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High Intensity Laser Versus Ischemic Compression on Myofascial Trigger Points in the Upper Trapezius: A Randomized Controlled Trial

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Abstract

Background: A prevalent clinical condition known as myofascial pain syndrome (MPS) is marked by myofascial trigger points creating hypersensitive spots of pain within the fascia and muscles. In addition, MPS is treated by deactivating MTrPs and reestablishing normal bodily biomechanics. At present, MTrPs are treated manually, with methods including ischemia compression as well as physiotherapy modalities like laser, ultrasound, and TENS.

Aim of Study: To examine the impact of high intensity laser (HIL) versus ischemic compression (IC) on neck pain and cervical range of motion (ROM) in patients with myofascial trigger points in the upper trapezius.

Material and Methods: 63 patients, ranging in age from twenty to fifty, were chosen from the outpatient clinic of Sinai University's Faculty of Physical Therapy. They all suffered from MTrPs in the upper trapezius. They were randomly assigned to one of three groups, with 21 individuals per group. One group, Group A, was given both HIL and traditional physiotherapy. Group B (was given IC in addition to traditional physiotherapy). Group C (only was given traditional physiotherapy). The measured parameters were pain as assessed by visual analogue scale (VAS) in addition to cervical range of motion (ROM) as assessed by cervical ROM instrument. Outcome measurements were taken and recorded before and after intervention so patients received intervention for 12 sessions (three sessions per week).

Results: In order to compare the effects of time and treatment, in addition to the interaction among the two, a mixed MANOVA was performed. A significance criterion of $p<0.05$ was established. The findings revealed that HIL has statistically significant effect on all the measured variables as compared to IC. The HIL reduced pain as measured by VAS and improved cervical ROM.

Conclusion: For patients suffering from myofascial trigger points in the upper trapezius, laser therapy appears to be more effective than ischemic compression in alleviating pain and enhancing neck range of motion.

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Key Words: *High intensity laser – Ischemic compression – Myofascial trigger points – Upper trapezius.*

Introduction

ONE muscle that is frequently impacted by trigger points is the upper trapezius muscle (UTM). Consequently, trigger points in the upper trapezius muscle can lead to a variety of musculoskeletal issues, including but not limited to headaches, shoulder problems, and pain in the neck **[1]**. Both psychological and physiological variables can increase the possibility of experiencing neck pain. A decrease in quality of life is caused by the development of trigger points inside the affected muscles, which cause pain and other symptoms **[2].**

A myofascial trigger point is a hyperirritable area that is uncomfortable upon compression and can cause referred pain and motor dysfunction. Acutetrauma or repeated micro-trauma can cause muscle fibertension and the creation of trigger points **[3].** The muscles and the fascia that surround them are frequently the sites of myofascial pain syndrome (MPS) **[4]**. Referred pain to the back of the head, specifically the temporal region, as well as the posterior lateral aspect of the neck is a common symptom of trigger points in the UTM **[5].**

Among the main causes of disability worldwide, neck pain reduces productivity at work, lowers quality of life, and increases the healthcare costs. Chiropractic care, massage, and mobilization are all forms of manual treatment **[6].** As a form of manual therapy, ischemic compression is frequently used to treat MPS **[7]**. Muscle metabolism can be accelerated when this pressure triggers local ischemia and subsequent blood reperfusion **[8].**

Although both low-level laser therapy (LLLT) as well as high-intensity laser therapy (HILT) have comparable photo-biomodulation and anti-inflammatory impacts, HILT (energy output >500 mW) is able to penetrate deeper tissues in the body, making it a non-invasive and pain free physiotherapy technique. Photothermal effects are another potential outcome of HILT **[9].**

Therefore, the purpose of this study was to investigate the efficacy of combining ischemia compression with high-level laser therapy for treating of active trigger points located in the upper trapezius muscle, as well as their effects on pain and function. This study's findings may guide physiotherapists in their decision-making regarding the best course of treatment for patients experiencing pain at activated trigger points located in the upper trapezius muscle.

Material and Methods

Study design, setting and participants:

Sixty-three male and female patients from the outpatient clinic at Sinai University's, Faculty of Physical Therapy were chosen at random utilizing a folded paper based on inclusion criteria. The study was done in the period between 2nd November 2024 to 30 December 2024. Research Ethics Committee of Physical Therapy Faculty, Cairo University (P.T.RC\012\005287) gave its approval to the study protocol. All patients received detailed information regarding the test procedures and trained to do the required tests.

This research was a randomized controlled trial. Every person who is a part of this study has given their informed permission. Each of the three groups included twenty-one participants; Patients in Group A were given both traditional PT and high-intensity laser (HIL) treatments. Group B was given traditional physiotherapy in addition to ischemia compression (IC). In Group C, the only intervention was the traditional physiotherapy program. The traditional physiotherapy program included electrical stimulation, ultrasonic, stretching in addition to isometric exercises of the upper trapezius muscle.

Inclusion criteria:

The patient's age 20-50 years. Body mass 19-25kg/m^2. Myofascial trigger points (MTrPs) are located in the shorter upper trapezius muscle. Individuals having chronic neck pain for longer than 3 months. The patients were diagnosed and referred from orthopedic or neurosurgeon specialist.

Exclusion criteria:

Patients with fibromyalgia, tumor, disc herniation, spinal canal stenosis, cervical radiculopathy. Use of analgesics or anti-inflammatory drugs, pregnancy or epilepsy.

Instrumentation and procedures:

After explaining the study's purpose and collecting baseline data from each patient, we had them sign a consent form indicating their intention to take part. Each patient's medical history was completely recorded. This study compared the effectiveness of ischemia compression therapy with high intensity laser treatment for myofascial trigger points in the upper trapezius muscles, measuring pain on a VAS and cervical ROM on a device. Outcome measurements were taken before and after intervention so patients received intervention for 12 sessions (three sessions per week).

Evaluation instrumentation:

1- Visual analogue scale:

It's a self-reporting scale that uses two verbal descriptions of the pain state to anchor two horizontal or vertical lines, typically 10cm (100mm) long, at either end **[10].**

2- Cervical range of motion measuring instrument:

The CROM apparatus, manufactured by Performance Attainment Associate in Roseville, MN, was used to test the cervical ROM. A plastic frame, covering the nose and ears, is positioned on top of the head and fastened with a Velcro strap. Three inclinometers, one positioned in the sagittal plane along with one is positioned the frontal plane, are fastened to the frame; they reveal the head's position so that the line of gravity can be determined **[11]**. The test can measure cervical ROM in all directions, involving flexion, extension, rotation, along with lateral flexion. In a transverse plane, the 3rd inclinometer shows where the head is while it's rotating and serves as a reference **[12].**

Intervention instrumentation:

1- High intensity laser device:

The instrument utilized was an HIRO 3 instrument from ASA in Arcugnano, Vicenza, Italy. The given parameters are as follows: Peak power of 3,000 W, with an average power of 10.5 W, wavelength of 1,064 nm, pulse duration of 100 µs, frequency of 15 Hz, duty cycle of 0.1%, as well as spot size of 0.2cm^2. Laser emitted energy calculated automatically according to selected functions set in the treatment.

2- Transutaneous electrical stimulation device:

Gymna device model: DUO 400 electrotherapy unit was used, Serial number: Gy-110334, manufactured in 2018. Two channels, four poles, Rubber electrodes 6*8 cm was used. It had modular vacuum unit controlled by Duo 400 full color touch screen navigation. Enlarged therapy screens in dashboard design. Guided therapy system (GTS). Main voltage 100-240-VAC 50/60Hz +-/10%. Max power in operation 100 VA. Dimensions(h*b*d): 330 *360*285 mm. Electrical safety protection class 2.

3- *Ultrasound Therapy:*

Gymna electrotherapy device model: Pulson 400 serial number: 1317125 was used with multifrequency heads (1MHz,3 MHz), (1cm^2, 4cm^2). Two ultrasound output connectors. Main voltage 100-240-VAC 50/60 Hz+-/10%. Max power in operation 100VA. Dimensions (b*h*d):360*285*330.

Evaluation procedures:

1- *Visual analogue scale:*

On the VAS, patients were requested to mark the line that most accurately represented their level of pain, from 0 (no pain) to 10 (severe pain) **[13].**

2- *Cervical range of motion measuring instrument:*

The subject was asked to sit straight in a chair with their back straight, arms relaxed at their sides, and feet flat on the floor while their cervical ROM was measured in degrees of flexion, extension, side bending, as well as rotation. A little tucking of the chin before each movement was one of the specific ROM cues. The sequence of motion included three attempts of flexion to extension, lateral bending left to right, as well as rotation left to right **[14].**

Intervention procedures:

1- High intensity laser device:

The patient sat down, and the therapist stood behind him. Four times, the laser probe was moved in a perpendicular fashion to the upper trapezius muscles, which were identified in advance as trigger points. The patients were administered 10, 12, 5, and 15 J, respectively, at each point in the 1st, 2nd, 3rd, as well as phases, with energy densities of 510, 610, 710, and 810 mJ/cm^2 delivered in 7, 6, and 6 seconds, respectively. At least eight trigger points were treated. Throughout all four stages, the total energy supplied was 50 J/point **[15].**

2- Ischemic compression:

Patients were assessed for active trigger points in the UT muscle by using manual palpation **[16].** The myofascial trigger points were treated by gradually applying pressure with the therapist's thumb. The procedure was discontinued in the event that the pain subsided after approximately 90 seconds **[17].**

3- Transutaneous electrical stimulation:

The patient was in the sitting position. Using a conventional apparatus, asymmetrical rectangular biphasic pulsed electrical currents were delivered for a period of twenty minutes at a rate of 100 Hz using a width of 250 Ksecs. A cathode, or negative electrode, was positioned on the upper trapezius muscle's MTrP while a positive electrode was positioned on the insertion of the acromial tendon as part of the device's application, which involved two channels as well as four electrodes **[18].**

4- Ultrasound Therapy:

The patient was in the sitting position. Conventional ultrasound was applied in pulse mode at an intensity of 1 MHz for 10 minutes in the suboccipital region and the vicinity of the trapezius muscle **[19].**

3- *Passive stretching and exercise treatment protocol:*

The patients were instructed to relax while stretching in order to achieve the most effective relaxation effort. The upper trapezius and sternocleidomastoid muscles were bilaterally stretched using a passive gentle stretching technique for thirty seconds. each, with a one-minute rest in between each repetition. During each session, patients were instructed to execute three sets of isometric neck exercises, with each side holding the position for six seconds in flexion, extension, along with side bending **[20].**

Data analysis:

To compare the gender distribution among groups, we used a Chi-squared test, and to compare the individual's characteristics, we used an ANOVA test. For every variable, we used the Shapiro-Wilk test to ensure that the data followed a normal distribution. We checked for group homogeneity using Levene's test for homogeneity of variances. The impacts on VAS and cervical ROM were compared within and across groups using mixed MANOVA. subsequently, we compared the results many times using post hoc tests that included the Bonferroni correction. All statistical tests were set to have a significance level of $p<0.05$. All statistical analysis was carried out using SPSS version 25 for Windows, which is a program developed by IBM SPSS in Chicago, IL, USA.

Results

Subject characteristics:

A, B, and C groups' subject characteristics are shown in Table (1). Age, weight, height, body mass index, and gender distribution did not differ significantly ($p>0.05$) among the groups.

Table (1): Basic characteristics of participants.

	Group A Mean ± SD	Group B Mean ± SD	Group C Mean ± SD	*p*-value
Age (years)	32.69±6.72	34.62±7.57	32.19±7.63	0.53
Weight (kg)	67.02±7.02	66.33±7.91	65.03±5.06	0.63
Height (cm)	169.14±9.68	169.57±9.25	165.19±8.30	0.24
BMI (kg/m^2)	23.40±0.98	23.03±1.46	23.87±1.53	0.13
Sex, n (%):				
Females	13 (62%)	11 (52%)	12 (57%)	0.82
Males	8 (38%)	10 (48%)	9 (43%)	

SD: Standard deviation. *p*-value, level of significance.

Impact of treatment on VAS and cervical ROM:

Time and treatment interacted significantly (F = 73.55, p = 0.001, η2 = 0.95), according to mixed MANOVA. The main effect of time was statistically significant (F = 2470.45, p = 0.001, η2 = 0.99). With F = 14.96, p = 0.001, and η2 = 0.79, the treatment had a significant main impact.

Within group comparison:

When comparing the three groups' VAS levels before and after therapy, a significant reduction was seen (p<0.001). In Table (2).

Table (2): Mean VAS pre and post treatment of group A,B&C.

	Group A Mean ± SD	Group B Mean ± SD	Group C Mean ± SD
VAS:			
Pre treatment	7.00±0.87	7.21±0.98	7.19±0.78
Post treatment	2.26±0.70	3.64±0.65	4.74±0.75
MD (% of change)	4.74 (67.71%)	3.57 (49.51%)	2.45 (34.08%)
95% CI	4.48: 5.00	3.31: 3.83	2.19: 2.71
	p=0.001	p=0.001	p=0.001

SD : Standard deviation.
MD: Mean difference.
CI : Confidence interval.
p-value: Probability value.

The three groups' ROM after treatment was significantly higher than their ROM before treatment in terms of flexion, extension, right and left bending, in addition to right and left rotation (p<0.001) (Table 3).

Between group comparison:

Group A's VAS showed a significant decline when compared with groups B and C (p<0.001). The VAS of group B was significantly lower than that of group C (p<0.001).

There was a significant improvement in flexion, extension, right and left side flexion, right and left rotation ROM of group A compared with that of group B and group C (p<0.001). There was a significant improvement in flexion, extension, right and left side flexion, right and left rotation ROM of group B when compared to that of group C (p<0.01). (Table 4).

Table (3): Mean cervical ROM pre and post treatment of group A, B and C.

ROM (degrees)	Group A Mean ± SD	Group B Mean ± SD	Group C Mean ± SD
Flexion:			
-Pre treatment	49.57±1.66	48.95±2.67	49.76±2.47
-Post treatment	62.29±1.90	57.10±2.70	53.62±2.52
-MD (% of change)	-12.72 (25.66%)	-8.15 (16.65%)	-3.86 (7.76%)
-95% CI	-13.17: -12.26	-8.60: -7.69	-4.31: -3.40
	p=0.001	p=0.001	p=0.001
Extension:			
-Pre treatment	47.52±1.91	48.38±1.36	47.90±1.87
-Post treatment	61.14±1.35	55.29±0.90	53.52±2.02
-MD (% of change)	-13.62 (28.66%)	-6.91 (14.28%)	-5.62 (11.73%)
-95% CI	-14.54: -12.69	-7.83: -5.98	-6.54: -4.69
	p=0.001	p=0.001	p=0.001
Right bending:			
-Pre treatment	31.14±1.98	30.76 ± 1.58	30.24 ± 2.61
-Post treatment	42.14±1.53	36.81 ± 1.72	35.19 ± 1.99
-MD (% of change)	-11 (35.32%)	-6.05 (19.67%)	-4.95 (16.37%)
-95% CI	-11.83: -10.17	-6.88: -5.22	-5.78: -4.12
	p=0.001	p=0.001	p=0.001
Left bending:			
-Pre treatment	30.29±1.85	30.05 ± 2.18	30.76±2.51
-Post treatment	41.95±1.63	37.76 ± 1.81	34.57±2.50
-MD (% of change)	-11.66 (38.49%)	-7.71 (25.66%)	-3.81 (12.39%)
-95% CI	-12.07: -11.27	-8.11: -7.32	-4.21: -3.41
	p=0.001	p=0.001	p=0.001
Right rotation:			
-Pre treatment	55.52±3.75	53.95 ± 4.08	55.14±3.15
-Post treatment	68.57±3.57	64.62 ± 4.20	60.48±3.57
-MD (% of change)	-13.05 (23.51%)	-10.67 (19.78%)	-5.34 (9.68%)
-95% CI	-14.33: -11.76	-11.95: -9.38	-6.62: -4.05
	p=0.001	p=0.001	p=0.001
Left rotation:			
-Pre treatment	57.86±2.03	56.71 ± 3.51	57.67±2.94
-Post treatment	70.19±2.06	64.43 ± 3.17	62.14±2.48
-MD (% of change)	-12.33 (21.31%)	-7.72 (13.61%)	-4.47 (7.75%)
-95% CI	-13.17: -11.50	-8.54: -6.88	-5.31: -3.64
	p=0.001	p=0.001	p=0.001

SD : Standard deviation.
MD: Mean difference.
CI : Confidence interval.
p-value: Probability value.

Table (4): Comparison of VAS and cervical ROM between group A, B and C post treatment.

Outcome	Group A vs B		Group A vs C		Group B vs C		r^2
	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value	
VAS	-1.38 (-1.90: -0.85)	0.001	-2.48 (-2.99: -1.95)	0.001	-1.1 (-1.62: -0.57)	0.001	0.69
ROM (degrees):							
Flexion	5.19 (3.41: 6.97)	0.001	8.67 (6.89: 10.45)	0.001	3.48 (1.70: 5.25)	0.001	0.70
Extension	5.85 (4.75: 6.97)	0.001	7.62 (6.51: 8.73)	0.001	1.77 (0.65: 2.87)	0.001	0.83
Right bending	5.33 (4.03: 6.64)	0.001	6.95 (5.65: 8.25)	0.001	1.62 (0.32: 2.92)	0.01	0.75
Left bending	4.19 (2.70: 5.69)	0.001	7.38 (5.89: 8.88)	0.001	3.19 (1.70: 4.69)	0.001	0.70
Right rotation	3.95 (1.14: 6.77)	0.001	8.09 (5.28: 10.91)	0.001	4.14 (1.33: 6.96)	0.002	0.44
Left rotation	5.76 (3.83: 7.70)	0.001	8.05 (6.11: 9.98)	0.001	2.29 (0.35: 4.22)	0.01	0.64

MD: Mean difference. CI: Confidence interval. *p*-value: Probability value. r^2: Partial Eta Squared.

Discussion

A study by Rezaeian et al. **[21]** compared the impacts of laser versus ischemic compression on patients with upper trapezius MTrPs. After five sessions of treatment, the groups who received laser therapy had significantly smaller VAS scores than the groups that received ischemia compression. The authors attributed this to the anti-inflammatory and neuromodulatory effects of laser therapy, which lead to prolonged pain relief.

Moreover, Iqbal et al. **[22]** conducted a comparative study on ischemic compression versus laser therapy for upper trapezius MTrPs. The study found that patients receiving laser therapy exhibited a mean VAS reduction of 4.2 points, whereas those receiving ischemic compression showed only a 2.1-point reduction. This significant difference supports the greater efficacy of laser therapy in reducing pain intensity.

Moreover, Khan et al. **[23]** evaluated ischemic compression versus laser therapy for chronic upper trapezius MTrPs. Their study found that ischemic compression resulted in an average VAS reduction of 4.6 points, compared to 3.1 points for laser therapy over a three-week period.

Kaur et al. **[24]** conducted a randomized controlled trial examining the impact of laser therapy and ischemic compression in patients with upper trapezius MTrPs. Their findings revealed that laser therapy increased cervical ROM by 57%, whereas ischemic compression led to only a 34% improvement. The study attributed laser therapy's superior effects to deep tissue penetration, muscle relaxation, and neuromodulation.

Moreover, Bareth **[25]** compared IC with high-intensity laser therapy (HILT) and found that HILT significantly improved cervical extension and rotation, whereas ischemic compression provided only short-term improvements. The study highlighted that laser therapy's ability to enhance cellular activity and reduce inflammation contributed to superior outcomes.

Conclusion:

For patients suffering from myofascial trigger points in the upper trapezius, laser therapy appears to be more effective than ischemic compression in alleviating pain and enhancing neck range of motion.

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جهاز الليزر ذو الشدة العالية مقابل الضغط المستمر على العقد العضلية المتواجدة بالعضلة شبه المنحرفة: دراسة عشوائية

الخلفية: متلازمة الألم الليفى العضلى هى متلازمة سريرية شائعة تتميز بمناطق شديدة الحساسية من الألم فى العضلات واللفافة الناجمة عن نقاط تحفيز الليفى العضلى.

الهدف: دراسة تأثير الليزر عالي الكثافة مقابل الضغط الإقفاري على آلام الرقبة، وعتبة ألم الضغط، المدى الحركى للفقرات العنقية وإعاقة الرقبة لدى المرضى الذين يعانون من نقاط تحفيز الليفى العضلى فى شبه المنحرف العلوى.

المواضيع وطرق العمل: تم اختيار ثلاثة وستين مريضاً من الذكور والإناث يعانون من نقاط تحفيز الليفى العضلى فى العضلة شبه المنحرفة العلوية وتتراوح أعمارهم بين ٢٠ –٥٠ سنة من كلية العلاج الطبيعى بجامعة سيناء. وتم تقسيمهم عشوائياً إلى ثلاث مجموعات؛ المجموعة أ (الليزر والعلاج الطبيعى التقليدى). المجموعة ب (الضغط المستمر والعلاج الطبيعى التقليدى). المجموعة ج (برنامج العلاج الطبيعى التقليدى فقط). كانت المعلمات المقاسة هى الألم الذى تم تقييمه بواسطة المقياس التناظرى البصرى وعتبة ألم الضغط (التى تم تقييمها بواسطة مقياس الجومتر)، ونطاق حركة الفقرات العنقية الذى تم تقييمه بواسطة أداة قياس المدى الحركى، والإعاقة العنقية كما تم تقييمها بواسطة النسخة العربية من مؤشر إعاقة الرقبة.

النتائج: تم إجراء اختبار MANOVA المختلط لمقارنة تأثير الوقت وتأثير العلاج وكذلك التفاعل بين الوقت والعلاج. تم تحديد مستوى الأهمية عند $p<0.05$. أظهرت النتائج أن الليزر له تأثير ذو دلالة إحصائية على جميع المتغيرات المقاسة مقارنة بـ الضغط المستمر. أدى الليزر إلى تقليل الألم ، وزيادة عتبة الألم، وتحسين المدى الحركى للفقرات العنقية وزيادة وظائف الرقبة .

الاستنتاج: العلاج بالليزر يتفوق على الضغط الإقفارى فى تقليل شدة الألم، وزيادة عتبة الألم، وتحسين المدى الحركى الرقبة ووظائف الرقبة فى المرضى الذين يعانون من نقاط الزناد فى العضلة شبه المنحرفة العلوية.