly assigned by selection of the card method of randomization into two equal groups.

Procedures

Group (A):composed of15 patients who received laser acupuncture (Wavelength: 904nm, Laser probe power density: 15 J/cm^2, Pulse repetition frequency: 5000Hz, contact technique,Time: 1 min per point, on UB-25, GB-30, UB-36, UB-37, UB-40, UB-57 and UB-60) in addition to physical therapy program which include infrared radiation (Power: 250watt, distance: 60 Cm, 20 min), stretching and strengthening exercises for back and abdominal muscles (finger to toe, bridging and back extension, 5 repetition per session) for 12 sessions over four weeks period and Group (B): composed of15 patients who received continuous ultrasonic (frequency: 1Mz, Head area: 4 Cm^2, power: 2watt\ Cm, continuous mode, paravertebral) in addition to physical therapy program(as group A) which include infrared radiation, stretching and strengthening exercises for back and abdominal muscles for 12 sessions over four weeks period.

All patientshave read and signed the consent form; a full data collection sheet was done for every patient, not pay anything to be treated and given an advice paper to follow at home. Patients with age from 30 to 50 years old, Body mass index of less than 35 or back and leg pain with duration of at least three months ago were included in the study. Patients with piriformis syndrome and sacroiliac joint pain were excluded from the study. Improvement was assessed by visual analogue scale (VAS) to assess pain level, modified oswestry disability questionnaire (MODQ) to assess functional disability, straight leg raising test (SLR) to assess range of motion and speed test (ST) to assess walking performance.

Statistical analysis

Results were expressed as mean ± standard deviation (SD) or number (%). Comparison between the mean values of different variables pre and post treatment is performed using paired student t-Test.

Comparison between the mean values of the different variables as regards post treatment in the two groups was performed using unpaired student t-Test. SPSS computer program (version 17) was used for data analysis

RESULTS

Demographic data of ages, gender, weights, heights, body mass index, and the distribution of more affected side within each group were represented in Table 1. Also Demographic data of the **e**ffects of treatment procedures on pain level, functional disability, range of motion, and walking speed within each group were represented in Table 2. Results of paired t test for each group were represented in Table 3. Results of unpaired t test between both groups were represented in Table 4.

DISCUSSION

In this study we found that: sciatica causes pain and disability and this is in agreement with study that reported that the most common cause for sciatica is lumbar disc herniation that is associated with significant pain and disability.

Table 1. Demographic data of ages, gender, weights, heights, body mass index, and the distribution of more affected side within each group

Group	Number	Age	Weight (KG)	Height (Cm)	BMI (KG/Cm^2)
A	mean	41.13	81.3	165.2	29.85
	median	40	81	165.5	29.94
	SD	5.097	3.278	4.518	1.743
	Rang	50	86.5	172.5	32.83
		35	74	158.5	26.72
B	mean	41.07	81.35	164.9	29.97
	median	40	81	165	30.1
	SD	4.383	2.257	4.519	1.844
	Rang	50	85.5	174	32.79
		35	78	156.5	26.59

Key:
BMI=body mass index
SD=standard deviation

Table 2. Demographic data of the effects of treatment procedures on pain level, functional disability, range of motion, and walking speed within each group

Group	Number	Pre				Post			
		VAS	MODQ	SLR	ST	VAS	MODQ	SLR	ST
A	mean	7.73	33	40.4	1.263	3.52	14.8	64.68	1.47
	median	7.7	33	39	1.27	3.6	14	64	1.47
	SD	0.42	1.77	4.7	0.076	0.507	3.489	6.124	0.031
	Rang	8.5	36	48.1	1.39	4.2	20	72.5	1.51
		7.2	30	34	1.13	2.8	10	54.5	1.43
B	mean	8.05	32.9	41.57	1.244	5.507	20.33	55.35	1.404
	median	7.9	32	43.5	1.24	5.6	20	55.9	1.41
	SD	0.54	2.34	5.46	0.053	0.5	3.132	2.902	0.027
	Rang	8.9	37	47.7	1.33	6.3	25	59.5	1.44
		7.1	30	32	1.17	4.7	16	50.3	1.36

Key:
Pre=before treatment
Post=after treatment
VAS=Visual Analogue Scale
MODQ=Modified Oswestry Disability Questionnaire
SLR=Straight Leg Raising Test
ST=Speed Test
SD=standard deviation

Table 3. Results of paired t test within each group

Group		t value	t table	significance	p value
A	VAS	26.6578	2.0484	yes	2.123E-13
	MODQ	16.0987		yes	1.991E-10
	SLR	-14.206		yes	1.043E-09
	ST	-10.054		yes	8.739E-08
B	VAS	13.6615	2.0484	yes	1.741E-09
	MODQ	13.2653		yes	2.569E-09
	SLR	-8.6806		yes	5.229E-07
	ST	-11.593		yes	1.455E-08

Key:
VAS=Visual Analogue Scale
MODQ=Modified Oswestry Disability Questionnaire
SLR=Straight Leg Raising Test
ST=Speed Test

Table 4. Results of unpaired t test between both groups

	homogeneity	t value	t table	significance	p value
Age	yes	0.0384088	2.0484	no	0.9696343
Weight	yes	-0.0519049		no	0.958973
Height	yes	-0.7399841		no	0.8885594
BMI	yes	-0.1861363		no	0.8536798
pre VAS	yes	-1.8417186		no	0.0761327
Pre MODQ	yes	0.0878507		no	0.9306206
Pre SLR	yes	-0.6217289		no	0.5391499
Pre ST	yes	0.8057776		no	0.4271616
post VAS	yes	-10.393041		yes	4.082E-11
Post MODQ	yes	-4.5709788		yes	8.955E-05
Post SLR	yes	5.3306166		yes	1.124E-05
Post ST	yes	6.1788859		yes	1.132E-06

Key:
Pre=before treatment
Post=after treatment
VAS=Visual Analogue Scale
MODQ=Modified Oswestry Disability Questionnaire
SLR=Straight Leg Raising Test
ST=Speed Test
SD=standard deviation
BMI=body mass index

Chronic low back pain (CLBP) may lead to significant disability in performing activities of daily living (ADL) (David *et al*., 2008). Also we found that laser acupuncture showed significant effect regarding VAS, MODQ, SLR and ST and this agreed with study that reported that in a double blind study, repeated irradiation with a low-power (1 mw) helium-neon laser produced relief in chronic pain.

Analgesia was observed after exposure of the skin overlying the radial, medial and saphenous nerves and in some cases, irradiation of the appropriate painful nerve. Exposure of areas of skin not innervated by these nerves did not result in pain relief, of the patients with trigeminal neuralgia, post-herpetic neuralgia, sciatica and osteoarthritis, 19 of 26 experienced pain reliefs without the use of drugs. Patients who received sham stimulation reported no analgesia.

Subjects who were exposed to laser irradiation had a large increase to the urinary excretion of 5-hydroxyindoleacetic acid, the product of serotonin (Walker, 2003). The very highly significant improvement of self-reported pain taken by VAS, self-reported functional disabilities taken by MODQ, functional range of motion taken by SLR and walking performance taken by ST in laser group suggested to be referred to the analgesic effect of laser and acupuncture stimulation which come in agreement with study that reported that Laser irradiation was suggested to provide analgesia by decreasing the spasm in muscle arterioles, which is essential for tissue oxygenation, and by increasing ATP formation with a consequent normalization in metabolic rate of the tissues with diminished energy levels, the other mechanisms may be related with its effects on endorphin levels and gate control of pain (Ozdemir *et al*., 2001). By all these mechanisms it can interrupt the vicious cycle of pain. Also this agreed with a study that used A total of 72 male patients with a mean (SD) age of 32.81 (4.48) years. Patients were randomly assigned into three groups and treated with high intensity laser therapy (a high level of fluency/energy density (510–1,780 mJ/cm), a brief duration (120–150 μs), a low frequency (10–40 Hz), a duty cycle of about 0.1 %, a probe diameter of 0.5 cm, and a spot size of 0.2 cm2)plus exercise (HILT + EX), placebo laser plus exercise (PL + EX), and HILT alone in groups 1, 2, and 3, respectively. HILT means (1,064 nm), very high peak power (3 kW).

The outcomes measured were lumbar range of motion (ROM), pain level by visual analog scale (VAS), and functional disability by both the Roland Disability Questionnaire (RDQ) and the Modified Oswestry Disability Questionnaire (MODQ), Statistical analyses were performed to compare the differences between baseline and post-treatment measurements. The level of statistical significance was set as $P < 0.05$, ROM significantly increased after 4 weeks of treatment in all groups, then significantly decreased after 12 weeks of follow-up, but was still significantly more than the baseline value in groups 1 and 2. VAS, RDQ, and MODQ results showed significant decrease post-treatment in all groups, although the RDQ and MODQ results were not significantly different between groups

2 and 3, Pulsed Nd: YAG laser treatment (HILT) is an effective physical therapy modality for patients with CLBP.

In fact, HILTcombined with exercise is more effective and has a more prolonged effect than sham laser with exercise or laser alone in increasing lumbar ROM and in decreasing pain and functional disability, with effects lasting up to 3 months (Alayat *et al*., 2013). But this is not in agreement with the results of study that studied the effect of infrared laser acupuncture in reducing pain and disability in treatment of chronic low back pain, he used laser machine of 20mw. 480nm diode, 0.1W/cm2and application was on 3 groups sham (0 joules/point), low dose (0.2 J/point) and high dose (0.8 joules/point) then he found that there is no difference between sham and the laser groups at 6 weeks for pain or disability. There was a significant reduction in mean pain and disability in all groups at 6 weeks ($p<0.005$; NPRS): sham (-1.5 (95% CI -2.1 to -0.8)), low dose (-1.3 (-2.0 to -0.8)), high dose (-1.1 (-1.7 to -0.5)). ODI: sham (-4.0 (-7.1 to -1.0)), low dose (-4.1, (-6.7 to -1.5)), high dose (-2.6 (-5.7 to 0.5)). All secondary outcomes also showed clinical improvement over time but with no differences between groups, so he concluded that LA using energy density range (0-4 J/cm2) for the treatment of chronic non-specific LBP resulted in clinical improvement unrelated to laser stimulation, may be this is because different parameters (described earlier in the paragraph) that he used (Glazov *et al*., 2013).

Also this disagreed withstudy which included forty patients with acute (26 females/14 males) and 40 patients with chronic (20 females/20 males) low back pain caused by LDH, Patients were randomly allocated into four groups. Group 1 (acute LDH, n = 20) received hot-pack + laser therapy; group 2 (chronic LDH, n = 20) received hot-pack + laser therapy; group 3 (acute LDH, n = 20) received hot-pack + placebo laser therapy, and group 4 (chronic LDH, n = 20) received hot-pack + placebo laser therapy, for 15 sessions during 3 weeks, laser used was LLLT of The gallium–aluminum–arsenide (GaAlAs, infrared laser) diode laser device (Chattanooga group, USA) with a wavelength of 850 nm, power output of 100 mV, continuous wave, and 0.07-cm2 spot area. Finally that study concluded that there were statistically significant improvements in pain severity, patients' and physician's global assessment, ROM, RDQ scores, and MODQ scores in all groups ($p < 0.05$). However, no significant differences were detected between four treatment groups with respect to all outcome parameters ($p > 0.05$).

There were no differences between laser and placebo laser treatments on pain severity and functional capacity in patients with acute and chronic low back pain caused by LDH (Ay *et al*., 2010). Also we found that ultrasound showed significant effect regarding VAS, MODQ, SLR and ST and this agreed with study that studied the effect of continuous US compared with placebo US additional to exercise therapy for patients with NSCLBP, 50 patients with NSCLBP were randomized into two treatment groups: 1) continuous US (1 MHz &1.5 W/cm2) plus exercise 2) placebo US plus exercise. Patients received treatments for 4 weeks, 10 treatment sessions, 3 times per week, every other day. Treatment effects were assessed in terms of primary outcome measures: 1) functional disability, measured by Functional Rating Index, and 2) global pain, measured by a visual analog scale. Secondary outcome measures were lumbar flexion and extension range of motion (ROM), endurance time and rate of decline in median frequency of electromyography spectrum during a Biering Sorensen test. All outcome variables were measured before, after treatment, and after one-month follow-up, An intention to treat analysis was performed, Main effects of Time and Group as well as their interaction effect on outcome measures were investigated using repeated measure ANOVA, he found that both groups had improved regarding function (FRI) and global pain (VAS) ($P < .001$). Lumbar ROM as well as holding time during the Sorensen test and median frequency slope of all measured paravertebral muscles did not change significantly in either group ($P > .05$). Improvement in function and lumbar ROM as well as endurance time were significantly greater in the group receiving continuous US ($P < .05$), he concluded that adding continuous US to a semi supervised exercise program significantly improved function, lumbar ROM and endurance time. Further studies including a third group of only exercise and no US can establish the possible effects of placebo US (Ebadi *et al*., 2012).

Also the findings of the present study came in agree with study that reported that Low-intensity pulsed ultrasound (LIPUS) has been reported to stimulate the activity of various cells. We have reported that the capacity of human intervertebral nucleus pulposus cell line to synthesize proteoglycan (PG) was increased by exposure to LIPUS, and postulated that one of the mechanisms underlying this response was an increase in expression of the transforming growth factor-p type I receptor gene (TGFBRl) (Akihiko *et al*., 2007). These findings are in consistent with the opinion of studywhich designed a study to evaluate the effects of therapeutic ultrasound on pain, disability, walking performance, quality of life (QOL) and depression in patients with chronic low back pain CLBP. Forty-two patients with CLBP were randomly allocated into two groups. Patients in group 1 received therapeutic ultrasound, exercise, and hot packs, while patients in group 2 received sham ultrasound, exercise, and hot packs. All treatment programs (ultrasound, sham ultrasound, hot packs, and exercise) were performed 5 days a week for 3 weeks. Patients were evaluated by the following parameters: pain (visual analog scale [VAS]), disability (Modified Oswestry Low Back Pain Disability Questionnaire and Pain Disability Index), functional performance (6-Minute Walk Test [6MWT]), QOL (Short Form 36 [SF-36]), and depression (Beck Depression Inventory [BDI]) (Dilek *et al*., 2010).

Also this disagreed with study that studied the efficacy of osteopathic manual treatment (OMT) and ultrasound therapy (UST) for chronic low back pain, and found that there was no statistical interaction between OMT and UST. A randomized, double-blind, sham-controlled, 2 × 2 factorial design was used to study OMT and UST for short-term relief of nonspecific chronic low back pain. The 455 patients were randomized to OMT (n = 230) or sham OMT (n = 225) main effects groups, and to UST (n = 233) or sham UST (n = 222) main effects groups, and he concluded that There was no statistical interaction between OMT and UST (Licciardone *et al*., 2013).
Also this disagreed with study that made a systematic review to assess the evidence on the efficiency, effectiveness, cost effectiveness, and safety of ultrasonic and shock wave to treat LBP. An electronic search was performed in MEDLINE, EMBASE, and the Cochrane Library databases up to July 2009

to identify randomized controlled trials (RCTs) comparing vibrotherapy with placebo or with other treatments for LBP, Thirteen studies were identified. The four RCTs complying with the inclusion criteria included 252 patients. Two of the three RCTs on ultrasound had a high risk of bias. For acute patients with LBP and leg pain attributed to disc herniation, ultrasound, traction, and low-power laser obtained similar results. For chronic LBP patients without leg pain, ultrasound was less effective than spinal manipulation, whereas a shock wave device and transcutaneous electrical nerve stimulation led to similar results. Results from the only study comparing ultrasound versus a sham procedure are unreliable because of the inappropriateness of the sham procedure, low sample size, and lack of adjustment for potential confounders. No study assessed cost-effectiveness. No adverse events were reported, so he concluded that the available evidence does not support the effectiveness of ultrasound or shock wave for treating LBP. High-quality RCTs are needed to assess their efficacy versus appropriate sham procedures, and their effectiveness and cost-effectiveness versus other procedures shown to be effective for LBP. In the absence of such evidence, the clinical use of these forms of treatment is not justified and should be discouraged (Seco *et al*., 2011).

Also we found significant differences between both groups regarding post treatment values of VAS, MODQ, SLR and ST resulting in better improvement laser group than ultrasonic group and this findings agreed with study that studied the short-term effectiveness of high-intensity laser therapy (HILT) versus ultrasound (US) therapy in the treatment of LBP, he used 30 patients into 2 groups, he found that there were no differences between group at baseline in Visual Analogic Scale (VAS) and Oswestry Low Back Pain Disability Questionnaire (OLBPDQ) scores. At the end of the 3week intervention, participants in the HILT group showed a significantly greater decrease in pain (measured by the VAS) and an improvement of related disability (measured by the OLBPDQ) compared with the group treated with US therapy, so he can concluded that after 15 treatment sessions there was greater effectiveness of HILT than of US therapy in the treatment of LBP, proposing HILT as a promising new therapeutic option into the rehabilitation of LBP (Fiore *et al*., 2011).

Also these findings came in agreement with study involved 94 people divided into three groups (A, B, C). Group A (n=35) received a series of 10 low energy laser therapy sessions (wave length 808 nm, surface density of radiation 5-0 mW/cm(2), continuous wave form, scanning mode, a dose of 12 J/cm(2) on a surface of 100 cm(2) [10x10cm]). Patients in Group B (n=27) had ultrasound sessions with a wave intensity of 1 W/cm (2) for 3 minutes. Patients in Group C (n=32) underwent vacuum therapy (8 kPa) combined with Ultra Reiz current. Subjective pain assessment was carried out using a modified Latinen questionnaire and a visual analogue scale of pain intensity. Lumbosacral spine mobility was evaluated with the Schober test and the finger-to- floor test, so he found that In Group A, following low energy laser therapy, a statistically significant decrease in pain intensity was observed, together with decreased analgesic consumption compared to the other groups. In Group C, following vacuum therapy combined with Ultra Reiz currents, a significant decrease in the frequency of pain was observed together with increased physical activity compared to both Groups A and B, assessed according to a modified Latinen pain indicator questionnaire. The biggest improvement in global spine mobility and lumbosacral flexion was observed in Group C (vacuum therapy plus Ultra Reiz current) compared to the other groups. However, the most significant improvement in lower spine extension was noted in Group B (ultrasound) (Charłusz *et al*., 2010). But this findings disagreed with the opinion of study designed to measure and compare the outcome of traction, ultrasound, and low-power laser (LPL) therapies by using magnetic resonance imaging and clinical parameters in patients presenting with acute leg pain and low back pain caused by lumbar disc herniation (LDH). A total of 60 patients were enrolled in this study and randomly assigned into one of three groups equally according to the therapies applied, either with traction, ultrasound, or LPL.

Treatment consisted of 15 sessions over a period of three weeks. Magnetic resonance imaging examinations were done before and immediately after the treatment Physical examination of the lumbar spine, severity of pain, functional disability by Roland Disability Questionnaire, and Modified Oswestry Disability Questionnaire were assessed at baseline, immediately after, and at one and three months after treatment. There were significant reductions in pain and disability scores between baseline and follow-up periods, but there was not a significant difference between the three treatment groups at any of the four interview times. There were significant reductions of size of the herniated mass on magnetic resonance imaging after treatment, but no differences between groups. This study showed that traction, ultrasound, and LPL therapies were all effective in the treatment of this group of patients with acute LDH. These results suggest that conservative measures such as traction, laser, and ultrasound treatments might have an important role in the treatment of acute LDH (Unlu *et al*., 2008).

Conclusion

We found that both laser acupuncture group and ultrasound group showed significant improvement between pre and post values of VAS, MODQ, SLR and ST, but laser acupuncture group showed more significant improvement than ultrasound group regarding VAS, MODQ, SLR and ST. So we can conclude that laser acupuncture and ultrasound may be used in treatment of discogenic sciatica but laser acupuncture is more beneficial.

Recommendations

The results of my study have indicated a need to consider the following recommendations:

- Further studies are required using different laser acupuncture parameters (such as wavelength, power, and duration).
- Further studies are required to determine the source of effect of laser acupuncture whether it is because of laser effect or acupuncture point stimulation effect.

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