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Effects of TENS and LEL on Pain and Functional Performance of Patients with Shoulder Pain

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The purpose of this study was to determine the effectiveness of Transcutaneous Electrical Nerve Stimulation (TENS) therapy, Low Energy Laser (LEL) therapy and combine therapy (TENS and LEL) on pain and functional performance of patients with shoulder pain. Fortyfive individuals with shoulder pain have participated in this study. Subjects were randomly divided into 3 groups and were assessed before and after a 3 week therapy phase. Groups were re-assessed for control one month later. Pain intensity was scored on a Visual Analogue Scale (VAS). Range of Motion (ROM) was measured with goniometer. Constant's shoulder index was applied for functional assessment. First group performed TENS, second group performed LEL and third group performed combine therapy (TENS and LEL). Statistically significant differences were found before and after therapy for ROM, VAS and functional performance in all three groups. When the three groups were compared, ROM, VAS and functional performance test results were found to be significantly better in the combine group than the other groups after the therapy. The results of this study suggested that when LEL and TENS were used combined in shoulder pain treatment, they can improve ROM and functional performance and reduce pain better than when they are applied separately.

Key words: Transcutaneous electrical nerve stimulation, low energy laser, shoulder pain, constant shoulder index, functional assessment

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INTRODUCTION

The anatomy of the shoulder joint complex allows for tremendous range of motion. This wide range of motion of the shoulder complex proximally permits precise positioning of the hand distally, creating both gross and skilled movements. However, the high degree of mobility requires some compromise in stability, which in return increases the vulnerability of the shoulder joint to injury, particularly in dynamic overhead activities[1,2]. The most common sources of injuries to the shoulder are come across in sports, direct fall or overuse. The shoulder complex plays an integral role in the activities of daily living, sometimes acting as part of an open kinetic chain, sometimes as part of a closed kinetic chain. Limitation of function can affect the patient tremendously[3,4].

Shoulder pain can be caused by intrinsic disease of the shoulder joints or by pathology in the periarticular structures. Causes of shoulder pain include supraspinatus tendinitis, bicipital tendinitis, rotator cuff tendinitis, impingement syndromes, supraspinatus rupture, subacromial bursitis, arthritis, frozen shoulder and various conditions that create pain to the shoulder. Pain restricts shoulder motion and limits daily activities, causing disability[5-7].

The goals of shoulder rehabilitation are to relieve pain, restore muscle and maximize dynamic function[1]. Shoulder pain physiotherapy programs consist various methods such as heat, cold, electrotherapy, mobilisation techniques and exercises. The usual applications of electrotherapy are Ultrasound, Transcutaneous Electrical Nerve Stimulation (TENS) and Laser in this field[8-11].

TENS is non-invasive, analgesic technique that is claimed to have an effect. There is wide spead use of TENS throughout health care and it is a common treatment modality for musculoskeleteal pain. The TENS settings are based on the gate control theory of pain. TENS is agreed to produce a significant reduction in pain[12-15].

Low Energy Laser (LEL) has been promoted as an effective way to produce analgesia and accelerate healing of a variety of clinical conditions, also in shoulder pain. The main mechanism of the therapy is considered to be the biostimulation with the light energy enhancing the level homeostasis. LEL is used in acute, chronic pain and in the inflammation by the irradiation of very weak (1-10 mW) but special wavelength (630-904 nm)[16-18].

The purpose of this study was to compare the effectiveness of TENS, LEL and combined therapy (TENS and LEL) on pain and functional performance of patients with shoulder pain.

MATERIALS AND METHODS

Subjects: This study was performed in Istanbul University School of Physical Therapy and Rehabilitation between January 2002 and December 2004.

Patients recruited for this study suffered from shoulder pain with soft tissue disorders of the shoulder pain. Patients were excluded if their shoulder pain was due to systemic inflammatory diseases such as rheumatoid arthritis or neoplastic disorders or trauma.

Fortyfive patients completed the study. The studied subjects were 30 female and 15 male outpatients (mean age, X = 46.12, SD = 3.3). The symptoms duration was 3-6 months (mean duration, X= 4.2, SD= 0.97).

The inclusion criteria for the patients were as follows:

- VAS score had to be between 4-6 at rest.
- Right-dominant upper extremity.
- Unilateral shoulder pain.
- No experience of professional sports.
- In subacute phase (in 3-6 months).
- No serious cardiovascular or respiratory diseases.

Subjects were required to sign an institutionally approved information consent prior to participation in this study.

Examinations: Assessment of pain relief was performed using a Visual Analogue Scale (VAS)[19]. VAS provides simple and efficient measure of pain intensity. It is widely used in clinical settings and correlates highly with pain measured by verbal numerical rating scales. The patients were asked to quantify the pain on VAS from 0 (no pain) to 10 (most severe pain). The patients gave answer for the level of their pain in rest and in activity.

Active shoulder Range of Motion (ROM) was measured with universal goniometer. Shoulder flexion, abduction, internal rotation and external rotation were measured based on Kendall-Mc Creary criteria[20]. Pivot for shoulder flexion is tuberculum major of humerus. It was measured and full range is 180°. Pivot for shoulder abduction was acromion and full range was 180°. External and internal rotation pivot is olecranon and full range is 90° for both of them. Supine position was used at all assessments. The end of volunteer motion was measured as active ROM in pain free range.

The Constant's shoulder Index (CI)[21,22] form was preferred for functional assessment. It consists of 4 parts; pain, Activity Daily Living (ADL), ROM and poverity. Pain total score was 15 and 20 for ADL, 40 for ROM and 25 for poverty. Total score is 100.

Therapy procedure: In this study 45 patients with shoulder pain were separated randomly in three groups. In each group there were 15 patients. TENS was applied to the subjects in Group 1. LEL was applied to the subjects in Group 2. Combine therapy (TENS and LEL) was applied to Group 3.

Patients in Group 1 received 30 min TENS (Mod. EX404, Pagani Ltd., Italy; A dual-channel Tens). Stimulation was given in continuous TENS of 140 ms pulses at 80 hertz.

Four surface electrodes, 4×4 cm each, were placed on the painful areas in cross form. LEL was used in Group 2 (Mod. IR27, Pagani Ltd., Italy; Ga As type 1-10 mW and 904 nm) and was irradiated on painful points (minimum two-maximum four points) every 3-4 min and maximum 15 min totally. All the groups had therepeutic exercise in addition to electrotherapy modalities. Those exercises were isometric shoulder muscle exercises, wand exercise and therabant exercise[1-6].

The patients continued their Electrotherapy (ET) and exercise programs together for 3 weeks (15 sessions). After the ET program ended, they continued their exercises as home program for another 30 days. The evaluations were repeated Before the Treatment (BT), after the Treatment (AT) and after the home program as Control Assessment (CA).

Data analysis: Data were analyzed using the SPSS program. Comparison before treatment was made by ANOVA-one way test in all the groups. Repeated measurements ANOVA test was used to compare three different time phases in all the groups.

The acceptable level of significance for all statistical analyses was $p<0.05$.

RESULTS AND DISCUSSION

The mean values and standard deviations for all patients before treatment, after treatment and in the control assessment of ROM, constant index and VAS results were shown in Table 1.

Before treatment, three groups were studied with ANOVA-one way test. There were no statistically significant differences found in none of the parameters in none of the groups The three groups were homogen in the beginning of the treatment.

In all patients, within the groups, significant improvement were found between repeated measures ($p = 0.0005$). There were significant improvements between Before Treatment (BT) and After Treatment (AT) and BT and Control Assessment (CA) (Table 2).

Group 1 was TENS and Group 2 was LEL and Group 3 was Combine group (TENS and LEL). When the groups were compared, significant improvements were found in all of them between BT and AT and also between BT and CA.

Schoulder flexion was improved better in Group 3 than the other groups specially in control assessment. Shoulder abduction improvement was highly better in Group 3 and insufficient in Group 2 in control assessment. Shoulder internal and external rotation results were better in Group 3 after treatment and control assessment. Constant index was same degree after treatment but in control assessment result was meaningfully better in Group 3 than the other groups and VAS results were decreased in Group 3.

However, the best results among groups belonged to the combine group (Group 3). Especially statistically significant differences between AT and CA were meaningfully improved in combine group (Group 3).

In this study, statistically better significant improvement in all parameters were found in all the groups. However combine group's improvement was better than the other groups after the therapy. This study has shown that when LEL and TENS were used combined in shoulder pain treatment, it can improve ROM and functional performance and reduce pain better than when they are applied separately. Primary importance should be given to reduce pain in soft tissue disorders that lead to shoulder pain. ROM will increase while the pain decreases. It will then be easier to use upper extremity and this would result in higher functional performance.

Laser therapy is becoming increasingly popular among patients and therapists in the treatment of musculoskeleteal pain sydrome[17]. The beneficial effects of laser on human tissue is not completely understood and is the focus of continuing researches[17,18]. *Vitro* experimental evidence indicates that the enhanced healing effects may be due to increased cell proliferation although not all agree that this effect is any more than that seen in controls[23,24]. There are also reports of restoration of skin resistance over trigger points from abnormally low levels to that of the surrounding skin after application of laser and that this results in symptom relief[16,18,23]. The usefulness of laser in shoulder pain has only been subjected to limited study[17,18,23-26]. Vechio *et al.*[23] found that there were no beneficial effects on rotator cuff tendinitis after 16 treatments over 8 weeks with LEL in ROM and VAS. Nevertheless, their patients had longer duration of symptoms than our groups, 15 months versus 4 months respectively. However, England *et al.*[25] reported favorable on the beneficial effect of laser in

Table 1: Mean±SD of measured parameters

	Before Treatment (BT)			After Treatment (AT)			Control Assessment (CA)		
	X	SD	Range	X	SD	Range	X	SD	Range
Shoulder flexion (°)	135.77	7.22	120-145	143.11	7.40	125-155	147.40	8.50	130-165
Shoulder abduction (°)	100.33	5.26	90-110	120.11	9.68	95-135	137.88	23.02	100-175
Shoulder internal rot. (°)	65.88	8.67	55-90	75.12	8.88	60-90	78.88	8.97	65-90
Shoulder external rot. (°)	50.55	3.23	45-55	65.11	8.49	50-80	72.00	12.67	50-90
Constant index	32.48	1.96	30-36	45.02	2.35	40-50	62.75	9.94	42-80
VAS at rest	5.22	0.51	4-7	2.64	0.95	1-5	1.95	1.49	0-5
VAS in activity	7.00	0.47	6-8	3.00	1.26	1-5	2.06	1.43	0-5

VAS: Visual Analogue Scale

Table 2: Comparison of ROM, Constant index and VAS in groups with repeated measures with ANOVA test

		Shoulder flexion	Shoulder abduction	Shoulder int rot.	Shoulder ext rot.	Constant index	VAS at rest	VAS in activity
Within the groups	BT-AT	F=243.23	F=467.91	F=151.17	F=313.65	F=645.04	F=300.93	F=1938.46
		p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005
	BT-CA	F=352.42	F=625.26	F=179.78	F=817.37	F=947.83	F=500.87	F=740.32
		p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005
	AT-CA	F=264.89	F=470.46	F=135.37	F=686.54	F=606.01	F=468.89	F=1778.29
		p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005
Between the groups	BT-AT	F=2.35	F=34.79	F=26.35	F=26.55	F=0.68	F=4.65	F=92.08
		p=0.01	p=0.0005	p=0.0005	p=0.0005	p=0.511	p=0.015	p=0.0005
	BT-CA	F=16.88	F=105.74	F=24.74	F=119.83	F=36.35	F=32.61	F=68.95
		p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005
	AT-CA	F=26.64	F=100.25	F=16.18	F=127.23	F=35.09	F=56.89	F=24.69
		p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005	p=0.0005

BT: Before treatment, AT: After treatment, CA: Control assessment, int rot: internal rotation, ext rot: external rotation, VAS: Visual Analog Scale, ROM: Range of Motion

supraspinatus and bicipital tendinitis using only 6 treatments over 2 weeks. Their patients had shorter duration of symptoms than some of my patients, 3 versus 4 months, respectively.

Heijen *et al.*[8] reported that 20 randomized clinical trial of soft tissue shoulder disorders between January 1984 to December 1995. Four of them were about laser, 2 were about Cold Pack (CP) and TENS and one of them was about exercise therapy. The validity of the 4 trials that studied the effectiveness of the LEL therapy could not find statistically significant difference on shoulder pain and 2 studies results dealing with TENS did not seem to be more effective than other electrical methods. Vlak *et al.*[24] compared CP and laser therapy in painful shoulder syndrome. As a result, although the patients in the laser group concluded that they were satisfied with the results, the results were indeed slightly better. Statistic results of data processing showed no significant difference in efficiency, regarding the objective parameters between the CP and laser groups. Green *et al.*[27] reported that laser therapy was demonstrated to be more effective in terms of short term recovery in rotator cuff tendinitis and longer term benefit with respect to function. Ginn *et al.*[9] has evaluated the efficiency of physical therapy to the treatment of shoulder pain. The duration of the treatment was one month. Stretching exercise, strengthening exercise and motor training were used. They have reported that these exercises are effective in improving shoulder function and reducing pain. In this study a very similar home exercise program was given to the patients.

After home exercises, the results of the combined group were even better compared to other two groups. One of the major factors of exercise period is that the exercises should be done regularly. Second important factor is nonexistence of pain during exercises. As LEL groups' pain problem was not completely solved, this group practiced their exercises regularly but they reported to have cut down the number of exercises because of pain. As an outcome of this, results of LEL group were not sufficient. Combine group reported that as they started the exercise programme with reduced pain, they did have no problems with the home exercises practice and therefore their results came out better. Importance of exercise in shoulder pain is emphasized.

In the three groups, there were statistically significant improvements in ROM, VAS and CI after the therapy. However when the improvement was compared among three groups, laser groups' improvement was the least and combine group was the best. This is also evident in this study, especially in improving functional performance.

TENS group's results were better than the LEL group's. For this reason, it was decided that LEL group was insufficient in pain reduction when compared with TENS. Among our groups, combined groups pain

reduction was the highest and therefore ROM was increased, they could exercise regularly, their functional performances were thus increased. When LEL and TENS are used combined, tissue restoration and pain reduction are more effective than when they are used apart.

REFERENCES

1. Schneider, R. and W.E. Prentice, 2001. Rehabilitation of the Shoulder. In: Techniques in Musculoskeletal Rehabilitation (Eds. Prentice, W.E. and M.I. Voight). Mc Graw-Hill, pp: 411-456.
2. Skyhar, M.J. and T.C. Simmons, 1992. Rehabilitation of the Shoulder. In: Orthopaedic Rehabilitation, (Eds. Nickel, V.L. and M.J. Botte). 2nd Edn., Churchill Livingstone, New York, pp: 747-763.
3. Yahara, M.L., 1994. Shoulder. In Clinical Orthopaedic Physical Therapy, (Eds. Richardson J.K. and Z.A. Iglarsh). W.B Saunders Company, London, pp: 159-220.
4. Jobe, F.W., D.M. Schwab and K.E. Wilk *et al*., 1995. Rehabilitation of the Shoulder. In: Clinical Orthopaedic Rehabilitation (Ed. Brotzman, S.B.). Mosby, St Louis, pp: 91-141.
5. Bonafede, R.P. and R.M. Bennet, 1987. Shoulder pain. Guidelines to diagnosis and management. Postgrad Med., 82\1:185-9.
6. Diamond, W., 1995. Upper Extremity: Shoulder. In: Saunders Manuel of Physical Therapy Practice, (Ed. Myers, R.S.). W.B Saunders Company, London, pp: 789-839.
7. Magee, D.J., 1997. In: Orthopaedic Physical Assessment, 3rd Edn., W.B Saunders Company, London, pp: 175-246.
8. van der Heijden, G.J., D.A. van der Windt and A.F. de Winter, 1997. Physiotherapy for patients with soft tissue shoulder disorders: A systematic review of randomised clinical trials. Br. Med. J., 315: 25-30.
9. Ginn, K.A., R.D. Herbert and W. Khouw *et al*., 1997. A randomised, controlled clinical trial of a treatment for shoulder pain. Phys. Ther., 77: 802-11.
10. Green, S., R. Buchbinder and S. Hetrick, 2003. Physiotherapy interventions for shoulder pain. Cochrane Database Syst. Rev., 2: CD004258.
11. Gürsel, Y.K., Y. Ulus and A. Bilgiç, 2004. Adding Ultrasound in the management of soft tissue disorders of the shoulder. Phys. Ther., 84: 336-43.
12. Lewis, D., 1994. The comparative analgesic efficacy of tens. Br. J. Rheumotol., 33: 455-60.
13. Robinson, A.J., 1996. Trancuteneous electrical nerve stimulation for the control of pain in musculoskeleteal disorders. J. Orthop. Sports Phys. Ther., 24: 433-38.
14. Sluka, A.K., 2001. The basic science mechanism of tens and clinical implications. APS Bull., 11\2: 1-10.
15. Barr, J.O., 1991. Trancutaneous Electrical Nerve Stimulation for Pain Management. In: Clinical Electrotherapy, (Eds. Nelson, R.M. and D.P. Currier). 2nd Edn, Norwalk, Appleton and Lange, pp: 261-315.
16. Low, S. and A. Reed, 1990. Laser Therapy.In: Electrotherapy Explained Principles and Practice, London, Butterworth-Heinemann, pp: 299-313.
17. Kitchen, S.S. and W.A. Partridge, 1991. Review of low laser therapy. Physiotherapy, 77: 161-68.
18. Caspers, K.H., 1977. Laser stimulation therapy. Phys. Med. Rehab., 18: 426-45.
19. Bowsher, D., 1988. Acute and chronic pain and assessment. In: Pain Management in Physical Therapy (Eds. Wells P.E.,V. Frampton and D. Bowsher). Norwalk, C.T. Appleton and Lange, pp: 11-18.
20. Kendall, P.F. and E.K. Mc Creary, 1993. Joint Motion. In: Muscles Testing and Function, 4th Edn., Baltimore, William and Wilkins, pp: 9-26.
21. Constant, C.R., 1987. Clinical method of functional assessment of the shoulder. Clin. Ort. and R.R., 214: 160-64.
22. Constant, C.R., 1991. Assessment of the Shoulder. In: Surgical Disorders of the Shoulder, Edinburgh, (Ed. Watson, M.S.). Churchill Livingstone, pp: 56-66.
23. Vecchio, P., C. Cave and V. King *et al.* 1993. A double blind-blind study of the effectiveness of low level laser treatment of rotator cuff tendonitis. Br. J. Rheumotol., 32: 740-2.
24. Vlak, T., K. Jakelic and I. Jajic, 1994. Comparative study of effectiveness of lasers and cryotherapy in the treatment of painful shoulder syndrome. Rheumatizam, 41\1:9-15.
25. England, S., A.J. Farrel and J.S. Coppock *et al.* 1989. Low laser therapy of shoulder tendinitis. Scand. J. Rheumatol., 18: 427-31.
26. Saunders, L., 1995. The efficacy of low-level laser therapy in supraspinatus tendinitis. Clin. Rehabil., 9: 126-34.
27. Green, S., R. Buchbinder and R. Glazier *et al.* 1998. Systematic review of randomised controlled trials of interventions for painful shoulder: Selection criteria, outcome assessment and efficacy. BMJ., 316: 354-61.