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EFFECT OF LOW LEVEL LASER THERAPY ON HEMIPLEGIC SHOULDER PAIN IN POST STROKE SUBJECTS

Physiotherapy and Rehabilitation

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ABSTRACT

Shoulder pain is a common complication of a stroke which can impede participation in rehabilitation and has been associated with poor outcomes. Low Level LASER Therapy (LLLT) is one of the adjunct treatments of choice with exercise therapy for shoulder rehabilitation in Physiotherapy. The objective of this study was to investigate the effect of LLLT on Hemiplegic Shoulder Pain (HSP) in reducing shoulder pain and improving upper limb function in post Stroke subjects. Prospective study design. 68 subjects with mean age of 53 years having a clinical diagnosis of Stroke with HSP were randomly allocated into two groups. In Group-A (n=34) subjects were treated with LLLT and standardized Rehabilitation Programme, where as in Group-B (n=34) subjects were treated with standardized Rehabilitation Programme. Participants were given interventions twice a week for 8 weeks. The outcomes of this intervention were measured by SPADI for pain, disability and FMA-UE for function. Statistical analysis of the data revealed that within group comparison both groups showed significant improvement in all parameters, where as in between groups comparison Group-A showed better improvement compared to the Group-B. After 8 weeks of interventions both Group-A and Group-B showed significant improvement in reducing pain and improving upper limb function. However LLLT along with Standardized Rehabilitation Programme showed more improvement when compared to the Standardised Rehabilitation Programme alone. Thus this study concludes that LLLT is a useful adjunct in HSP along with rehabilitation.

KEYWORDS

Stroke, Hemiplegic Shoulder Pain, Low Level LASER Therapy, Standardised Rehabilitation programme, SPADI.

INTRODUCTION

Hemiplegic Shoulder Pain (HSP) has been reported to be one of the most common complications after Stroke. It hinders rehabilitation, an important contributor to length of hospital stay and has been associated with a reduction in functional usage of arm, higher rates of depression and decreased Quality Of Life [1].

The prevalence of HSP among Stroke survivors is 84% although estimates depending upon evaluating methods. Shoulder pain may develop early in the course of recovery with an estimated prevalence of 17% in the first week and remains elevated throught recovery with 20 to 24% experiencing it from 1 to 16 months after Stroke[2].

The causes of HSP are multi factorial and it can be classified into neurological (spasticity, flaccidity, impaired sensation and neuropathic pain) and mechanical factors (shoulder subluxation, soft tissue injuries such as rotator cuff tears, bicipital tendonitis, muscle imbalance, weakness and altered scapula position)[3].

Kalichman et al proposed a systemization of pathologies underlying HSP are soft tissue lesions, impaired motor control (specifically muscle tone changes) and altered peripheral and central nervous system activity each could present as separate phenomenon, coexist or evolve to trigger each other's development [4]

Risk factors for developing HSP is loss of motor control, impaired arm motor function, higher NIHSS scores, decreased passive range of abduction, left sided hemiplegiaand sensory impairment. Other reported factors include reduced deltoid muscle strength, presence of spasticity, reduced glenohumeral rotation and altered proprioception and scapular position [5].

Sonography and MRI were found to be non-invasive methods for diagnosis soft tissue injuries and rotator cuff pathologies associated with HSP. Ultrasonography allows for both anatomical and functional assessments of hemiplegic patients [6].

The clinical presentation of patients associated with HSP are glenohumeral joint subluxation, Pain may be localized to the shoulder or can radiate to the elbow and hand, localized tenderness over the biceps brachii and supraspinatus tendons frequently present. Although pain may be present at rest, the patient complains of increased pain with attempted passive motion are with a dependent position of arm. The most painful and limited shoulder movement is usually lateral rotation, which is followed in severity by abduction. Pain may intensify at night, interfering with sleep [7].

In medical management Analgesics, Anti inflammatory and Anti spasmodic drugs used to treat HSP[8]. Intra articular injections may be used in resistant cases. If conservative therapy fails, surgery should be considered, the following procedures are surgery on the contractures in muscle tendons, surgical repair of rotator cuff tears, surgical release of spastic internal rotator muscles and stellate ganglion block [9].

Physiotherapy has been used in the treatment of HSP, treatment options include Heat and Cold therapy, Slings are often used to support the affected arm. Strapping/taping the Hemiplegic shoulder used as a method to prevent or reduce the severity of shoulder subluxation and positioning is also considered important by many authors. Other approaches include those of Bobath, Brunstrom and Proprioceptive neuromuscular facilitation. Electrotherapeutic modalities like FES, IFT, TENS, may be effective in reducing pain and improve motor function. However none of these treatments has been significantly superior to other [10].

However recent studies have postulated that Low Level LASER Therapy (LLLT) is effective in reducing pain and shoulder disability in different pathologies. It is believed to modulate neuronal activity in the tissue and have a pain relieving effect [11].

Low Level LASER Therapy also known as Phototherapy, is a non-invasive application of non thermal low powered LASER light of single wavelength of classes 2 a and 3 b. All forms of LASER can be applied on the joint capsule, cartilage, tendon, muscle or nerve supplying area on trigger points, Evidence from previous studies and in vitro studies shows that LLLT is effective in stimulation of fibroblasts collagen synthesis in connective tissue repair, reduces inflammation and modulates pain through reduction of prostaglandin E2 receptor concentration and inhibition of cyclooxygenase pathway [12].

Various literature suggested that Standardised Rehabilitation Programme helpful to resolution of pain and restoration of function in post Stroke shoulder pain [13-15], which includes sensorimotor training have shoulder control exercises to achieve reeducation of movement and correct kinematic alterations, Manual therapy like joint mobilization to improve ROM, stretching exercises to enhance flexibility of muscles, strengthening exercises to increase the strength of specific or group of muscles and patient education about the management of affected shoulder to reduce pain and improve arm function [16].

Many researchers have conducted studies on effect of LLLT in treating the shoulder pain with other musculoskeletal conditions, but less work has been done on the effects of LASER on treating shoulder pain in post Stroke subjects. So the aim of this study was to know the effects of Low Level LASER Therapy on Hemiplegic Shoulder Pain.

MATERIALAND METHODS

Study design: Prospective study

Ethical clearance and informed consent: The study protocol was approved by the Ethical Committee of GSL Medical College & General Hospital, the investigator explained the purpose of the study and given the patient information sheet. The participants were requested to provide their consent to participation in the study . All the participants signed the informed consent and the rights of the included participants have been secured.

Study population: Subjects clinically diagnosed as stroke having Hemiplegic Shoulder Pain.

Study setting: The study was conducted at out Patient Department of Physiotherapy, GSL Medical College and General Hospital, Rajamahendravaram, Andhra Pradesh, India.

Study duration: The study was conducted during the period between July 2019 and June 2020.

Sampling method: Simple Random Sampling

Intervention duration: 8 weeks of training programme which includes Low Level LASER Therapy and Standardized Rehabilitation Programme.

Sample size: A total of 75 subjects were screened in that 68 subjects were recruited who are willing to participate in the study. Recruited participants were explained the purpose and relevance of the study. Those willing to voluntarily be included in the study after obtaining informed consent. Participant's age, weight, height, and body mass index were determined. All the eligible Participants were consecutively randomized to Pilates Exercises Group or Closed Kinematic Chain Exercises Group with 34 in each group.

INCLUSION CRITERIA:

Unilateral ischemic or hemorrhagic stroke lesion confirmed by Computerized Tomography (CT scan) or Magnetic Resonance Imaging (MRI)**,** First incidence of stroke**,** Age group 41-80 years**,** Pain in the affected shoulder Subjects have communication abilities**.**

EXCLUSION CRITERIA:

History of surgery in the affected shoulder before the onset of stroke**,** Hypersensitivity to Light**,** Patients have central post stroke pain**,** Severe depression or other psychiatric patients**,** Systemic neuromuscular diseases.

OUTCOME MEASURES:

Shoulder pain and Disability Index (SPADI) [17]**:** The SPADI is a self administered questionnaire of two dimensions one for pain and other for functional activities. The pain dimensions of five questions regarding the severity of an individual's pain. Functional activities are assessed with eight questions designed to measure the degree of an individual has with various activities of daily living that require upper extremity use. T

Fugl-Meyer Assessment upper extremity (FMA-UE) [18]**:** The Fugl-Meyer assessment scale is an index to assess the sensorimotor impairment in individuals who have had stroke. The FMA motor assessments for the upper extremity (maximum score 66 points) is recommended as core measures to be used in stroke recovery and rehabilitation.

INTERVENTIONS

GROUP A: LOW LEVEL LASER THERAPY (LLLT) + STANDARDISED REHABILITATION PROGRAMME

Subjects were made to sit in a chair in a comfortable position. The treatment was applied around the affected shoulder joint. The system used in this study was the class 3B Laser. The device was a GA-AI-AS laser, wavelength 810 nm, 30 Mw of power, and the duration of treatment point was 3 J and total dose per session was 15 J, Protection from the LASER radiation glasses should be used. The most painful points on the shoulder joint (five points) found on clinical examination. The laser was held perpendicular to body surface in skin contact without pressure [19].

During 8 week of treatment the patients received 16 sessions of LASER two sessions per week. Each treatment session lasted for 10 minutes.

After application of Low Level Level LASER Therapy, Standardised Rehabilitation Programme is given same as in Group-B.

GROUP-B: STANDARDISED REHABILITATION PROGRAMME

Each patient will attend 16 physiotherapy sessions over 8 weeks (two sessions during each week), 30 minutes per each session. The standardized Rehabilitation Programme includes Sensorimotor training, Manual therapy, Stretching, Muscular strengthening and Patient education.

Sensorimotor training: Shoulder control exercises with progressive complexity in terms of movement plane, ROM, speed and resistance would be the basis of this rehabilitation programme. These exercises would be implemented aiming at the reeducation of movement control to correct kinematic alterations that lead to superior migration of the humeral head and to scapular dyskinesis, or changes in the muscle activity of shoulder muscles. The exercises would be performed in the frontal, saggital and scapular planes, being graded according to resistance level (no resistance, passive, active assisted, and active with and without external resistance) and the use of feedback (with or without). When the exercises are going to be executed properly, participants would perform them at home, in three sets of repetitions a day. Once participants are able to elevate the injured arm without compensatory movements, suggesting adequate shoulder control, goal directed reaching tasks will be performed to retrain movements requiring upper limb coordination.

Manual therapy : Joint mobilization techniques would be applied on Sternoclavicular, Acromioclavicular, Glenohumeral and thoracic spine, wherever the ligamentous and capsular restraints are identified during the initial evaluation. Once its necessary is confirmed, each technique would be performed three times for approximately 60s with a between set rest interval of 30s each.

Stretching: Stretches would be performed to enhance the flexibility of the glenohumeral capsules and underlying soft tissues, according to the individual needs. Stretches should be performed as exercises throught treatment, in three repetitions held for 30 s each.

Strengthening : Free weights, extremities weight and resistance elastic tube will be used to strengthen rotator cuff muscles and scapular stabilizers. Exercises will progress according to the following phases phase 1, Humerus in a neutral position to improve shoulder function, phase 2, ascending arm movements and, phase 3, higher level exercises, including strengthening. The number of repetitions would vary from one to three sets 10-30, progressing gradually. Patients should begin using a light resistance elastic band (yellow) in phase 1. Participants were progress to next phase when exercises are performed with medium resistance band (red and green). Patients should perform phase 2 without increasing symptoms for 1 week as requirements to advance to phase 3.

Patient education:

General guidance would be verbally provided to all patients to enhance understanding of shoulder pain, neuroscience, pain management, posture, rehabilitation stages, graded exposure to exercise, shoulder and body mechanics and movements that provoke impingement [20].

STATISTICALANALYSIS

All statistical analysis was done by using SPSS software version 21.0

and Microsoft excel-2007. Descriptive data was presented in the form of Mean ± Standard deviation and Mean difference percentages were calculated and presented. Independent student "t" test was performed to assess the statistical significant difference in mean value between the groups for Pain, Muscle strength and Functional performance. Paired Student "t" test was performed to assess the statistical difference with in the groups for Pain, Muscle strength and Function score from Pre-test and Post- test values. For all statistical analysis, $P < 0.05$ was considered as statistically significant.

RESULTS

Table1: Comparison of Mean score of SPADI in between the Groups

Groups	Pre VAS		Post VAS		P-value	Inference
	Mean	SD	Mean	SD		
Group-A	69.81	12.93	33.40	8.6	0.0001*	Highly Significant
Group-B	65	10.16	57.37	7.24	0.0003*	Highly Significant

Table2: Comparison of Mean score of FMA-UE in between the Groups

Groups	Pre VAS		Post VAS		P-value	Inference
	Mean	SD	Mean	SD		
Group-A	30.71	5.03	54.21	7.08	0.0001*	Highly Significant
Group-B	29.62	3.86	38	4.47	0.0003*	Highly Significant

DISCUSSION

The aim of this study was to investigate the effect of Low Level LASER Therapy (LLLT) on reducing shoulder pain and improving upper limb function in post stroke subjects. Recently LLLT has been used increasingly in rheumatologic, neurologic and musculoskeletal disorders. Several studies have reported positive effects of LASER use on shoulder Range Of Motion, decreasing pain and disability in various shoulder pathologies, but there were limited studies on exploring the effect of LLLT on Hemiplegic Shoulder Pain and improving upper limb function in post stroke subjects.

Subjects were assessed for shoulder pain and upper limb function at baseline and at the end of intervention using the SPADI for shoulder pain and Disability and FMA-UE for motor function. There were two drop outs in Group-A (LLLT + Standardised Rehabilitation Programme) one due to spontaneous recovery and one due to recurrent stroke and in Group-B (Standardized Rehabilitation Programme) there were five drop outs three due to recurrent stroke and two due to spontaneous recovery.

In Group-A there is statistically more significant improvement in SPADI ($P<0.0001$) and improve FMA-UE ($P<0.0001$). According to Gross AR et al, Low Level LASER Therapy produces a better pain relief and accelerates healing. The mechanisms by which LASER produce analgesic effects are taught to be release of endogenous opioids, elevating pain thresholds and modifying the release of noxious mediators like bradykinin and histamine, pain modulation through changes in nerve conduction velocity. In the healing process LASER acts through anti-inflammatory effects in reducing prostaglandin levels which helps in reducing edema, swelling, and inflammation around the structures and repair the damaged tissue [21]. Azra Karabegovic et al in his study stated that LASER acts as an analgesic modality and decreases oedema in turn causing significant reduction of pain in the shoulder and hand of hemiplegic arm as well as improve ROM in shoulder when compared to the application of electrotherapy modalities. Disabilities of the Arm, shoulder and Hand (DASH) and Level of independence was significantly improved in experimental group. He concluded that there is decrease in disability and improve ROM in the painful shoulder[22].

In a study Fahmida Jan et al LLLT was compared with IFT in post stroke shoulder pain. The study findings showed that there was significant difference ($P<0.05$) between VAS, Pen Shoulder Score, SPADI in laser group. They concluded that LASER therapy was more effective than the Interferential current in deceasing pain and increasing satisfaction level in post stroke shoulder pain [23]. Our findings in this study were consistent with the above studies.

Findings has also shown in Group-B there is statistical significant reduction in SPADI ($P<0.0003$) and FMA-UE ($P<0.0003$) scores. Standardized Rehabilitation Programme in the management of shoulder pain was effective in previous studies by Snels et.al, Gloag et.al, vlope BT et.al [13-15]. In this programme sensorimotor training restore the joint stability, neuromuscular control and help in achieving functional joint mobility [24]. Mobilization has been proven to be effective treatment technique for improving shoulder mobility and decreasing in pain through stimulation of type 2 mechanoreceptors and by inhibition of type 4 nociceptors [25]. Many studies stated that Stretching had positively affect on pain by decreasing muscle passive resistance, improving connective tissue extensibility and influencing neural activation patterns [26]. Strengthening programme improves strength and upper limb function in HSP, Resistance training programme through various grades increases recruitment in the number of motor firing units as well as an increased rate and synchronization of firing [27]. Poor handling and positioning of the affected upper limb in stroke patients contributes towards shoulder pain. Patient education about the handling and careful positioning of limb thought to prevent HSP in early phases [28-29].

Sharon wang et al in his study on comparison of customized exercises versus standardized exercises in rehabilitation of shoulder disorders stated that shoulder rehabilitation emphasizes exercises to strengthen rotator cuff and scapular stabilizers is an effort to restore proper shoulder biomechanics. Patient had significant improvements in shoulder strength, pain intensity and function significant improvements after 8 weeks. The customized exercises did not add additional benefit than standardized exercises [30].

The study findings indicting that after 8 weeks of interventions LLLT along with Standardized Rehabilitation Programme was more effective than Standardised Rehabilitation Programme alone in reducing shoulder pain and improving upper limb function. Thus this study concluded that Low Level LASER Therapy is a useful adjunct in Hemiplegic Shoulder Pain along with Rehabilitation.

CONCLUSION

The present study concludes that after eight weeks of Interventions both groups were shown statistically significant improvement in post test values. However Low Level LASER Therapy along with Standardized Rehabilitation Programme is more effective when compared to the Standardised Rehabilitation Programme alone. Thus this study concludes that Low Level LASER Therapy is a useful adjunct in Hemiplegic Shoulder Pain along with rehabilitation.

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