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# The effectiveness of routine physiotherapy with and without neuromobilization in patients with shoulder impingement syndrome

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## Abstract

**Objective:** The purpose of this study was to evaluate the neuromobilization (NM) on the pain and active forward flexion of participants with shoulder impingement syndrome (SIS).

**Methods:** A randomized control trial was conducted in Social Security Hospital, Gujranwala. The duration of study was September 2016 to March 2018. A sample of 80 participants was selected and allocated in to two groups using computer generator method in simple random sampling technique.

Consent was taken from patients with SIS for this trial. At the first session, participants were randomly assigned to either control group (40) or experimental group (40). After the baseline assessment routine physiotherapy was executed for both groups, while NM was provided to experimental group. Pain and active forward flexion (AFF) were evaluated on baseline, 5$^{th}$ week and 11$^{th}$ week. The data were entered and analyzed using SPSS (version 22.0).

**Results:** The experimental group compared with control group at 11$^{th}$ week had lower mean pain score 2.15(1.66-2.64) vs 4.90(4.41-5.40); between group

difference, 1.82; 95% confidence interval (CI), -2.38 to -1.25; P < 0.001 and Partial $\eta^2$=0.33, similarly with AFF 147.13(142.46-151.79) vs 123.45(118.79-128.11); between group difference ,19.35; 95% CI,(12.86-25.83); P < 0.001 and Partial $\eta^2$=0.30. Over all pain and AFF were improved among experimental group relative to control group at 11$^{th}$ week.

**Conclusion:** In an experimental setting, the delivery of neuromobilization led to significantly different outcomes in participants than in control group.

**Clinical Trial Number:** IRCT20190121042445N1.

**Keywords:** shoulder impingement syndrome, pain, rotator cuff.

## Introduction

Shoulder pain is a common problem among patients seeking medical attention. Correct diagnosis and therapy might be difficult due to the variety of disorders. Differential diagnosis considerations of shoulder pain include cervical radioculopathy, rotator cuff tears, bicipital tenosynovitis and shoulder impingement syndrome (SIS) (1).

SIS consists of rotator cuff tendonitis and bursitis of shoulder (2). The SIS involves inflammation of supraspinatus tendon between anteroinferior junction of acromion and greater tuberosity of humerus. SIS is categorized by severe pain that increases during overhead activities and at night sleeping on affected side(3).

Shoulder pain especially SIS creates a substantial socioeconomic burden(4) affecting quality of life(5) impacting on physical capacity through abnormal movement, aberrant muscle patterning, immobility (6)and causing cognitive and emotional changes(7). Several treatment approaches have been described across the literature to manage this painful condition(8). One of the approaches included neural tissue management, which is a physical therapy intervention advocated for nerve-related musculoskeletal pain(9). Neural tissue management are used on the basis of dynamic imbalance between the relative movement of

neural tissues and surrounding mechanical interfaces, more commonly known as adverse neurodynamics, found during physical examination (9).

In a review, three theories projected for the local etiological origin of tendon pain:1- mechanical, 2-vascular and 3- neural(10).

Neuromobilization(NM) is a specific stretch training to either muscular or non-muscular structures which induces collagen and cellular mechanical changes in the target tissue (11). Mechanical and vascular theories are regularly used for the treatment of tendon pain. The neural component is over looked due to poor outcomes among patients with tendinopathy. Monica A Matocha et al. highlighted neural involvement in patients with tendon pain and discussed the role of NM for tendon pain(12). The utilization of NM might be important for the treatment in patients who suffer with tendonopathies, which has neural component (10). NM was neglected in previous studies. This study was carried out to discover evidence based conservative and cost effective treatment for SIS on pain and AFF. Furthermore, the aim of this study was to create awareness among health professionals to have faith in physiotherapy (non operative treatment) and to introduce new non invasive technique in Pakistan.

## Patients and Methods

A single blinded (by assessor) randomized controlled trial was performed with parallel design where participants were allocated two groups (one experimental group and other control group) using equal allocation (1:1). After the approval form by Institutional Review Board of University of Lahore, consent was taken from participants.

Sample size calculation was derived from the previous research (13). Sample size was calculated using the method of Kelsey and Fleiss (14) (15).

Where SD= Standard deviation=14.08, $Z_{1-\alpha/2}$ is type 1 error=1.96, $Z_{\beta}$=0.84 and $d=\mu_2-\mu_1$=10.70.

Based on this a total sample size of around 80(experimental = 40, controls = 40) was calculated. Total 120 patients who were attending the physiotherapy department at Social Security Hospital Gujranwala were screened for eligibility process from September 2016 to March 2018 which is presented in flow sheet diagram-1.

Out of total, 80 patients fulfilled the eligibility criteria. Patients complaining of shoulder pain that come positive on special tests (Neer, Hawkins-Kennedy and Empty Can tests) (16) supra scapular neurodynamic test(17), painful arc test, cross body adduction test (18) and age between 20-50 years was included in the study. Patients with co-morbidities such as cervical radiculopathy, acromioclavicular joint pathology, history of shoulder dislocation, subluxation, or fracture(19), history of cervical, shoulder, or upper back surgery were excluded from study. A sample of 80 participants was selected and allocated into two groups using computer generator method in simple random sampling technique. Out of 80, 40 patients were enrolled in experimental group and other 40 were selected in control group randomly. After the baseline assessment, which was carried out by a physiotherapist who was having more than seven years of clinical experience, routine physiotherapy was executed for both groups, while NM was provided to experimental group only. Pain and shoulder AFF were evaluated on baseline, $5^{th}$ week and $11^{th}$ week. Both treatments had been performed three times per week for total fifteen sessions over 05 weeks. The missing values of dropped out patients were included in the current analysis by using last observation carried forward (LOCF(20). Demographic details, visual analogue scale (VAS) for pain and shoulder AFF by Goniometry were recorded.

All information and collected data was kept confidential. Participants remained aware while assessor was blinded throughout the study. They were being informed that there had no disadvantages or risks during the procedure of the

study. They were also informed that they were free to withdraw at any time during the process of the study.

VAS was used to assess the intensity of pain. A continuous scale was used to ask the patients to think about their shoulder pain during the activity and to rate it by marking on a 10-mm line; it was anchored with “no pain” and the “worst pain you have ever felt”. This is a well-accepted method of evaluating the pain intensity levels. Studies have shown that the VAS has high reliable and valid method to assess the pain.(21)

Shoulder AFF was measured by universal goniometer according to the described procedure. Universal goniometer is a commonly used tool for measuring joint range of motion by the clinicians in whole world. Shoulder AFF was assessed while the patient sitting straight with his/her back tied to the chair. The patients were requested to move their arm as far as possible in a standard way: flexion. Patient has repeated each movement three times. An average score of these three movements was used for data analysis. Before taking the measurements, each patient was directed for performing shoulder flexion as far as possible to minimize creep and to become familiar with the testing procedure. To complete these measurements, each patient was provided with consistent and same verbal instructions. Studies have reported excellent intra-rater reliability of the universal goniometer for measuring shoulder AFF(22).

The routine Physiotherapy consisted of pulsed Short Wave Diathermy (SWD) with frequency 27.12 MHZ, Ultrasonic Therapy(US) with frequency 1.0 MHZ and intensity 1.45w/cm$^2$ (23) and Transcutaneous Electrical Nerve Stimulator (TENS) 2-200 HZ with output current < 20Ma width 200µ seconds along with continuous mode. Exercises comprised were shoulder strengthening and stretching (24) (See Table-1).

NM sequencing is the performance of set of particular component body movements so as to produce specific mechanical events in the nervous system.

NM of the nervous system was described by Maitland in 1955 Elvey in 1986 and referred by Butler in 1991 is an adjunct to assessment and treatment. NM is a gentle movement technique used by a physiotherapist to move the nerves is based on neurodynamic(9) (25).Neural gliding or sliders and tensile loading techniques were used in present study.

Gliding techniques, or 'sliders', are NM maneuvers that attempt to produce a sliding movement between neural structures and adjacent nonneural tissues, and they are executed in a non-provocative fashion. The purpose of NM tensile loading techniques is to restore the physical capabilities of neural tissues to tolerate movements that lengthen the corresponding nerve bed.

The patient performed neural sliders and gradually progressed to neural tensioners. Neural sliders consisted of cervical lateral flexion movement, toward the involved side, simultaneously with elbow flexion and extension movements. While moving the head in to cervical lateral flexion the elbow was extended. When the elbow began to flex, the cervical spine was returned to neutral position. Neural tensioners are performed to create tension in the nerve to get the desired results. The tension position is not held for a length of time, but is released by extending the elbow and returning the cervical spine to neutral, once the patient had pushed slight pain or discomfort at any point (17). NM technique was performed for 5 sec with 10 repetitions to control the pain.

Patients were assessed at baseline, after post treatment ($5^{th}$ week) and after 1st follow up ($11^{th}$ week) on VAS (0 no pain 10 maximum pain) (21). Pain was considered as primary outcome.

Shoulder AFF was assessed at baseline, on post treatment ($5^{th}$ week) and at 1st follow up ($11^{th}$ week) using goniometry (26). Shoulder AFF was considered as secondary outcome.

The data were analyzed by using SPSS 22.0 programme. Qualitative data was presented in frequencies and percentages while mean and standard deviation (S.D) was calculated for Quantitative data.

Data were analyzed at 95% confidence level and p value ≤ 0.05 was considered as significant.

For primary and secondary outcome repeated measures ANOVA was applied to calculate the average pain scores at different times (baseline, 5th week, 11th week) between groups. Similarly for secondary outcome repeated measures ANOVA was applied to compare the average shoulder AFF score at different time points (baseline, 5th week, 11th week).

## Results

Baseline characteristics are reported in table 2. Demographic profile showed that most of the patients suffering from SIS are female, who are 32 in experimental group and 26 in control group. It is also observed that mostly patients falling in type -1 Neer classification.

The results of primary and secondary outcome are reported in table 3.

The experimental group compared with control group at 11th week had lower mean pain score 2.15±1.54(1.66-2.64) vs 4.90±1.58 (4.41-5.40); between group difference, 1.82; 95% confidence interval (CI), -2.38 to -1.25; $P < 0.001$ and Partial $\eta^2=0.33$.

Similarly experimental group compared with control group at 11th week had higher shoulder AFF 147.13±15.25 (142.46-151.79) vs 123.45±14.35 (118.79-128.11); between group difference, 19.35; 95%CI, (12.86-25.83); $P < 0.001$ and Partial $\eta^2=0.30$. Over all pain and shoulder AFF were improved among experimental group relative to control group at 11th week.

## Discussion

The results of the present study demonstrated statistically significant differences in pain and AFF scores between the two groups of patients with SIS at 5th week and at 1st follow up (11th week). However, there was greater improvement in the experimental group compared to the control group. The findings of this

study strengthen the fact that NM has beneficial effects for the reduction of pain and improvement in shoulder AFF. The findings of the study of Ganesh et al. proved NM was effective in reducing pain and improving shoulder AFF (27). Previous studies assessing the NM techniques did not clearly indicate this type of management for SIS, however our results showed that there is significant difference in NM group as compare to routine physiotherapy group.

The results of current study found to be similar to those of Matocha et al who found that pain intensity decreased as decreased in our study on 5$^{th}$ and 11$^{th}$ week (28).

Neural mobilization is no more effective (or better) than other forms of intervention to reduce nerve-related chronic musculoskeletal pain. But on the flip side of the coin, this might also suggest that neural mobilization is not worse than other forms of intervention, for example, ultrasound (29) mechanical traction (30) or joint mobilization (31) in the treatment of nerve-related chronic musculoskeletal pain. In fact, it is noteworthy that the 95% CI result indicated that the direction of summary estimate tends to favour neural tissue mobilization. The lack of significance in disability between NM and other forms of intervention might likely be due to the small number of studies pooled; such that the meta-analysis was under-powered to detect any true effect(32).The reason for tissue repair is being observed in the study of Lederman E et al. In his study it is observed that normal tissue regeneration and remodeling depend on mechanical stimulation of nerve during the repair. This might help to enhance the tissue's overall mechanical and physical behaviors, such as tensile strength and flexibility. Soft tissue NM techniques have stimulated the more superficial level of proprioception, whereas the manual techniques of joint movement, stretching or deep kneading would stimulate the deep level of proprioception (33).

Different neuromuscular responses (like hypoalgesia, motorneuron pool activity, afferent discharge and changes in the activity of muscle) indirectly

associated with manual therapy indicates the spinal cord mediated effect of the manual therapy. Hypoalgesia following NM might also occur due to its effect mediated through spinal cord (34).

Recognizing the close relationship between physical capacities and life style, it is likely that implementation of effective NM treatment as standard part for SIS would decrease shoulder pain and improve AFF. This study showed that NM is feasible part of the treatment, as it also has a large effect size and is time efficient.

SIS patients suffer from many challenges, it is important to recognize that their shoulder pain and AFF constitutes an important part of overall health and daily tasks. Since SIS are known to be important key factor for daily life activities in term of pain and AFF. Importantly, this study, as well as NM regimes is feasible and safe to carry out within this patient group. The participants included are recruited from a single hospital. They may have specific demographic and clinical characteristics which might limit the generalization of the results. Lack of placebo group, multiple neurophysiological effects related to NM are also associated to non specific effects like placebo (34).

It is recommended to clinicians on the basis of published data summaries of research focusing on treatment of shoulder pain, it seemed that exercise therapy (home exercises with regular therapist follow up) is not enough to treat chronic shoulder pain and it is necessary to combine with other modalities to obtain the best results (35).To effectively manage a patient with SIS, the physical interventions need to address the multiple aspects of the presenting clinical problem.

**Conclusion**

In an experimental setting, the delivery of neuromobilization led to significantly different outcomes in participants than in control group.

**Disclaimer:** The abstract of this study did not present or published in any conference. It is a part of my PhD thesis.

**Conflict of Interest:** Professor Dr. Amir Gilani is the Dean of Faculty of Allied Health Sciences and Chairmen Ethical Review Committee. He is also co-author of my article.

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**Abbreviations**

1) SIS (Shoulder Impingement Syndrome)
2) VAS (Visual Analogue Scale)
3) ROM (Range Of Motion)
4) SWD (Short Wave Diathermy)
5) US (Ultra Sonic)
6) TENS ( Transcutaneous Electrical Nerve Stimulation)
7) NM (Neuromobilization)
8) ANOVA (Analysis of Variance)
9) A.C Joint (Acromio Clavicular Joint)
10) S.C Joint (Sterno Clavicular Joint)
11) S.D (Standard Deviation)
12) C.I(Confidence Interval)
13) AFF(Active Forward Flexion)

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**Table 1: List of exercises performed under experimental and routine physiotherapy group.**

| Experimental group (stretching and strengthing exercises + Neuromobilization) | Routine physiotherapy group (Stretching and strengthing exercises) |
|---|---|
| 1) STRETCHING EXERCISES<br>a) Shoulder external rotation stretch<br>b) Cross body posterior stretch<br>c) Stretch for anterior aspect of shoulder<br>d) Shoulder flexion stretch<br>2) STRENGTHING EXERCISES<br>a) Chair press<br>b) Restricted scapular retraction<br>c) Restricted scapular protraction<br>d) Shoulder abduction ''Scaption'' (0º-90º) with theraband<br>e) Shoulder scapular extension with theraband<br>3) NEUROMOBILIZATION EXERCISES<br>a) Neural slider technique<br>b) Neural tensioner technique | 1) STRETCHING EXERCISES<br>a) Shoulder external rotation stretch<br>b) Cross body posterior stretch<br>c) Stretch for anterior aspect of shoulder<br>d) Shoulder flexion stretch<br>2) STRENGTHING EXERCISES<br>a) Chair press<br>b) Restricted scapular retraction<br>c) Restricted scapular protraction<br>d) Shoulder abduction ''Scaption'' (0º-90º) with theraband<br>e) Shoulder scapular extension with theraband |

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**Table 2: Demographic detail**

| VARIABLE | | EXPERIMENTAL GROUP (N=40) | CONTROL GROUP (N=40) |
|---|---|---|---|
| Age, (Mean±S.D) | Years | 36.38±8.93 | 34.40±9.32 |
| Gender, N(%) | Male | 8(20%) | 14(32.4) |
| | Female | 32(80%) | 26(65%) |
| Neer Test, N(%) | Type 1: Pain at 90º | 34(85.0%) | 38(95.0%) |
| | Type 2: Pain at 60º-70º | 6(15.0%) | 2(5.0%) |

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**Table 3: Comparison of experimental and control groups**

| Outcome Measures | | Mean±S.D (95% CI) Within group Comparison | | Mean Difference (95% CI) of Between group (Experimental vs Control) | Partial $\eta^2$ | P-value |
|---|---|---|---|---|---|---|
| | | Experimental group | Control group | | | |
| **Pain Assessment** | Baseline | 6.96±1.27 (6.60-7.30) | 6.78±1.05 (6.42-7.13) | 1.82 (-2.38 to-1.25) | 0.34 | <0.001 |
| | 5th week | 2.15±1.86 (1.60-2.71) | 5.03±1.80 (4.46-5.59) | | | |
| | 11th week | 2.15±1.54 (1.66-2.64) | 4.90±1.58 (4.41-5.40) | | | |
| **Shoulder Active Forward Flexion** | Baseline | 124±18.74 (118.53-129.47) | 111.5±15.89 (106.03-116.97) | 19.35 (12.86-25.83) | 0.31 | <0.001 |
| | 5th week | 142.43±13.58 (137.87-146.98) | 120.55±15.31 (116-125.11) | | | |
| | 11th week | 147.13±15.25 (142.46-151.79) | 123.45±14.35 (118.79-128.11) | | | |

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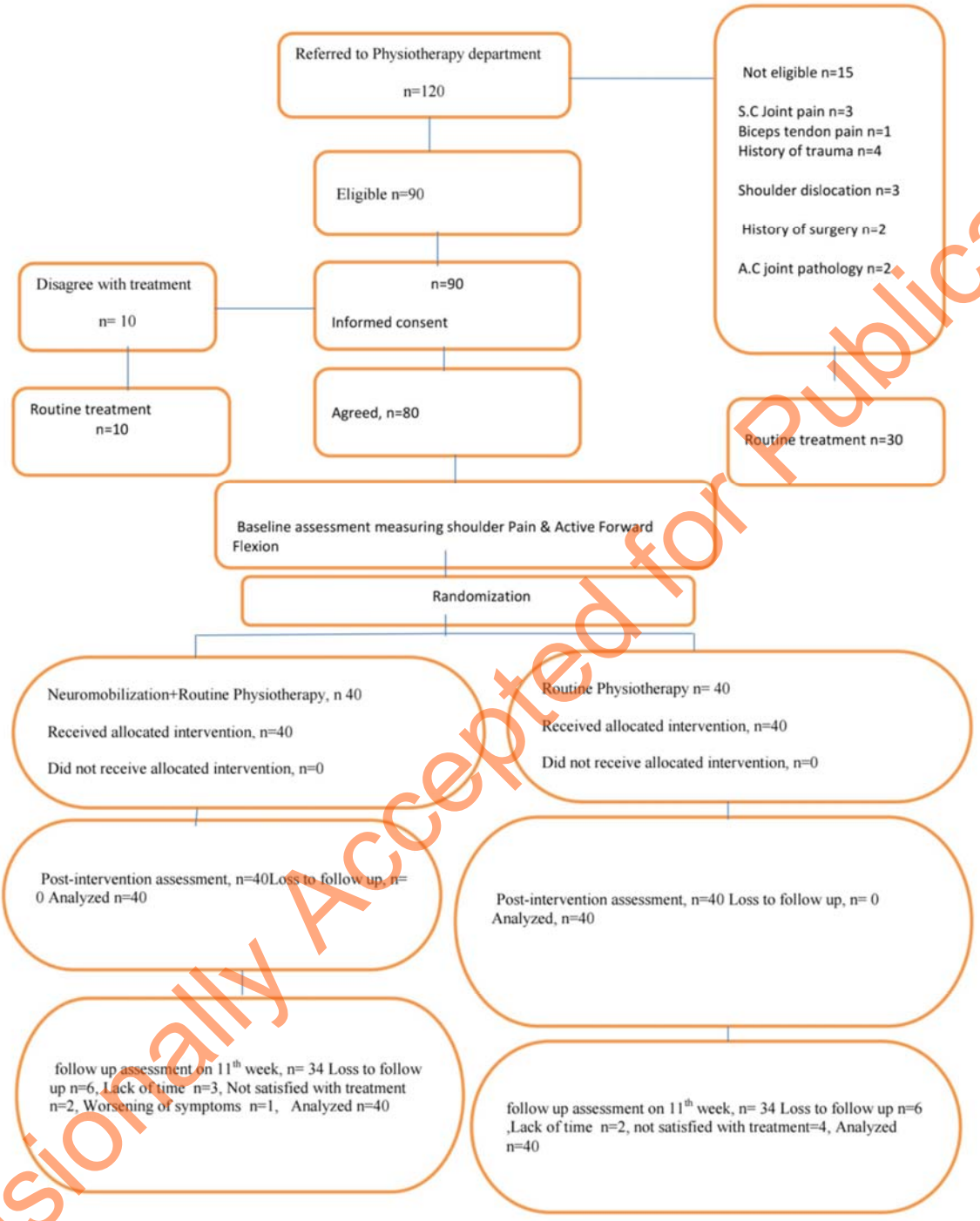


**Figure-1: Flow sheet diagram**