EFFICIENCY OF HIGH-POWER LASER VERSUS PULSED ELECTROMAGNETIC THERAPY ON HEMIPLEGIC SHOULDER PAIN

Ahmed Mohamed El Sayed[1*], Eman Samir Fayez[2], Ahmed Karmallaah Mohamed[3], Hossam Mohamed Elsayed[4]

1 B.Sc. of Physical Therapy, physical therapist outpatient clinics Faculty of Physical Therapy Cairo University.

2 Professor and Chairperson of the Department of Physical Therapy for Neuromuscular and Neurosurgical Disorder and Its Surgery ,Faculty of Physical Therapy Cairo University.

٣ Lecturer of Neurology and Neurosurgery , Faculty of Medicine Cairo University.

٤ Lecturer of Physical Therapy for Neuromuscular and Neurosurgical Disorder and Its Surgery, Faculty of Physical Therapy Cairo University.

*Corresponding author: Ahmed Mohamed El Sayed. Email address: ahmedkhalelovic@gmail.com.

ABSTRACT

Background:

Among stroke survivors, hemiplegic shoulder pain (HSP) is a prevalent disorder that frequently hinders recovery and quality of life. There is considerable disagreement over the best therapeutic strategy despite the availability of therapy options. Although there is little direct comparative data, high-power laser therapy (HPLT) and pulsed electromagnetic field therapy (PEMF) are new non-invasive techniques with encouraging results.

Purpose:

This study compared the efficacy of high-power laser therapy versus pulsed electromagnetic field therapy in treating patients with chronic hemiplegic shoulder pain in terms of pain reduction, shoulder function improvement, and range of motion enhancement.

Subjects & Methods:

42 stroke patients who had chronic HSP participated in a randomized controlled experiment. Group A got high-power laser therapy, Group B got pulsed electromagnetic field therapy, and Group C got standard exercises. The participants were divided randomly into three groups. Treatment sessions were given three times a week for four weeks. The Shoulder Pain and Disability Index (SPADI), the Visual Analogue Scale (VAS) were used to evaluate shoulder function and pain, and digital goniometric was used to measure the range of motion of shoulder flexion, abduction, and external rotation.

Conclusion:

All three interventions significantly reduced pain and improved function and range of motion. HPLT produced the highest percentage of clinical improvement, followed by PEMF, while conventional exercise showed the least improvement. Although statistical differences between groups were not significant, HPLT showed superior clinical outcomes and limited statistical superiority especially for HPLT over exercises in shoulder flexion active range of motion. These results suggest, HPLT may be a more effective treatment option for chronic HSP.

Keywords: Hemiplegic Shoulder Pain, High-Power Laser Therapy, Pulsed Electromagnetic Field.

INTRODUCTION

Stroke is a medically recognized condition characterized by abrupt, localized neurological impairment brought on by vascular damage (hemorrhage, infarction) to the central nervous system. Globally, stroke ranks as the second leading cause of disability and death (1). Stroke is the second leading cause of death and the third most common neurological disorder in the world. Among the known medical effects of stroke include deep vein thrombosis, infections, and hemiplegic shoulder pain (HSP) (2). Hemiplegic shoulder pain (HSP) is the most prevalent discomfort issue among stroke victims and a major contributor to poststroke disability (3). A common post-stroke issue that hinders a patient's quality of life and ability to recover is hemiplegic shoulder pain (HSP). This condition is invariably linked to stroke and is typified by hemiplegic shoulder pain. HSP's fundamental causes are still unknown, despite a number of possible etiologies being identified. Owing to an unclear knowledge of the pathophysiology of HSP, a number of therapy approaches have been suggested but have not received adequate investigation (4). Shoulder pain that appears may last for several months or even longer than a year, accompanied by stiffness, a reduction in range of motion (ROM), or worsening psychological strain (5). The therapy of HSP is complex, and there is not enough data to recommend any one course of action (6). Numerous treatment options for HSP were identified by randomized controlled trials. These included local interventions like nerve blocks and intramuscular injections of botulinum toxin type A (BTX-A) to reduce spasticity, as well as physiotherapy, massage therapy, strapping, slings, and other supports to lessen glenohumeral subluxation (GHS). Regretfully, there is still uncertainty in the literature regarding the best therapeutic approaches for different types of HSP (7). One of the non-invasive, painless technique that successfully lowers inflammation and accelerates healing is high power laser therapy (HPLT) (8). High-power (> 0.5 W) class IV lasers can scan large areas, provide excellent fluency, and speed up repair processes. Because of its unique characteristics, multi wave locked system (MLS) laser therapy has been characterized by recent studies as a novel therapeutic strategy utilized in rehabilitation. A kind of Class IV laser with a high power is the MLS laser. (9). A new physical therapy technique that makes use of electromagnetic radiation is called pulsed electromagnetic field (PEMF) therapy (10). Pulsed electromagnetic field therapy (PEMF) is one of the possible long-term non-thermal, noninvasive further therapy for recovery following a stroke (11). Comparing between the effect of high-power laser therapy and pulsed electromagnetic field therapy on hemiplegic shoulder pain is the aim of the current study.

MATERIALS AND METHODS

Study design: randomized, single blind, experimental, pre-posttest, controlled trial study.

Participants: This study included 42 stroke patients with chronic HSP, from both genders, their age ranged from 40 to 65 years. The study was carried out at Cairo University's Faculty of Physical Therapy's outpatient clinic. The research project was conducted between December 2024 and February 2025. Prior to taking part in the trial, each participant completed an informed consent form after receiving a thorough description of the protocol. The Cairo University Faculty of Physical Therapy's Ethical Committee gave its approval to the protocol. P.T.REC/012/005477.

Clinical registration number: ClinicalTrials.gov ID: NCT06825832.

The sample size for this study was calculated using the G*power program (G power program version 3.1.9.4 Heinrich-Heine-University, Düsseldorf, Germany). Type I error (α) = 0.05, power (1-β error probability) = 0.80, effect size of 0.5000, The minimum proper sample size is 38 subjects, adding 4 (10%) subjects as a drop out, so the total sample size is 42 subjects.

The study was designed as randomized, single blind, experimental, pre-posttest, controlled trial study. Simple randomization using a randomization table designed by computer software program (Microsoft Excel) was used in this study with an allocation ratio of 1:1:1sequentially numbered opaque sealed envelopes (SNOSE) were used to conceal the allocation sequence so that all participants were not aware of the upcoming procedures.

Inclusion of all participants in this study based on the following criteria: First of all, we tested cognitive function by mini mental state examination with total score of 24 or more. Then Functional level was tested by The Action Research Arm Test (ARAT) with including participants with score between 39:57 indicating good level of function.

Stroke patients with chronic HSP aged from 40 to 65 years HSP patients aged 40 to 65 years. Unilateral hemiplegia for the first time, stroke that lasted longer than six months, a Visual Analogue Scale (VAS) score of four or higher for shoulder pain, and patients who had one, one plus or two degrees of spasticity on the Modified Ashworth scale. Participants were excluded if they have any of the following criteria: Individuals who had undergone shoulder injections within the preceding three months, heart problems or cardiac pacemakers, neck radiculopathy, inflammation-related rheumatic disease, uncontrollable seizures, or severe arrhythmia.

Measurement procedures: All participants underwent the following assessments before and after physical therapy interventions.

Visual analogue scale (VAS): Was used to determine level of pain. The VAS is often displayed as a 10 cm straight line with a point representing the participant's level of discomfort between "zero" pain at all" and "most severe pain possible." The VAS is an

optional technique for characterizing pain intensity because of its validity, straightforwardness, and reliability as well as its ratio scale characteristic(12)

Shoulder Pain and Disability Index (SPADI): Was used to evaluate shoulder impairment level. It can be easily rated; it is a helpful outcome measure that patient can complete in roughly five minutes. When used to evaluate shoulder impairments, SPADI has proven to have exceptional construct validity and reliability.(13).

RANGE OF MOTION BY DIGITAL GONIOMETER: It was used to measure shoulder range of motion in each participant in 3 groups (A, B and C). The most reliable instrument for dynamic measurements is a digital goniometer (DG), which has a minimal measurement error and statistically comparable reliability values to a universal goniometer (UG). The absence of a statistically significant difference between the two devices suggests that the two devices could potentially be used interchangeably for clinical assessments of ROM, however it would still provide greater reliability results than the UG(14). A digital goniometer was used to measure the active range of motion (AROM) of the shoulder's flexion, abduction, and external rotation.

Treatment procedures:

Group (A)

The M6 (ASA srl - Arcugnano, Italy) MLS® Laser Therapy device was utilized in this investigation. It has a robotised multi-diode head (up to 3,3W) that can carry out automated scans therapies and a MLS systems® handpiece (up to 1,1W) that can conduct mechanical one point to another or scans therapies. Two phases were utilized in each therapy: a robotized multi-diode head was used to scan the 93 cm2 anterior and posterior shoulder areas, and a manual handpiece was used to medicate a total of 21,98 cm2 at seven sites, each measuring 3,14 cm2.

Group(B)

Using PMT QS (ASA Srl, Arcugnano), which has Flex pads (36 x 21 x 2 cm (L x P x H) - 1.2 kg),a frequency range of 0.5 to 100 Hz, and an intensity range of 5% to 100% (2.5 to 40 Gauss), the PEMF application was performed. Two solenoid applicators were positioned anteriorly and posteriorly in the patient's shoulders, and the PEMF was applied for 25 minutes at 25 G intensity at a frequency of 50 Hz

Group(C)

The conventional exercise program for hemiplegic shoulder pain (HSP) was stretching exercise therapy, joint stabilization exercise therapy.

The stretching exercise was used as First, while in the supine position, a bearable shoulder external rotation at 45° abduction was carried out, and as long as there was no discomfort, the shoulder was gradually elongated. Then, while seated, stretching was done at a 90° angle to the shoulder and continued gradually as long as there was no discomfort. Lastly, while seated, the patients stretched their elbows and shoulders towards the ground with their hands, gradually

increasing their ability to extend as long as they were pain-free.

With the band in hand, the subjects began the joint stabilization exercise with their elbows flexed 90 degrees and their shoulders abducted 0 to 60 degrees.

Data analysis: Statistical measures were performed through the statistical package for social sciences (SPSS) version 25 for windows. The following statistical procedures were conducted:

Tests of Normality: Shapiro-Wilk test was conducted for checking normality of data and it was found to be normally distributed. One – way analysis of variance (ANOVA t-test): was conducted for comparison of subjects' characteristics between groups. Chi-squared test: was conducted for comparison of 1/ sex distribution and 2/ comparison of distribution of spasticity grades between groups. 3*2 mixed design multivariate analysis of variance (MANOVA): was conducted to investigate the effect of interventions on VAS, SPADI, and digital goniometric measurements. Post-hoc tests (univariate and multivariate): were carried out for subsequent multiple comparisons. Significance level for all statistical tests was set at probability ($P<0.05$).

RESULTS

42 patients with hemiplegic shoulder pain participated in this study. Study Group (A) included 14 participants have been receiving HPLT. Study Group (B) included 15 participants have been receiving PEMF. Control Group (C) included 13 participants have been receiving stretching exercise therapy, joint stabilization exercise therapy.

Each patient in each group received 12 treatment sessions (3 sessions per week) for 4 weeks. The number of male patients was 6 (42.86%), 11(78.57%) and 10 (83.3%), while the number of female patients was 8 (57.14%) ,3(21.43%) and 2 (16.6%) in groups A, B and C respectively. The affected side distribution revealed that the number of right affected side patients was 8 (57.14%), 9 (64.2%) and 10 (83.3%), while the number of left affected side patients was 6 (42.86%), 5(35.7%) and 2(16.6%) in groups A, B and C respectively. The number of right-handed patients was14(100%), 13(92.85%) and 12(100%), while the left-handed patients were 0, 1(7.14%) and 0 in groups A, B and C respectively.

The mean and SD of age were 57.87±4.92, 57.33±4.11 and 57.93±4.63 for groups A, B and C respectively. The mean values of weight were 80.80±15.52, 76.47±12.66 and 79.67±7.43 for groups A, B and C respectively. The mean values of height were 168.67±6.99, 165.13±8.96 and 169.47±6.64for groups A, B and C respectively. The mean values of Duration of illness were 10.07±3.17, 10.33±2.74and 10.93±3.08 for groups A, B and C respectively, statistical analysis by analysis of variance (ANOVA-test) revealed no significant differences in mean age, weight, height and duration of illness. ($P>0.05$).

1-Comparison of visual analogue scale score within each group and among groups.

A-Within groups: in table (1) and shown in the group comparison in figure (1) Group A's pre-test and post-test mean ± SD VAS values were 6.29±1.33 and 3.85±1.46, respectively. When compared to pretreatment, the VAS changed significantly after treatment, according to post hoc tests (p-value =.0001). Additionally, group B's before and post-test mean ± SD VAS values were 5.86±1.03 and 4.35±1.15, respectively. When compared to pretreatment, the VAS changed significantly after treatment, according to post hoc tests (p-value =.0001). Furthermore, group C's mean ± SD VAS scores in the previous and subsequent posttests were 5.66±.98 and 4.66±1.37, respectively. (Post hoc tests) showed that the VAS changed significantly after treatment compared to before. (p-value = .0001).

B-Among groups: There was not significant difference in the mean posttest values between groups A and B, A and C, and B and C, according to multiple pairwise comparison tests (post hoc tests) with P=.981, P=.392, and P=1.000, respectively.

Table (1): the 3*2 mixed multivariate analysis of variance (MANOVA) for visual analogue scale at different measurement periods among various groups.

Visual analogue scale	Group /A (Mean value ± SD)	Group /B (Mean value ± SD)	Group /C (Mean value ± SD)
Pre	6.29± 1.33	5.86± 1.03	5.66± .98
post	3.85 ±1.46	4.35± 1.15	4.66 ±1.37
% Of change	↓ 38.97	↓ 25.77	↓ 17.66
The visual analogue scale scores of the three groups were compared several times in pairs before and after therapy.			
Pretest Vs. Post test	Group/ A	Group /B	Group /C
P value	.0001	.0001	.0001
Three groups' scores on the visual analogue scale were compared using multiple pairwise comparison tests (post hoc testing).			
	Group/ A Vs. Group /B	Group /A Vs. Group/ C	Group/ B Vs. Group /C
Pre	.966	.5165	1.000
Post	.981	.392	1.000

*Significant at alpha level <0.05

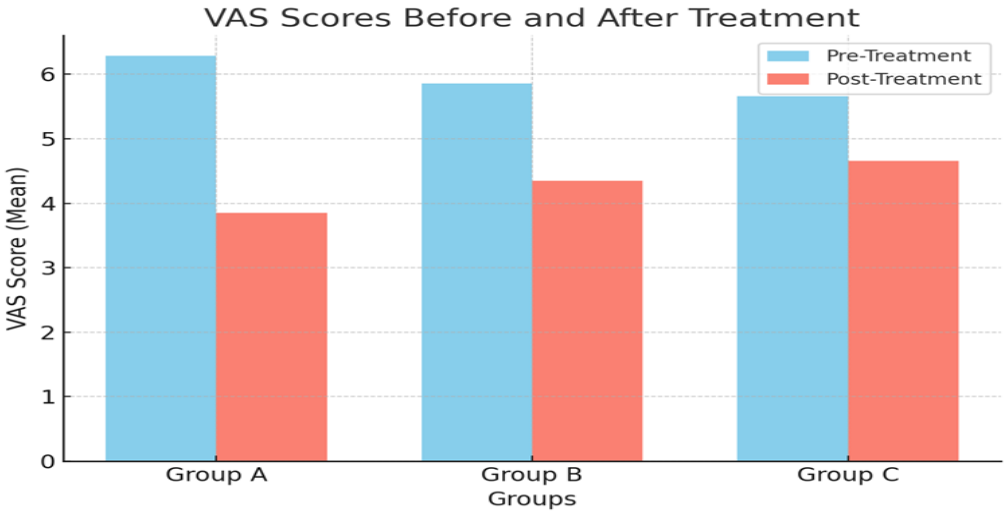

Fig. (1): Mean values of VAS of shoulder pain pre and post treatment among different groups

2-Comparison of shoulder pain and disability index total score within each group and among groups.

A-Within groups: in table (2) and shown inside the group comparison in figure (2) The mean ± standard deviation of SPADI in group A was 90.21±13.17 in the pre-test and 43.71±16.15 in the post-test. When compared to pretreatment, there was a significant change in SPADI at posttreatment (p-value =.0001), according to post hoc tests. Furthermore, group B's mean ± SD values for SPADI were 47.42±27.37 and 78.07±18.29 in the before and post examinations, respectively. Significant differences in SPADI between pretreatment and posttreatment were found using post hoc tests (p-value =.0001). Moreover, group C's mean ± SD SPADI values in the pre and posttests were 59.16±21.01 and 47.0±25.79, respectively. When comparing SPADI at the end of treatment to before, post hoc testing showed a significant change. (p-value = .0001).

B-Among groups: There was not significant difference in the mean posttest values between groups A and B, A and C, and B and C, according to multiple pairwise comparison tests (post hoc tests) with P = 1.000, P = 1.000, and P = 1.000, respectively.

Table (2): the 3*2 mixed multivariate analysis of variance (MANOVA) for shoulder pain and disability index at different measurement periods among various groups.

SPADI	**Group /A (Mean value ± SD)**	**Group /B (Mean value ± SD)**	**Group /C (Mean value ± SD)**
Pre	**90.21±13.17**	**78.07±18.29**	**59.16±21.01**
post	**43.71±16.15**	**47.42±27.37**	**47.0± 25.79**
% Of change	**↓ 51.55**	**↓39.26**	**↓20.55**
The three groups' shoulder pain and disability index scores were compared several times in			

pairs before and after therapy.			
Pretest Vs. Post test	**Group /A**	**Group /B**	**Group/ C**
P value	**.0001**	**.0001**	**.0001**
Three groups' shoulder pain and disability index scores were compared using multiple pairwise comparison tests (post hoc testing).			
	Group/ A Vs. Group /B	**Group/ A Vs. Group/ C**	**Group /B Vs. Group/ C**
Pre	**.228**	**.0001**	**.029**
Post	**1.000**	**1.000**	**1.000**

***Significant at alpha level <0.05**

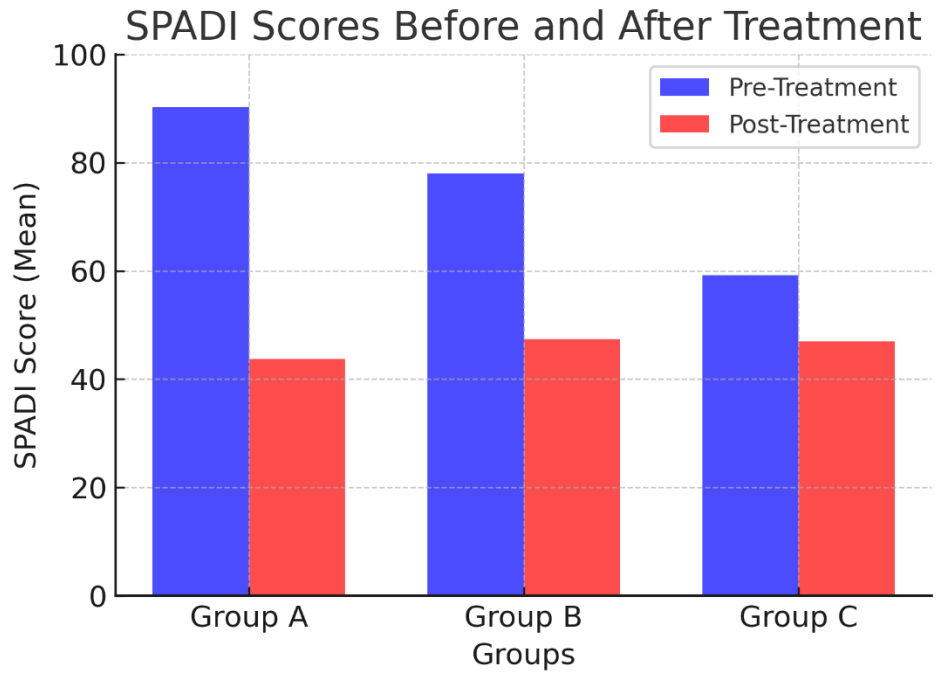

Fig. (2): Mean values of SPADI pre- and post-treatment among different groups

3-Comparison of shoulder active flexion range of motion within each group and among groups.

A-Within groups: in table (3) and shown in the group comparison in figure (3) In group A, the mean ± SD values for shoulder active flexion range of motion were 140.86±26.43 and 98.84±30.28 in the pre and post testing, respectively. Shoulder flexion active Rom changed significantly after treatment compared to before (p-value =.0001), according to post hoc tests. Additionally, group B's mean ± SD values for shoulder active flexion range of motion were 91.21±27.27 and 122.88±12.70, respectively, before and after the test. Shoulder flexion active range of motion was significantly altered after treatment compared to before (p-value =.0001),

according to post hoc tests. Furthermore, group C's mean ± SD values for shoulder flexion active range of motion were 100.52± 26.85 and 113.34± 27.22, respectively, before and after the examinations. Shoulder flexion active range of motion was significantly altered after treatment compared to before (p-value =.0001), according to post hoc tests.

B-Among groups: Group A versus B and group B versus C did not have significantly different posttest mean values, according to multiple pairwise comparison tests (post hoc tests) (P = 0.134 and P =.886). The posttest means values for groups A and C, on the other hand, showed a statistically significant difference (P=0.012) in favor of group A.

Table (3): the 3*2 mixed multivariate analysis of variance (MANOVA) for shoulder active flexion range of motion at different measurement periods among various groups.

Shoulder active flexion ROM	**Group /A (Mean value ± SD)**	**Group /B (Mean value ± SD)**	**Group /C (Mean value ± SD)**
Pre	**98.84±30.28**	**91.21±27.27**	**100.52± 26.85**
Post	**140.86±26.43**	**122.88±12.70**	**113.34± 27.22**
% Of change	**29.83%**	**25.77%**	**11.3%**
Shoulder active flexion range of motion values in the three groups were compared several times in pairs before and after therapy.			
Pretest Vs. Post test	**Group/ A**	**Group/ B**	**Group/ C**
P value	**.0001**	**.0001**	**.0001**
Three groups' shoulder active flexion range of motion was compared using multiple pairwise comparison tests (post hoc testing).			
	Group /A Vs. Group /B	**Group /A Vs. Group/ C**	**Group /B Vs. Group /C**
Pre	**1.000**	**1.000**	**1.000**
Post	**0.134**	**0.012**	**0.886**

***Significant at alpha level <0.05**

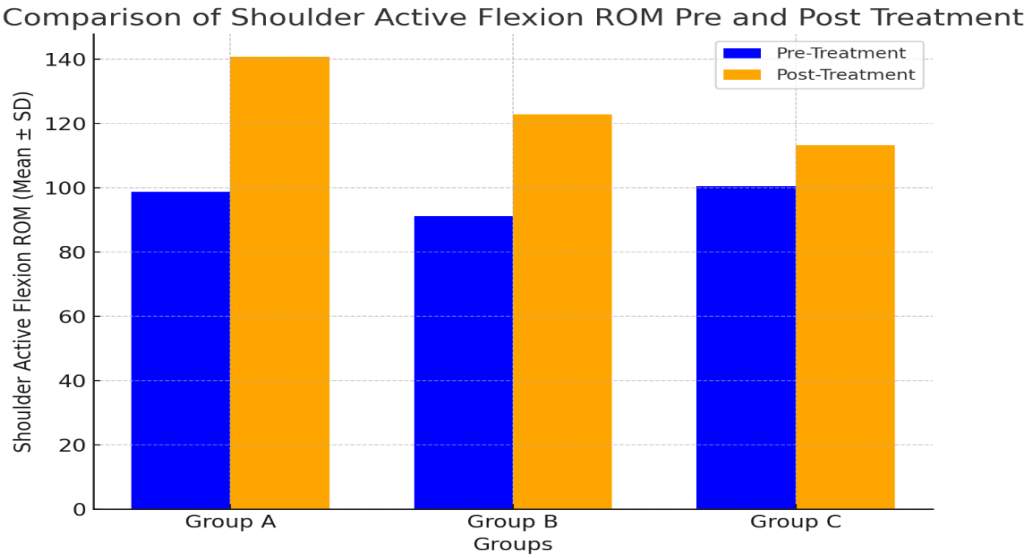

Fig. (3): Mean values of shoulder active flexion ROM pre and post treatment

4- Comparison of shoulder active abduction range of motion within each group and among groups.

A-Within groups: in table (4) and shown in the group comparison in figure (4) In group A, the mean ± SD values of shoulder active abduction range of motion were 73.27±10.15 before and 96.53±20.30 after the test. Shoulder abduction active Rom changed significantly after treatment compared to before (p-value =.0001), according to post hoc tests. Additionally, group B's mean ± SD values for shoulder active abduction range of motion were 65.44±26.85 and 98.00±19.76, respectively, before and after the test. Shoulder abduction active range of motion was significantly altered after treatment compared to before (p-value =.0001), according to post hoc tests. Furthermore, group C's shoulder abduction active range of motion mean ± standard deviation was 73.41±24.44 in the pre-test and 88.79±23.80 in the post-test. Shoulder abduction active range of motion was significantly altered after treatment compared to before (p-value =.0001), according to post hoc tests.

B-Among groups: There was not significant difference in the mean posttest values between groups A and B, A and C, and B and C, according to multiple pairwise comparison tests (post hoc tests) with P = 1.000, P = 1.000, and P = 0.831, respectively.

Table (4): the 3*2 mixed multivariate analysis of variance (MANOVA) for shoulder active abduction range of motion at different measurement periods among various groups.

Shoulder active abduction ROM	Group/ A (Mean value ± SD)	Group /B (Mean value ± SD)	Group /C (Mean value ± SD)
Pre	73.27±10.15	65.44±26.85	73.41±24.44
post	96.53±20.30	98.00±19.76	88.79±23.80
% Of change	28.7%	21.7%	13.4%
Shoulder active abduction range of motion values in the three groups were compared several times in pairs before and after treatment.			
Pretest Vs. Post test	Group /A	Group/ B	Group/ C
P value	.0001	.0001	.0001
Three groups were compared using multiple pairwise comparison tests (post hoc tests) for shoulder active abduction range of motion.			
	Group /A Vs. Group /B	Group /A Vs. Group /C	Group/ B Vs. Group/ C
Pre	1.000	1.000	1.000
Post	1.000	1.000	0.831

***Significant at alpha level <0.05**

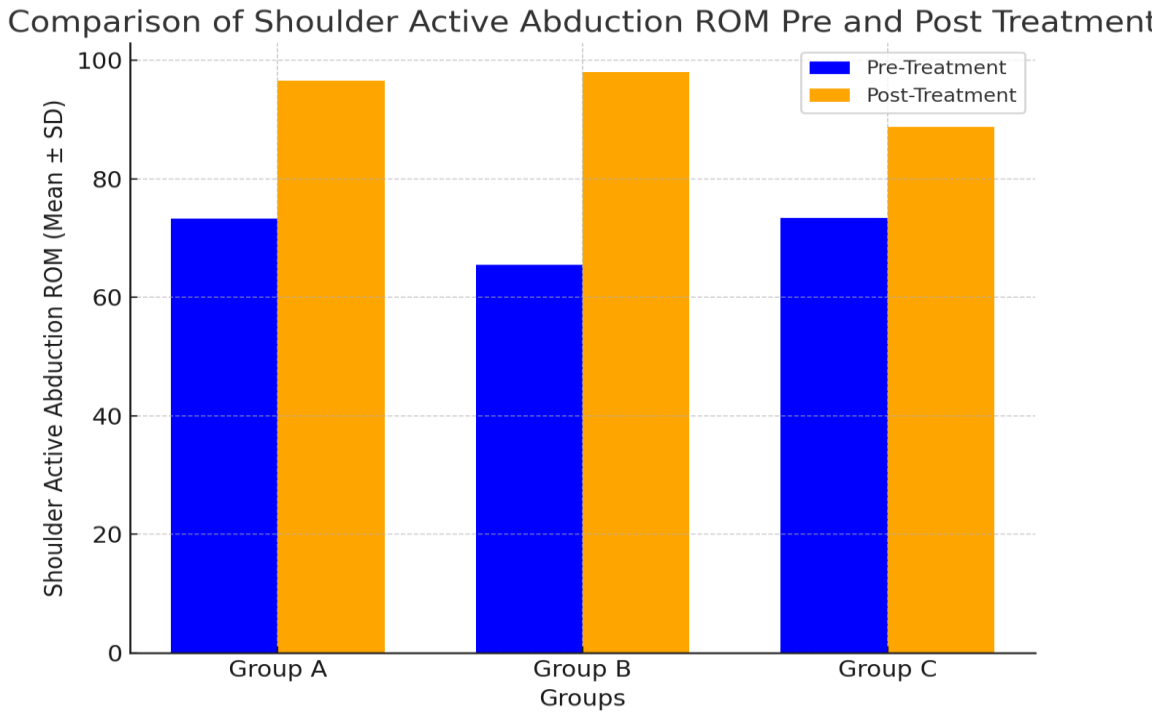

Fig. (4): Mean values of shoulder active abduction ROM pre and post treatment

5- Comparison of shoulder active external rotation range of motion within each group and among groups.

A-Within groups: in table (5) and shown in the group comparison in figure (5) In group A, the mean ± SD values for shoulder active external rotation range of motion were 51.35±8.49 before and 69.74±9.92 after the test. Shoulder active external rotation (ROM) changed significantly after treatment compared to before (p-value =.0001), according to post hoc tests. Additionally, group B's mean ± SD values for shoulder active external rotation range of motion were 43.90±21.22 and 64.84±15.41, respectively, before and after the test. Shoulder active external rotation range of motion was significantly altered after treatment compared to before (p-value =.0001), according to post hoc tests. Furthermore, group C's mean ± SD values for shoulder active external rotation range of motion were 55.81±25.85 and 64.76±22.30, respectively, before and after the test. Shoulder active external rotation range of motion was significantly altered after treatment compared to before (p-value =.0001), according to post hoc tests.

B-Among groups: There was not significant difference in the mean posttest values between groups A and B, A and C, and B and C, according to multiple pairwise comparison tests (post hoc tests) with P = 1.000, P = 1.000, and P = 1.000, respectively.

Table (5): the 3*2 mixed multivariate analysis of variance (MANOVA) for shoulder active external rotation range of motion at different measurement periods among various groups.

Shoulder active external rotation ROM	**Group /A (Mean value ± SD)**	**Group /B (Mean value ± SD)**	**Group /C (Mean value ± SD)**
Pre	**51.35 ±8.49**	**43.90 ±21.22**	**55.81 ±25.85**
post	**69.74 ±9.92**	**64.84 ±15.41**	**64.76 ±22.30**
% Of change	**25.2%**	**18.6%**	**5.1%**
Shoulder active external rotation range of motion values in the three groups were compared several times in pairs before and after treatment.			
Pretest Vs. Post test	**Group /A**	**Group /B**	**Group /C**
P value	**.0001**	**.0001**	**.0001**
Three groups were compared using multiple pairwise comparison tests (post hoc tests) for shoulder active external rotation range of motion.			
	Group/ A Vs. Group /B	**Group /A Vs. Group/ C**	**Group /B Vs. Group /C**
Pre	**0.959**	**1.000**	**0.390**
Post	**1.000**	**1.000**	**1.000**

***Significant at alpha level <0.05**

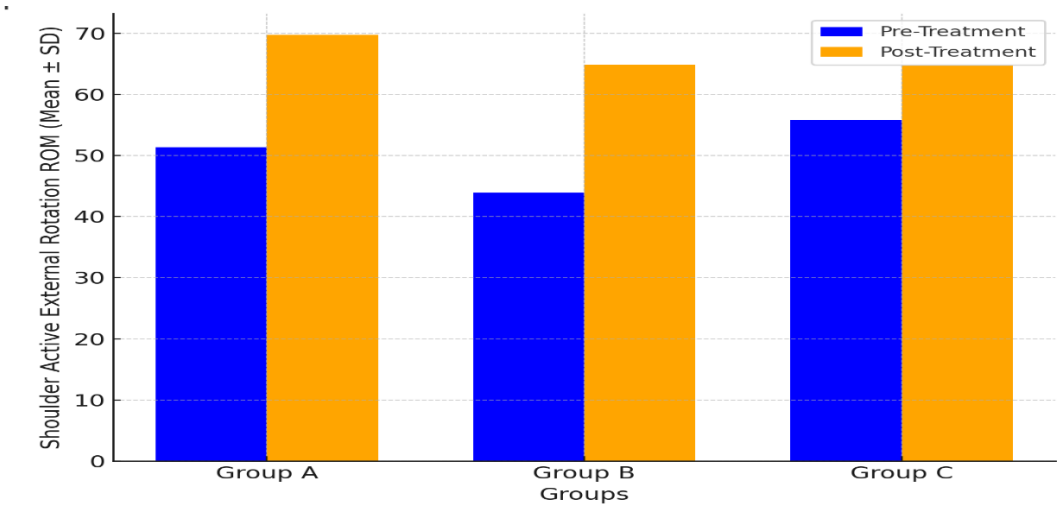

Fig. (5): Mean values of shoulder active external rotation ROM (Mean ± SD) for each group before and after treatment.

DISCUSSION

As far as the researcher is aware, there aren't many studies that compare the advantages of high-power laser therapy to pulsed electromagnetic fields for individuals with chronic hemiplegic shoulder pain. This study showed that HPLT, PEMF, and the traditional exercise program significantly decreased pain, enhanced range of motion, and improved shoulder discomfort and impairment level in individuals with post-stroke shoulder pain. All groups showed a significant improvement in all tested variables following a four-week intervention.

The findings demonstrated a significant decrease in pain levels across all three groups. However, the HPLT group (Group A) showed the greatest percentage of improvement in pain reduction (38.97%), followed by the PEMF group (25.77%) and the control group (17.66%). These findings suggest that HPLT has a more pronounced analgesic effect on HSP compared to PEMF and exercise therapy. Similarly, the SPADI scores showed a significant decrease post-intervention, with Group A exhibiting the highest reduction (51.55%), followed by Group B (39.26%) and Group C (20.55%). This indicates that both HPLT and PEMF contribute significantly to functional recovery and reduction of disability, with HPLT appearing to be the most effective. ROM measurements revealed improvements in shoulder flexion, abduction, and external rotation across all groups. The most notable improvements were observed in Group A, particularly in active flexion, where significant increases were noted. This suggests that HPLT has a superior impact on restoring shoulder mobility in post-stroke patients. Notably, HPLT showed the highest percentage of clinical improvement, followed by PEMF, with exercise therapy showing the least improvement as between group comparison. In addition, there was an advantage of HPLT over conventional exercise program in enhancing shoulder active flexion range of motion as between group comparison. (P=0 .012) (statistically significant improvement). Both cerebral and peripheral pain reduction mechanisms may be responsible for the significant decrease in

pain perception that was shown after HPLT was administered. Pain perception is decreased by laser treatment, which increases the synthesis of endogenous opioids, including β-endorphins, by the nervous system of the body (15). Hyperalgesia is brought on by substance P's stimulation of peripheral nervous system pain-transmitting neurons. However, it was shown that substance P release through peripheral receptors was reduced by laser treatment. (16, 17). By decreasing A δ- and C-fiber transmission, laser therapy may prolong the latency and decrease the conduction rate of sensory neurons, therefore decreasing the spread of signals that cause pain (18). Evidence suggests that using HPLT Laser Therapy as a monotherapy can effectively reduce pain and improve function (19). These results align with prior research showing how well laser therapy works to promote tissue repair, improve circulation, and reduce inflammation (9).When it comes to reducing musculoskeletal pain, high-power laser therapy works better than traditional techniques(8).The study's findings supported a study that found HPLT was effective in improving joint mobility and easing pain in patients with glenohumeral joint peri tendinitis.(20)Compared to controls, HPLT treatment for a variety of musculoskeletal diseases significantly reduced pain and disability scores(21).Our results also showed that the exercises alone had an important impact, which is consistent with an article that found that a program of joint stability and stretching exercises improved shoulder function and altered pathological damage to tendons in post-stroke hemiplegic patients(22). Electromagnetic field therapy enables an effective substitute or additional care option for injuries, diabetic neuropathy, persistent pain, and other medical disorders like wound healing and proliferation of cells. One of its many purported benefits is nitric oxide (NO)-induced vasodilation, resulting in greater microcirculatory flow of blood.(23). The process of action frequently takes place at the cellular level, where it initiates metabolic transfers, enzymatic processes, and cell membrane functions. Nitric oxide activity and the endogenous opioid system may be responsible for the analgesic effect. It has been demonstrated that magnetotherapy increases erythrocyte oxygen release, hence improving tissue oxygenation. Additionally, it promotes vasodilation, changes the concentration of blood ions, and speeds up blood flow. This lowers nociceptor sensitivity, increases nutrients and endorphins, and decreases toxic compounds in the injured area (24). The findings of the PEMF therapy study aligned with a study that found a three-week PEMF therapy is beneficial for enhancing functional level and lowering discomfort in patients suffering from shoulder impingement syndrome (25). However, PEMF therapy has been shown to be a promising noninvasive therapeutic option for improving function and managing pain in individuals with post-stroke shoulder discomfort (11).

LIMITATIONS

Despite the promising results, this study has several limitations: The intervention lasted only four weeks, which may not fully capture the long-term effects of HPLT and PEMF. A larger sample could provide more robust statistical power and generalizability. Since the study was single-blinded, potential

bias in outcome assessment cannot be ruled out. Pain is a subjective measure, and individual pain tolerance may have influenced the outcomes. Participants' response to therapy may have been affected by external factors, such as adherence to treatment sessions and psychological influences.

Recommendations for Future Research

To further validate these findings, future research should be conducted to compare different parameters of HPLT and PEMF to optimize treatment protocols, and further research are needed to explore the combination of HPLT and PEMF with other rehabilitation techniques to maximize therapeutic benefits.

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