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Immediate Effects of Electro Acupuncture versus Laser Acupuncture on Pain and Disability in Women with Chronic Cervical Myofascial Pain Syndrome

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ABSTRACT

Introduction: Neck pain is the fourth leading cause of disability worldwide. This study aims to investigate the effects of Electro Acupuncture (EA) versus Laser Acupuncture (LA) on symptoms of women with chronic cervical myofascial pain syndrome.

Materials and Methods: This is a single-blind randomized controlled clinical trial. Thirty women with chronic cervical myofascial pain syndrome were randomly divided into three groups: EA, LA, and sham. The EA group received electrical stimulation through needles at standard acupuncture points, while the LA group received low-intensity laser irradiation at the same points. The passive laser probe was applied for the sham group. The outcome measures were neck pain pressure threshold, neck pain severity, neck disability, and cervical range of motion

Results: The pain severity and disability were significantly lower in the EA group than in the other two groups. The neck range of motion (cervical lateral flexion and rotation) and pain pressure threshold increased significantly in the EA group immediately and one week after the intervention.

Conclusion: Both EA and LA interventions may be effective in alleviating the symptoms of cervical myofascial pain syndrome, but the EA can be more effective in reducing neck pain and disability in women with cervical myofascial pain syndrome.

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1. Introduction

Neck pain is defined as a feeling of pain and stiffness in the cervical region that may be exacerbated by movement and pressure [1]. According to the Cochrane Back Review, neck pain is considered chronic if it lasts for 12 weeks or more [2]. It is the third most common reason for chronic pain in the United States and the fourth leading cause of disability worldwide [3]. The prevalence of neck pain has recently increased [4]. Women are more susceptible to neck pain with a longer recovery period than men. This disability can disturb daily activities and reduce the quality of life [5, 6]. In general, cervical pain and disorders are divided into three categories: Radiculopathy, myelopathy, and mechanical neck pain [7]. Neck pain with the absence of myelopathy, radiculopathy, or a serious disorder is known as mechanical neck pain. This type of pain may arise from cervical muscle strain, myofascial pain syndrome (MPS), facet joint disorders, or cervical spondylosis [8]. According to epidemiological studies, MPS is a common cause of neck pain, affecting 55-90% of patients with chronic neck pain [9, 10]. It is a painful condition caused by highly sensitive areas of muscle fibers. It is characterized by painful taut bands, limited range of motions (ROMs) in the affected joints, muscle weakness, and higher levels of symptoms following stress [11, 12].

Acupuncture is a form of complementary medicine that stimulates certain parts of the body to prevent or alter pain perception and physiological function [13]. Electroacupuncture (EA) is a type of acupuncture in which the electrical current is applied through the needles to maximize the effects of acupuncture [14]. In this method, the needles are placed on the acupuncture points, and an electrical current is simultaneously transferred to the points to enhance the possible efficacy [15]. Laser acupuncture (LA) is the use of low-intensity laser irradiation to stimulate acupuncture points [16]. Recent studies have shown positive effects of LA on pain control and tissue repair [17-19]. The effects of EA on chronic pain at low back and trapezius areas have been investigated in previous studies [15, 20, 21]. Ahmed et al. compared the long-term effects of EA and LA in patients with cervical spondylosis. Their results showed that both acupuncture methods might effectively control the pain level of these patients [22]. However, no study was found on the immediate effects of EA and LA on pain and disability levels following cervical MPS which is manifested by the existence of painful taught bands, neck girdle muscles weakness, and joints stiffness which are mostly exacerbated by stress and anxiety [23]. Therefore, the present study aims to compare the immediate effects of EA and LA on neck pain and disability levels of women with chronic cervical MPS.

2. Materials and Methods

Study design and participants

This is a randomized controlled clinical trial (Code: IRCT20190104042229N1). Participants were women with cervical MPS recruited from the physiotherapy clinic of the School of Rehabilitation Sciences, Tehran University of Medical Sciences from August to October 2019. The inclusion criteria were: having cervical MPS, age 18-35 years, suffering from neck pain for at least 12 weeks, and pain severity of 3 or more based on the visual analog scale (VAS) score. Patients were excluded from the study in case of having fibromyalgia or myopathy, neurological disorders, cervical discopathy or history of cervical surgery, infection or malignancy, diabetes, pregnancy, fear of needles, any medical treatment or physiotherapy interventions in the past one month, feeling discomfort, and having disinclination or negative reactions to the treatment [24]. The sample size was determined 10 for each group by conducting a pilot study on 12 participants (4 patients for each group) considering a test power of 90% at 95% confidence interval.

Treatment

The eligible patients were randomly divided into three groups using the balanced block randomization method with a block size of 6. The researcher and examiner were blind to the process of randomization. The patients in the first group (n=10) received EA, the second group (n=10) reecived LA, and the third group (n=10) were under sham LA. The EA was applied in prone position with head in a neutral position. The dominant hand with 90 degrees of flexion in elbow and shoulder was placed on the body side, while the opposite hand was under the forehead (Figure 1). The intramuscular electrical stimulation was applied by needle insertion (0.25×25 mm) for 20 minutes [25] at standard acupoints including GB20, GB21, and BL43 (Bilaterally), and LI4 and LI11 (unilaterally) [25-27]. The electrical stimulation was produced by a stimulator (AS SUPER 4 digital, Schwa-Medico, Germany). The currents were applied at two frequencies of 2 and 100 Hz each for 3 seconds with a pulse width of 120 and 210 µs, respectively. The currents were switched automatically every three seconds. The intensity was adjusted based on the patient's sens of comfort and increased by therapist every 5 minutes at the time of application to reduce the chance of adaptation. The LA

was applied using a calibrated laser producer (Endolaser 422, Enraf Nonius, Netherlands). at an energy density of 10 J/cm² on the same standard acupoints. The laser was applied in pulsed mode (2000 Hz) [28] with a 905-nm wavelength and a 100-mW output power. The sham group were under the similar procedure, but the laser device was turned off. All groups received the intervention just at one single session.

Outcome measures

Pain intensity, Pain Pressure Threshold (PPT), active range of lateral flexion and rotation in the cervical spine, and neck disability were measured by an experienced therapist who was blind to the allocation. The outcome measures were assessed three times; before the treatment, immediately (10 minutes) after the intervention, and one week after the intervention. Pain intensity was assessed by a 10-cm VAS. The PPT was assessed by an algometer (FG-5020, Taiwan). at two symmetrical points in the midpoint of the top right and left trapezius muscles (GB21 acupuncture point). These symmetrical points have been reported as the most common painful points at MPS [29]. The algometer was placed on the mentioned points and the examiner gently applied pressure on the points and then increased it gradually. The amount of pressure felt by the patient and reported pain were recorded. The procedure was repeated twice and the average value was considered as PPT.

The Persian version of the neck disability index (NDI) questionnaire was used to measure neck disability, which is a reliable tool to assess Iranian samples [30]. A calibrated hand-held goniometer was used to measure cervical lateral flexion and also rotation bilateraly. The patient was in the upright sitting position on a chair while the thoracic and lumbar spine were well supported by armrest and backrest. For measuring lateral flexion, the center of the goniometer was located over spinous process of C7, the fixed arm was along the posterior midline of the head, while the moving arm was perpendicular to the ground to measure both right and left lateral flexions. For cervical rotation, patients were in the same position while the axis of goniometer was over the center of cranial aspect of the head; the fixed arm was parallel to imaginary line between the two acromial processes, and the moving arm was parallel to the tip of the nose to measure both right and left cervical rotations [31].

Statistical analysis

The collected data were analyzed in SPSS v. 24 software. Kolmogorov-Smirnov test was used to determine the normal distribution of data. One-way Analysis of Variance (ANOVA) was applied to assess the difference between the groups in case of normal data distribution. The non-parametric Kruskal-Wallis test was conducted for the parameters of cervical lateral flexion and rotation since these parameters did not had normal distribution. The significance level was set as 0.05.

3. Results

Of 35 women assessed for elgibility, 5 were excluded due to having unidentified discopathy and radicular pain Finally, 30 women with neck pain voluntarily participated in the study, 10 in each three group (Figure 2). The participants were approximately similar in terms of demographic features including age and duration of symptoms (Table 1).

Pain severity

The results showed a significant reduction in VAS scores of the EA group immediately after the treatment (post-test) and one week later (follow-up). Pain severity also decreased in the LA and sham groups immediately and one week after the treatment. However, there were no significant difference in pain scores of these groups (Table 2). The reduction in the EA group was significantly higher than in other groups (Table 3).

PPT

The scores of PPT over trapezius muscles (right and left sides) in the EA group increased immediately and one week after the treatment (Table 2). However, this difference was significant only between the pretest and posttest phases. Furthermore, there were no significant improvements in the LA and sham groups at the pretest and posttest phases, but there was a significant improvement in PPT scores of the EA group immediately after the treatment, and the difference between the groups was statistically significant at the posttest phase (Table 3).

Disability

The NDI score reduced significantly in the EA group one week after the treatment (Table 2). There were no significant differences in the NDI scores for the LA and sham groups, but the improvement in the NDI score was significantly higher in the EA group (Table 3).

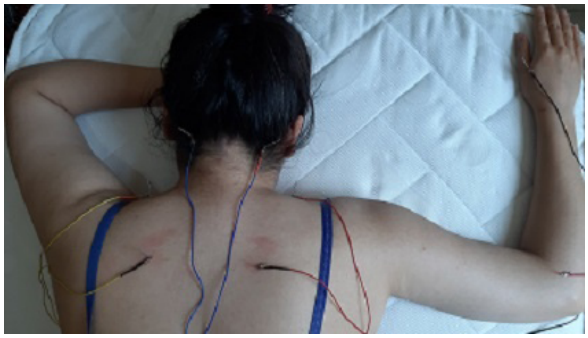

Figure 1. Patient position during intervention JMR

Cervical lateral flexion and rotation

The cervical lateral flexion increased bilaterally in all groups immediately and one week after the intervention (Table 4), where the improvement level was significantly higher in the EA group at both phases (Table 3). The cervical rotation increased significantly in the EA group immediately and one week after treatment (Table 4). There was no significant difference in the cervical rotation range of the LA and sham groups (Table 3).

4. Discussion

The results of the current study showed that the EA application is more effective than the LA in reducing neck pain and disability and increasing the cervical ROMs in women with cervical MPS. The results are consistent with the results of Maria et al. who reported that the EA application might reduce the pain and improve the function in patients with MPS in the upper trapezius muscle [20]. Ilbulduet et al. compared the effects of low-level LA, dry needling, and placebo LA application in MPS and reported that the LA could reduce pain levels at rest and at activity, and increase pain threshold [32]. Chowet et al. studied the effects of LA in 90 patients with chronic neck pain. These patients received 14 sessions of 300-

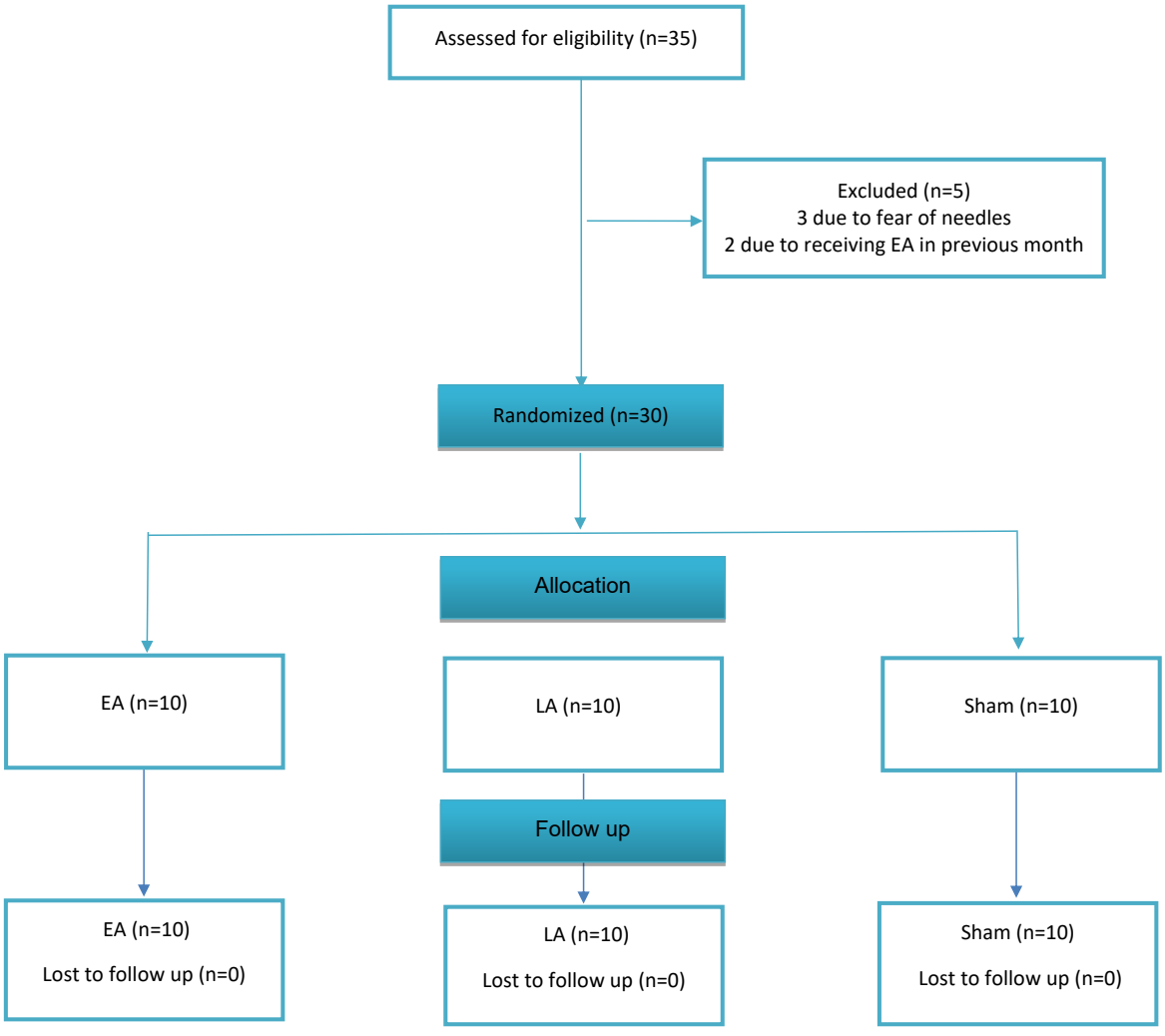

Figure.2. Flow diagram of sampling and allocation JMR

Table 1. Baseline characteristics of the patients (n=10)

	Mean±SD			P
	EA	LA	Sham	
Age (y)	22.43±1.90	24.14±2.03	23.50±3.50	0.159
Duration of symptoms (Months)	36±12	33±5	36±6	0.235
Gender	Female	Female	Female	

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mW, 830-nm laser irradiation, and their pain level improved significantly based on the VAS and the 36-item short-form survey's physical functioning subscale scores compared to the sham laser group [33]. Ahmed et al. compared the effects of EA and LA on pain and disability level in patients with cervical spondylosis [22]. They assessed the long-term effects of the two methods. Their results showed that both EA and LA methods might effectively control the pain and disability levels of these patients. However, the results of our study did not report the effectiveness of the LA. It should be considered that patients in Ahmed et al.'s study had neck pain due to spondylosis that was different from the cause of neck pain in the present study. They did not use a control group to clarify the exact difference in improvement under LA. Besides, they assessed the PPT scores under finger pressure which has poor validity. The cervical ROM was not assessed in their study, either. More importantly, they provided laser irradiation at 12 sessions. Therefore, the amount of applied laser density was much higher than in the present study, which could be the main reason for our discrepancy in results.

The most important concept about the pathophysiology of MPS is the pathological increase in the release of acetylcholine from free nerve endings of the abnormal motor endplate, called the "integrated hypothesis" [34-36]. Permanent depolarization of the postsynaptic membrane and shortening of sarcomeres may lead to increasing energy consumption and decreasing peripheral blood circulation due to muscle trauma, overload, and sarcoplasmic retinaculum damage [37]. Several studies have reported that the EA may improve blood circulation and opioid peptides secretion and inhibit the nociceptive pathway [38-43]. Different frequencies of electrical stimulation can exert different types of opioid peptide secretion [44]. Animal studies have shown that the use of high-frequency (100 Hz) electrical stimulation can lead to dynorphin secretion, while low-frequency (2 Hz) electrical stimulation induces endorphin, endomorphin, and

Table 2. The mean scores of VAS, PPT, and NDI in three groups before, immediately after, and one week after intervention

Group	Assessment Phase	Mean±SD	P	Mean±SD	P	Mean±SD	P	Mean±SD	P
		VAS		PPT in Right Trapezius		PPT in Left Trapezius		NDI	
EA	Pre-test	5.70±1.35	-	7.16±1.90	-	6.04±1.05	-	11.90±4.22	-
	Post-test	3.25±1.81	0.028*	9.15±3.75	0.048*	8.63±2.84	0.035*	-	-
	Follow-up	2.95±1.64	0.002*	8.69±3.58	0.191	8.25±3.12	0.147	9±3.55	0.006*
LA	Pre-test	4.55±0.89	-	6.19±1.82	-	7.66±2.40	-	7.70±3.46	-
	Post-test	3.80±1.53	0.449	6.52±2.45	1.000	7.92±2.19	1.000	-	-
	Follow-up	4.40±1.41	0.237	6.13±2.43	1.000	7.11±2.24	0.311	8.90±4.86	0.347
Sham	Pre-test	4.30±0.88	-	8.25± 2.75	-	7.75±2.00	-	7.90±1.91	-
	Post-test	3.67±1.13	0.176	7.94±2.13	0.296	7.82±2.03	1.000	-	-
	Follow-up	3.71±1.35	0.115	8.75±3.16	0.114	9.50±3.21	0.118	7±2.74	0.262

* Significant at P<0.05

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Table 3. Comparison of improvement in VAS, PPT, cervical lateral flexion, cervical rotation, and NDI among three study groups (n=10)

Variables		Mean±SD			P
		EA	LA	Sham	
VAS	Improvement at initial stage	-2.45±0.74	-0.75±1.03	-0.63±0.92	0.06
	Improvement after one week	-2.75±1.73	-0.15±1.73	-0.59±0.76	0.001*
PPT in right trapezius	Improvement at initial stage	1.99±2.13	0.32±1.14	-0.31± 1.58	0.01*
	Improvement after one week	1.52±2.30	-0.06± 3.02	0.49±1.46	0.31
PPT in left trapezius	Improvement at initial stage	2.58±2.59	0.26±3.17	0.06±2.50	0.09
	Improvement after one week	2.20±3.06	-0.55±2.06	1.74±2.28	0.000*
NDI	Improvement after one week	-2.90±2.58	1.20±3.82	-1.00±2.35	0.017*
Rotation (right)	Improvement at initial stage	10.88±5.33	0.6±3.94	4.06±6.85	0.000*
	Improvement after one week	10.98±6.73	-2.63±5.01	-0.02±5.77	0.001*
Rotation (left)	Improvement at initial stage	12.68±5.65	-0.63±4.62	2.90±7.33	0.000*
	Improvement after one week	12.96±10.16	-1.28±4.04	2.82±8.99	0.000*
Lateral flexion (right)	Improvement at initial stage	8.28±4.27	1.71± 3.93	1.66±2.59	0.001*
	Improvement after one week	7.93±7.62	3.31± 5.87	0.46±1.79	0.021*
Lateral flexion (left)	Improvement at initial stage	8.33±2.04	2.10±6.01	2.83±3.06	0.004*
	Improvement after one week	10.40±4.16	-1.79±3.35	1.33±3.96	0.000*

* Significant at P<0.05

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Improvement at initial stage=Posttest score, Pretest score; Improvement after one week=Follow-up score-Pretest score

Table 4. The mean scores of cervical lateral flexion and rotation in three study groups before, immediately after, and one week after intervention

Group	Assessment Phase	Mean±SD	P	Mean±SD	P	Mean±SD	P	Mean±SD	P
		Rotation (Right)		Rotation (Left)		Lateral Flexion (Right)		Lateral Flexion (Left)	
EA	Pre-test	62.49±9.85	-	62.29±8.40	-	28.23±7.46	-	26.42±5.87	-
	Post-test	73.38±6.87	0.000*	74.98±5.17	0.000*	36.51±5.68	0.001*	34.76±5.47	0.000*
	Follow-up	73.48±5.51	0.002*	75.26±7.10	0.009*	36.16±2.58	0.028 *	36.83±3.64	0.000*
LA	Pretest	76.93±8.72	-	74.29±14.21	-	33.94±5.15	-	34.69±6.62	-
	Posttest	76.99±6.09	1.000	73.66±12.15	1.000	35.66±4.84	0.602	36.79±6.41	0.893
	Follow-up	74.29±5.96	0.395	73.01±13.49	1.000	37.26±8.30	0.324	32.89±5.41	0.373
Sham	Pretest	68.13±6.48	-	63.09±7.15	-	34.43±7.53	-	32.06±4.33	-
	Posttest	72.19±5.95	0.280	65.99±2.53	0.097	36.09±7.59	0.087	34.89±5.42	0.061
	Follow-up	68.11±7.13	1.000	65.91±5.69	1.00	34.89±6.43	1.00	33.39±3.19	0.944

* Significant at P<0.05

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enkephalin secretion. The complementary studies have proven that the combination of high- and low-frequency electrical stimulation can cause the simultaneous release of all opioid peptides and promote pain relief [45-48]. In the present study, it seems that the EA improved blood circulation and nociceptive pathway inhibition, and consequently reduced the pain. The combination of frequencies (2 and 100 Hz) may help maximize the opioid peptide secretion and pain reduction.

Low-intensity laser irradiation is an approved phototherapy stimulation leading to biological effects with no thermal effects. However, photochemical reactions at the cellular or tissue level are still under investigation [49]. Four main mechanisms may explain the therapeutic effects of low- intensity lasers: (a) releasing opioid peptides, (b) inhibiting the secretion of toxic mediators such as bradykinin, (c) reducing the transmission of pain signals through the autonomic nervous system, and (d) regulating the release of serotonin and norepinephrine [50, 51]. It seems that LA may be an effective method to break the vicious cycle of MPS and relieve the symptoms. However, single session LA application in our study could not effectively improve the symptoms of chronic MPS in the neck. The applied energy density in the present study was also low; therefore, it might not be enough to induce any physiological changes. Therefore, it is recommended that the multi-session effects of LA be evaluated with appropriate energy density to compare it with the EA. Another limitation of this study was the short period of follow-up. Moreover, the gender impact was not considered in this study, since all participants were female.

5. Conclusion

The EA seems to be more effective than LA at one session in reducing neck pain, neck disability, and cervical ROMs in women with chronic cervical MPS. More studies are required to confirm the improvement levels and long-term effects, and compare them with other treatment methods.

Ethical Considerations

Compliance with ethical guidelines

This study obtained its ethicap approval from the ethics committee of Tehran University of Medical Science (Code: FNM.REC.1398.005). All patients were aware of the study methods and signed an informed consent form prior to the study.

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Authors' contributions

Contributed at data collection, project developement, manuscript writing: Atefeh Bahadori Bozchelooee; contributed at project development, research design, data analysis management, manuscript writing and revising: Siamak Bashardoust Tajali; Contributed at project development, research design and manuscript writing: Zahra Fakhari; Contributed at data collection and manuscript writing: Monavar Hadizadeh.

Conflict of interest

The authors declared that there were no conflicts of interest. There has been no significant financial support for this study which could have influenced the outcomes.

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