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Original Research Article

A Study to Compare the Effectiveness of Muscle Energy Technique, And Proprioceptive Neuromuscular Facilitation on Pain, Scapular Symmetry, And Functional Disability in Scapular Dyskinesis Among Computer Office Workers

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ABSTRACT

Background: Scapular dyskinesis refers to an alteration in normal scapular motion and positioning, resulting from impaired neuromuscular control. It is commonly associated with shoulder disorders, with a reported prevalence ranging from 67% to 100% in affected individuals.
Objectives: To compare the effectiveness of muscle energy technique (MET) combined with conventional physical therapy, proprioceptive neuromuscular facilitation (PNF) combined with conventional therapy, and conventional physical therapy alone on pain, scapular symmetry, muscle strength, and functional disability in individuals with scapular dyskinesis.
Design: Experimental study.
Methodology: 60 participants selected through convenience sampling and randomly allocated into three groups: Group A (n=20) received conventional therapy, Group B (n=20) received MET with conventional therapy, and Group C (n=20) received PNF with conventional therapy. The intervention was carried out for four weeks. Outcome measures included the Numerical Pain Rating Scale (NPRS), Lateral Scapular Slide Test (LSST), and Shoulder Pain and Disability Index (SPADI), assessed before and after treatment.
Results: All groups demonstrated significant improvement in pain, scapular symmetry, and functional disability ($p<0.05$). However, Group C showed superior outcomes compared to Groups A and B.
Conclusion: The results indicate that the treatments in all the groups were effective; however PNF combined with conventional therapy is more beneficial in managing scapular dyskinesis.

Keywords: Scapular Dyskinesis, MET, PNF, NPRS, LSST, SPADI.

INTRODUCTION

A change in scapular motion is referred to as scapular dyskinesis (SD), which is defined as "Dys" (alteration of) "kinesis (motion)[1]. This condition is observed in a significant proportion of shoulder injuries, ranging from 68% to 100%.[2].
Scapular dyskinesis (SD) can lead to mechanical dysfunction between the neck

and scapula, as both regions share common muscle attachments, may contribute to recurrent neck pain. SD is also strongly associated with various shoulder conditions, including shoulder impingement syndrome, rotator cuff tendinopathy, and multidirectional instability.[3]The scapula plays many roles in normal shoulder function like control of static position and control of the motions[4]. According to Khodaverdizadeh M, Mohammad Rahimi N, Esfahani M., the scapula serves as a stable base for optimal muscle activation, supports joint kinematics, and acts as a link in the kinetic chain, allowing effective transfer of forces during upper limb movements.[5] Scapular instability is considered a key factor in the development and persistence of shoulder pain and functional disability.

About 41.7% of computer office workers experience scapular dyskinesis, and the rate is especially high among office workers in general. People who spend a lot of time working at computers often develop neck and shoulder problems as a result.[6]

Scapular dyskinesis can occur for many reasons such as muscle injuries due to direct trauma, micro-traumas that lead to imbalances, fatigue, and pain[7]. Changes in bone structure due to poor posture or include thoracic kyphosis or clavicle fracture non-union or shortened mal-union, joint causes including high-grade acromio-clavicular (AC) joint instability, acromio-clavicular joint arthrosis and instability, and glenohumeral (GH) joint internal derangement and neurological causes including cervical radiculopathy, long thoracic or spinal accessory nerve palsy[8].

Scapular alignment and function are very important because the link between the scapula and humerus must work efficiently to deliver force[2]. The scapular muscle group which are mainly responsible for scapular movement and dynamic stabilization are Trapezius, Serratus anterior (SA), Pectoralis minor (PM), Pectoralis major, Levator scapulae (LS), Rhomboid muscle (RM), and Teres major (TM). Proper coordination between scapular muscles is essential to maintain both stability and mobility of the scapula at rest and during shoulder movements. When this coordination is disturbed, it leads to abnormal muscle activation patterns, which in turn alter scapular kinematics.

Pectoralis minor adaptive shortening may alter scapular resting position and scapular kinematics. The muscle attaches from the 3rd–5th ribs to the coracoid process of the scapula and is the only scapulothoracic muscle with an anterior thoracic attachment.[9]

Kibler classifies scapular dyskinesis into 4 types:

1. Inferior angle (type 1): It is characterized by prominence of the inferior medial border at rest, with anterior tilting of the acromion during movement.
2. Medial border (type II): It shows prominence of the entire medial border, which lifts away from the thorax during arm motion.
3. Superior border (type III): It involves elevation of the superior border and early shoulder shrugging during movement without significant winging.
4. Symmetric scapulohumeral (type IV): It represents a normal pattern, where both scapulae are symmetrical, although the dominant side may be slightly lower.

Abnormalities in scapular motion or position can be treated by physical therapy to relieve the symptoms and to re-gain muscle strength and activation patterns.

Strengthening exercise of the muscles around the scapula alone is considered an insufficient intervention for scapula dyskinesis and for preventing shoulder joint problems[10].

Ganesh BR, Patil P, Rodrigues A., in their study had concluded that Muscle energy technique is effective in increasing the range of motion and strength in young swimmers.[11]

Myeungsik Hwang, Sangbin Lee, Chaegil Lim.,in their study had concluded that proprioceptive neuromuscular facilitation can be used as a rehabilitation intervention for scapula position and movement, pain reduction, and functional improvement in office workers with scapula dyskinesis[10].

This effort of mine is to compare the effectiveness of muscle energy technique, and proprioceptive neuromuscular facilitation on pain, scapular symmetry, and functional disability in scapular dyskinesis among computer office workers.

The need for this study was to compare muscle energy technique, and proprioceptive neuromuscular facilitation so that the effective intervention may be used in clinical practice & greater benefits be obtained by the population.

Aim of the study was to evaluate if adding muscle energy technique to conventional physical therapy improves pain, functional disability, and scapular symmetry more than proprioceptive neuromuscular facilitation with conventional therapy in scapular dyskinesis patients.

Objectives of the study

- To find the effectiveness of conventional physical therapy alone on pain, scapular symmetry & functional disability in participants with scapular dyskinesis.
- To find the effectiveness of muscle energy technique along with conventional physical therapy on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.
- To find the effectiveness of proprioceptive neuromuscular facilitation along with conventional physical therapy on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.
- To compare the effectiveness of muscle energy technique along with conventional physical therapy, proprioceptive neuromuscular facilitation along with conventional physical therapy, & conventional physical therapy alone on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

Hypothesis

Null Hypothesis (H_0)

$H_0$1: There is no statistically significant effect of conventional physical therapy alone, on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

$H_0$2: There is no statistically significant effect of muscle energy technique along with conventional physical therapy on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

$H_0$3: There is no statistically significant effect of proprioceptive neuromuscular facilitation along with conventional physical therapy on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

$H_0$4: There is no statistically significant difference in the effects of muscle energy technique along with conventional physical therapy, proprioceptive neuromuscular facilitation along with conventional physical therapy, & conventional physical therapy alone on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

Alternate Hypothesis (H_1)

$H_1$1: There is a statistically significant effect of conventional physical therapy alone, on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

$H_1$2: There is a statistically significant effect of muscle energy technique along with conventional physical therapy on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

$H_1$3: There is a statistically significant effect of proprioceptive neuromuscular facilitation along with conventional physical therapy on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

$H_1$4: There is a statistically significant difference in the effects of muscle energy technique along with conventional physical therapy, proprioceptive neuromuscular facilitation along with conventional physical therapy, & conventional physical therapy alone on pain, scapular symmetry, & functional disability in participants with scapular dyskinesis.

REVIEW OF LITERATURE

1.Myeungsik Hwang, Sangbin Lee, Chaegil Lim (2021) conducted a study on "Effects of the Proprioceptive Neuromuscular Facilitation Technique on Scapula Function in Office Workers with Scapula Dyskinesis"for improving and maintaining Range of motion (ROM), increasing muscular strength and power especially after exercise in 42 patients with scapular dyskinesis recruited and randomly assigned to three groups: muscle strengthening exercise group, muscle balance exercise group, and movement control exercise group (n = 14). The authors came to the conclusion that office workers with scapula dyskinesis may benefit from proprioceptive neuromuscular facilitation as a rehabilitation strategy for the decrease of scapula position and movement pain and functional improvement.[10].

2.Ganesh BR, Patil P, Rodrigues A. (2020) conducted a study on "Effect of Muscle Energy Technique on Strength and Range of Motion in Young Swimmers with Sick Scapula Syndrome to evaluate whether MET improves resting pectoralis minor length (PML), forward scapular position, and scapular upward rotation in female collegiate swimmers. The study involved 26 participants. The authors concluded that the muscle energy technique effectively enhances range of motion and strength in young swimmers aged 8 to 15 years with sick scapula syndrome.[11]

3. W. Ben Kibler, and John McMullen (2003) in their article on "Scapular Dyskinesis and its Relation to Shoulder Pain" have stated that scapular dyskinesis is a common consequence of many shoulder joint injuries and is frequently brought on by injuries that cause the scapular stabilizing muscles' activation patterns to be inhibited or disorganized. By changing the typical scapular role during coupled scapulohumeral motions, it may worsen the functional deficiency linked to shoulder injuries. The authors came to the conclusion that the goal of treating scapular dyskinesis is to manage underlying causes and apply kinetic chain-based rehabilitation procedures to restore normal scapular muscle activation patterns.[2]

MATERIALS & METHODS

This study used an experimental design with convenience sampling followed by random allocation using a lottery method without replacement. The study population consisted of computer office workers, with a total sample size of 60 participants divided equally into three groups (Group A=20, Group B=20, Group C=20). The research was conducted at an Institutional Musculoskeletal and Sports Physiotherapy Outpatient Department (OPD) over duration of 10 months, with a treatment period of 4 weeks.

Inclusion criteria were clinically diagnosed scapular dyskinesis, Age between 20 and 50 years, both males and females, Positive results on scapular assistance, scapular retraction, and scapula slide tests and at least one year of computer use for a minimum of 20 hours per week [6,9,10,12-15].

Exclusion criteria included neurological disorders, Previous shoulder or neck surgery, Severe psychiatric illness, Cervical radiculopathy, History of shoulder surgery, fracture, dislocation, or traumatic shoulder pain, Systemic illnesses such as rheumatoid arthritis, Bone diseases, tumors, or infections and Pregnancy[10,13]

Outcome measures included pain intensity using the Numerical Pain Rating Scale (NPRS), Scapular symmetry using the Lateral Scapular Slide Test and Functional disability using the Shoulder Pain and Disability Index (SPADI)

Intervention

GROUP A: (CONVENTIONAL PHYSICAL THERAPY) [16-17]

Participants received moist heat therapy using a hydrocollator pack applied over the shoulder and scapular region for 10 minutes in supine lying, 5 days per week. The pack was wrapped in 4 towel layers, with temperature maintained at 60°C.

Active range of motion (AROM) exercises including flexion, extension, abduction, adduction, and internal/external rotation were performed in supine position (15 repetitions, 3 sets/day, 5 days/week for 4 weeks).

Open-chain scapular stabilization exercises (elevation/depression, protraction/retraction, upward/downward rotation) were performed with manual resistance (15 repetitions, 3 sets/day).

Pectoralis minor stretching was performed in standing position with 30-second hold, 3 repetitions/day, 5 days/week.

GROUP B: (MUSCLE ENERGY TECHNIQUE + CONVENTIONAL PHYSICAL THERAPY) [6,18]

Conventional physical therapy will be the same as given in Group A.

Additionally, MET was applied to pectoralis minor and upper trapezius.

For pectoralis minor, post-isometric relaxation was performed in side-lying with the arm lightly folded across the lower thorax, the treated side uppermost. The therapist stood behind, placing one hand on the pectoralis minor via the elbow and the other on the scapula. Gradual posterior pressure was applied to retract the shoulder, guided by the scapula hand. If the shoulder couldn't reach its correct position, participants gently pushed anteriorly against the therapist's hand for 90 seconds. After reducing muscle slack and stretching for 5–30 seconds, the process was repeated twice more.

For upper trapezius, MET involved isometric contraction with controlled stretching in supine position. The head and neck side-bent away from the treated side. The therapist stabilized the shoulder and neck at the restriction barrier and instructed participants to move their eyes toward the opposite side without moving the head. Participants resisted initially with moderate effort, increasing to maximal effort as the therapist gently moved the cervical joint through its range, overcoming the resistance. Contractions lasted 5 seconds, repeated 4 times. MET was applied every other day, 3 times a week for 4 weeks.

GROUP C: (PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUE + CONVENTIONAL PHYSICAL THERAPY) [10,19,20]

Conventional physical therapy will be the same as given in Group A.

Participants performed PNF patterns in supine position as follows:

D1 Flexion: Starting with shoulder extension, abduction, internal rotation; elbow extended; forearm pronated; wrist and fingers extended. Participants moved the arm across the face into shoulder flexion, adduction, external rotation; partial elbow flexion; forearm supination; wrist and finger flexion, either actively or against resistance.

D1 Extension: From the D1 flexion start position, participants completed shoulder extension, abduction, internal rotation; elbow extension; forearm pronation; wrist and finger extension.

D2 Flexion: Starting with shoulder extension, adduction, internal rotation; elbow extended; forearm pronated; wrist and finger flexed. Participants moved the arm up and out with shoulder flexion, abduction, external rotation; elbow extended; forearm supinated; wrist and fingers extended.

D2 Extension: From shoulder flexion, abduction, external rotation; elbow extended; forearm supinated; wrist and fingers extended, participants moved into shoulder extension, adduction, internal rotation; elbow extended; forearm pronated; wrist and fingers flexed.

All exercises were performed 15 repetitions per set, 3 sets per day, 5 days per week, for 4 weeks.

Outcome Measurement

Pain Intensity (NPRS): Pain will be measured using the Numerical Pain Rating Scale (NPRS) from 0 (no pain) to 10 (worst pain imaginable). Participants will self-rate their pain before the first session and after the last session.

Scapular Symmetry (Lateral Scapular Slide Test):

Scapular positions will be measured on both sides in three arm positions (neutral, 45° abduction with medial rotation, 90° abduction with maximal medial rotation). The distance from the scapula's inferior angle to the spine is measured. A difference greater than 1.5 cm between sides indicates scapular asymmetry.

Functional Disability (SPADI): The Shoulder Pain and Disability Index (SPADI) questionnaire evaluates pain (5 questions) and functional difficulty (8 questions) related to shoulder use. Scores from both sections are averaged to give an overall disability score.

1. Moist heat pack

2.Shoulder active AROM

3.Self stretching pectoralis minor

4.Scapular elevation and depression

5.Scapular upward and downward rotation

6.Scapular protraction and retraction

7. MET- Pectoralis minor

8. MET- Upper trapezius

9. PNF D1 Flexion

10. PNF D2 Flexion

11. PNF D1 Extension

12. PNF D2 Extension

Statistical Analysis

The study included 60 participants with scapular dyskinesis, randomly allocated into three groups (n=20 each). Data were analyzed using SPSS version 26.0. Normality was assessed using the Kolmogorov–Smirnov test. Descriptive statistics were expressed as mean ± standard deviation, and significance level was set at $p<0.05$. Appropriate parametric and non-parametric tests were used for within-group and between-group comparisons.

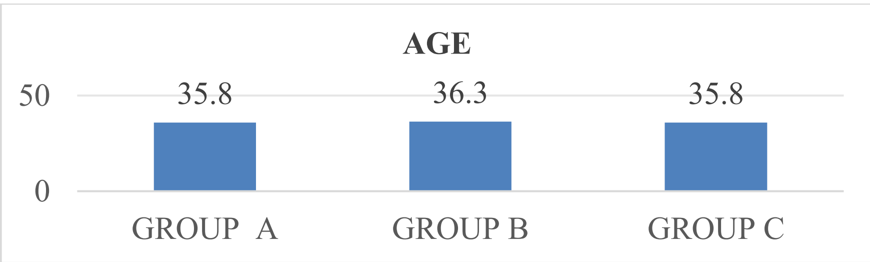
RESULT

Baseline characteristics of participants

The Table 1 and Graph 1 indicate No significant difference in age was found between groups ($p = 0.979$), indicating homogeneity. **Table 2 and Graphs 2 indicate** Gender distribution was similar across groups ($p = 0.934$).

TABLE 1: Age distribution

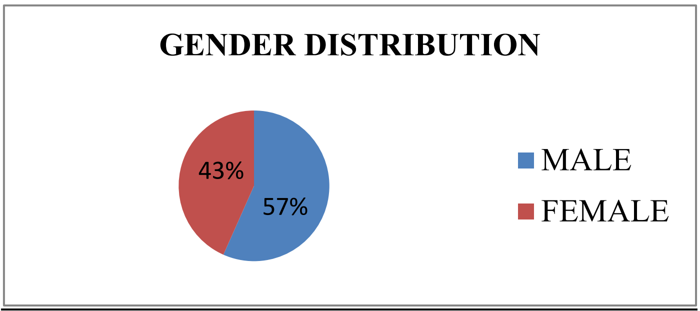
GROUPS	N	Mean ± SD	p value
A	20	35.80 ± 7.38	0.979
B	20	36.30 ± 7.86	
C	20	35.80 ± 7.38	
TOTAL	60		



GRAPH 1: Age distribution in Group A, Group B and Group C

Table 2: Gender distribution in Group A, Group B and Group C.

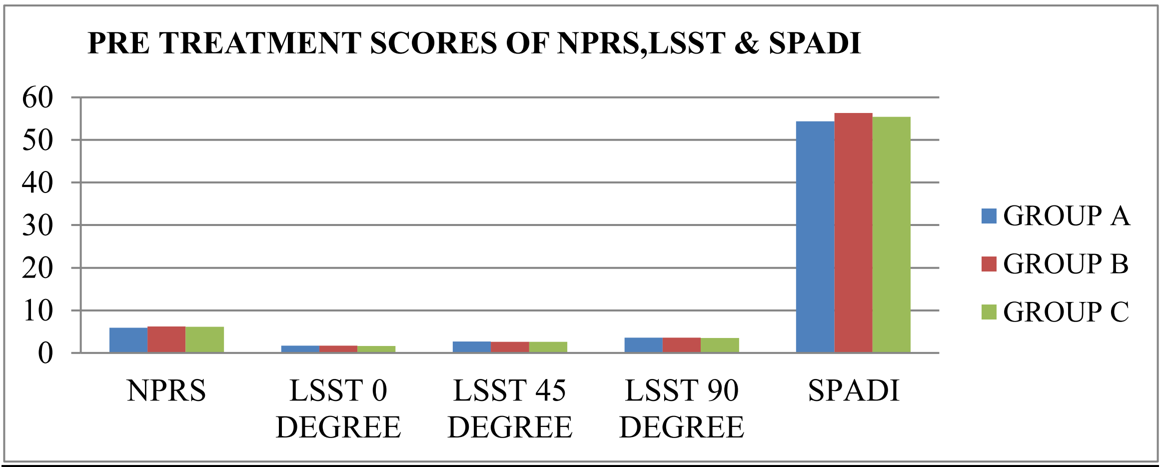
GROUPS	MALE	FEMALE	P value
GROUP A	12	8	0.934
GROUP B	11	9	
GROUP C	11	9	
TOTAL	34	26	



GRAPH 2: Gender distribution in Group A, Group B and Group C.

Table 3: Inter group comparison of pre-treatment scores of Group A, Group B and Group C.

Variables	GROUP A		GROUP B		GROUP C		F value	P value
	Mean	±SD	Mean	±SD	Mean	±SD		
NPRS	5.90	±0.96	6.25	±0.63	6.15	±0.93	1.27	0.528
LSST 0 DEGREE	1.74	±0.10	1.68	±0.10	1.67	±0.14	2.09	0.132
LSST 45 DEGREE	2.68	±0.11	2.61	±0.15	2.60	±0.09	2.50	0.090
LSST 90 DEGREE	3.59	±0.10	3.59	±0.07	3.52	±0.12	3.03	0.065
SPADI	54.40	±3.25	56.30	±2.22	55.40	±3.56	1.92	0.156

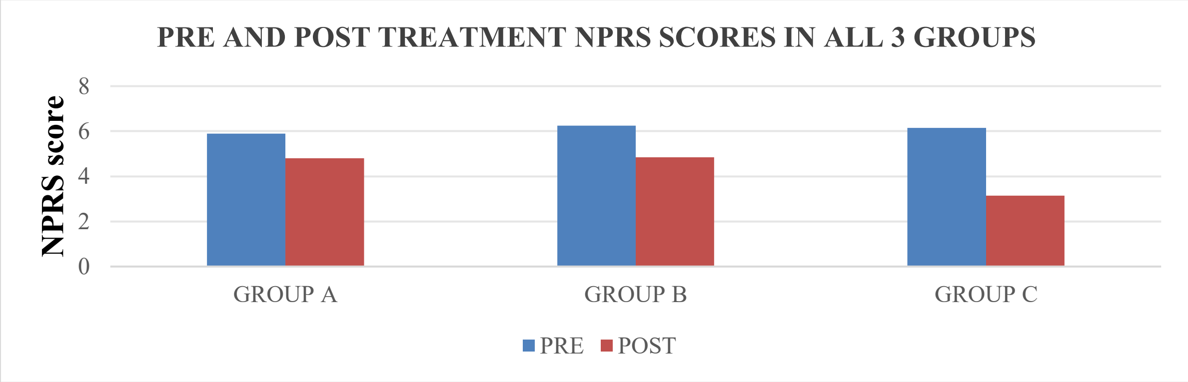


Graph 3: Inter group Comparison of Pre-Treatment Scores of NPRS, LSST, and SPADI Between Group A, Group B, and Group C

Table 3 and graph 3 shows the intergroup comparison of pre-treatment scores for NPRS, Lateral Scapular Slide Test (at 0°, 45°, and 90°), and SPADI between Group A, Group B, and Group C showed no statistically significant differences ($p > 0.05$). This indicates that the groups were homogeneous before treatment. The comparisons were conducted using the Kruskal-Wallis test for NPRS and one-way ANOVA for both LSST and SPADI.

Table 4: Intra group comparison of pre and post-treatment scores of NPRS in Group A, Group B and Group C.

NPRS	PRE		POST		t value	p value
	Mean	**±SD**	**Mean**	**±SD**		
GROUP A	5.90	±0.96	4.80	±1.05	-3.99	0.000
GROUP B	6.25	±0.63	4.85	±0.58	-4.05	0.000
GROUP C	6.15	±0.93	3.15	±0.81	-3.99	0.000

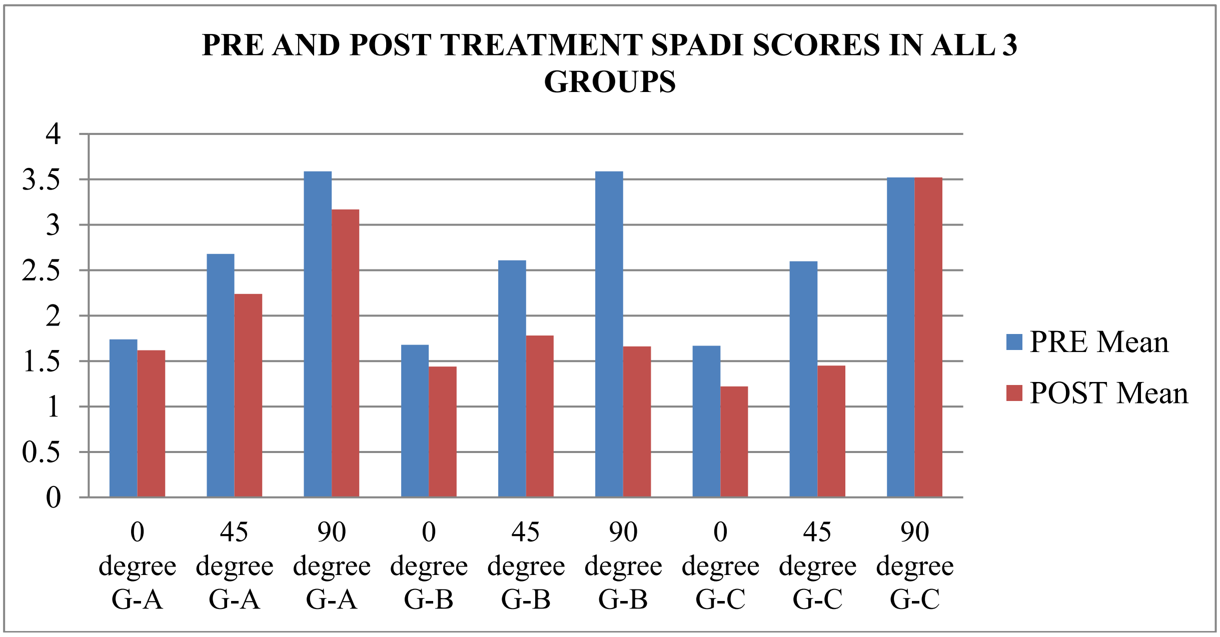


Graph 4: Intra group comparison of pre and post-treatment scores of NPRS in Group A, Group B and Group C.

Table 4 and Graph 4 show a significant reduction in NPRS scores within Groups A, B, and C after treatment ($p < 0.05$), indicating reduction in pain intensity. This was analyzed using the Wilcoxon signed-rank test.

Table 5: Intra group comparison of pre and post-treatment scores of LSST Scores at 0°, 45°, and 90° in Group A, Group B and Group C.

LSST	PRE		POST		t value	p value
	Mean	±SD	Mean	±SD		
0 degree G-A	1.74	±0.10	1.62	±0.10	5.22	0.000
45 degree G-A	2.68	±0.11	2.24	±0.20	11.18	0.000
90 degree G-A	3.59	±0.10	3.17	±0.35	4.81	0.000
0 degree G-B	1.68	±0.10	1.44	±0.05	9.96	0.000
45 degree G-B	2.61	±0.15	1.78	±0.06	21.17	0.000
90 degree G-B	3.59	±0.07	1.66	±0.12	51.10	0.000
0 degree G-C	1.67	±0.14	1.22	±0.11	16.88	0.000
45 degree G-C	2.60	±0.09	1.45	±0.05	46.99	0.000
90 degree G-C	3.52	±0.12	3.52	±0.12	57.28	0.000

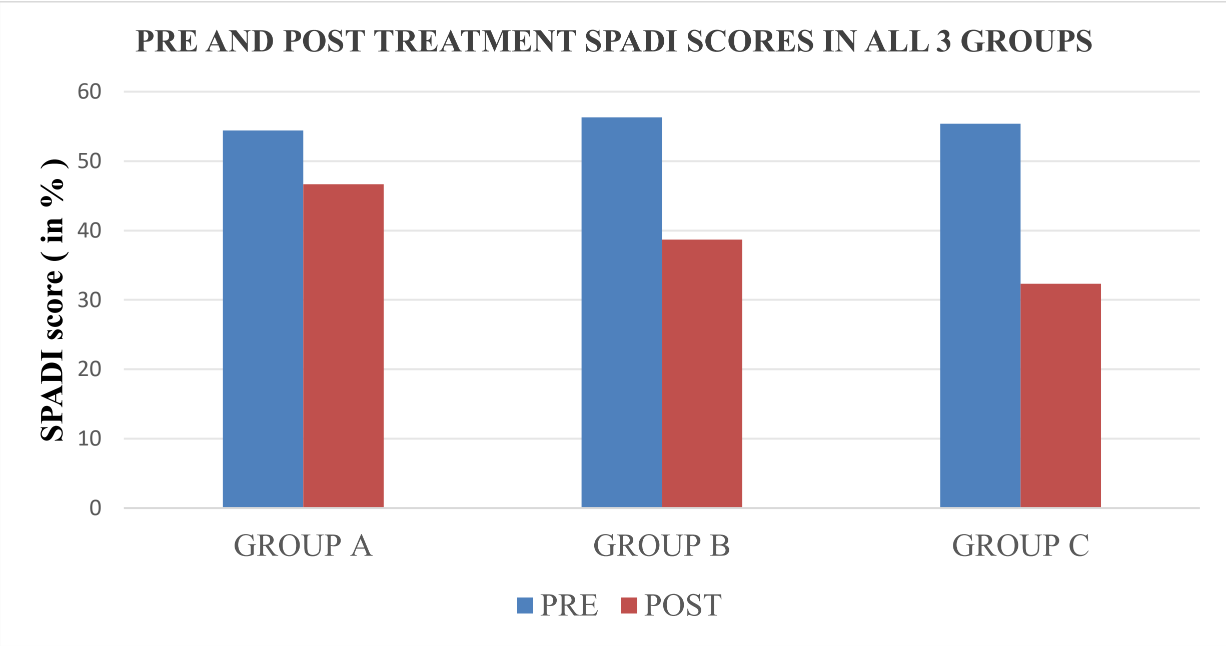


Graph 5: Intra group comparison of pre and post-treatment scores of LSST Scores at 0°, 45°, and 90° in Group A, Group B and Group C.

Tables 5 and Graph 5 show the intra group comparison of pre- and post-treatment Lateral Scapular Slide Test scores at 0°, 45°, and 90° for Groups A, B, and C. In all groups, a statistically significant reduction in LSST scores and improvement in scapular symmetry were observed after treatment ($p < 0.05$). These comparisons were conducted using paired t-tests.

Table 6: Intra group comparison of pre and post-treatment scores of SPADI in Group A, Group B and Group C.

SPADI	PRE		POST		t value	p value
	Mean	±SD	Mean	±SD		
GROUP A	54.40	±3.25	46.65	±1.22	8.96	0.000
GROUP B	56.30	±2.22	38.70	±2.02	28.51	0.000
GROUP C	55.40	±3.56	32.30	±1.65	28.49	0.000

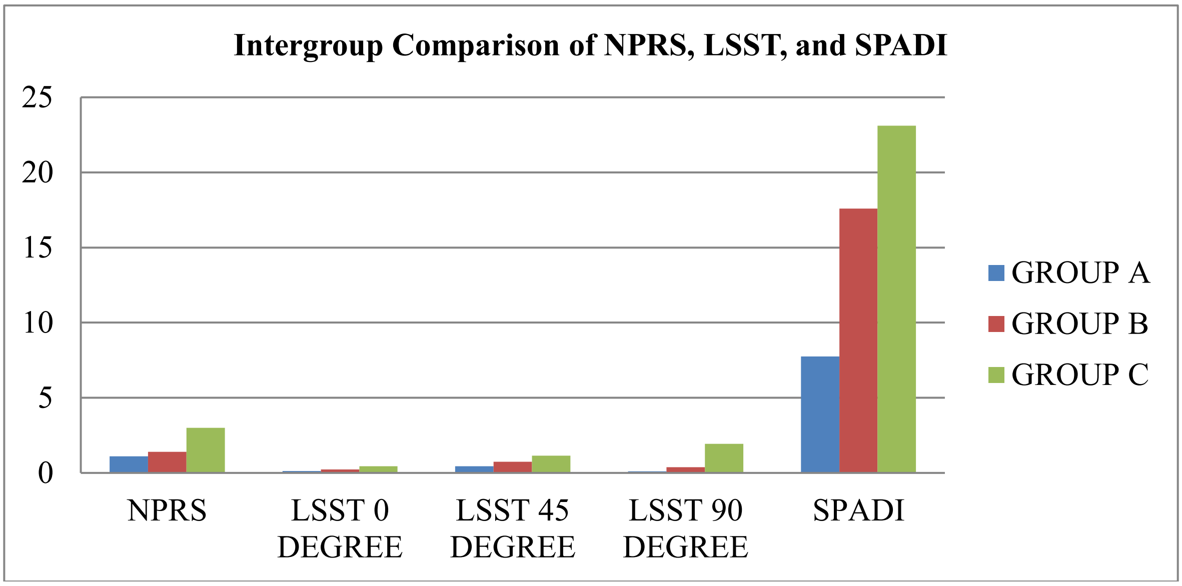


Graph 6: Intra group comparison of pre and post-treatment scores of SPADI in Group A, Group B and Group C.

Table 6 and Graph 6 show a significant reduction in SPADI scores within Groups A, B, and C after treatment ($p < 0.05$), indicating improvement. This was analyzed using the paired t-test.

Table 7: Intergroup Comparison of Mean Difference Scores of NPRS, LSST, and SPADI Between Group A, Group B, and Group C

Variables	GROUP A		GROUP B		GROUP C		F value	P value
	Mean	±SD	Mean	±SD	Mean	±SD		
NPRS	1.10	±0.64	1.40	±0.50	3.00	±0.72	38.29	0.000
LSST 0 DEGREE	0.125	±0.10	0.24	±0.10	0.45	±0.11	42.94	0.000
LSST 45 DEGREE	0.44	±0.17	0.74	±0.27	1.15	±0.10	66.63	0.000
LSST 90 DEGREE	0.11	±0.01	0.38	±0.37	1.93	±0.16	368.4	0.000
SPADI	7.75	±3.84	17.60	±2.76	23.10	±3.62	101.4	0.000



Graph 7: Intergroup Comparison of Mean Difference Scores of NPRS, LSST, and SPADI Between Group A, Group B, and Group C

Tables 7 and Graphs 7 present the intergroup comparison of mean difference scores for NPRS, Lateral Scapular Slide Test (at 0°, 45°, and 90°), and SPADI after 4 weeks. Statistically significant differences ($p < 0.05$) were found among Group A, Group B, and Group C for all three measures. The Kruskal-Wallis test was used for NPRS, and one-way ANOVA was applied for LSST and SPADI comparisons.

Table 8: Multiple Comparison for Mean of Difference of post NPRS between Group A, B & C

Groups		Mean diff	STD Error	SIG	95% confidence interval	
					Lower bound	Upper bound
A	B	-.300	.199	.295	-.78	.18
	C	-1.900		0.000	-2.38	-1.42
B	A	.300		.295	-.18	.78
	C	-1.600		.000	-2.08	-1.12
C	A	1.900		.000	1.42	2.38
	B	1.600		.000	1.12	2.08

Table 8 shows post-intervention NPRS differences with significant differences between Groups A & C and B & C ($p = 0.000$), but no difference between Groups A & B ($p = 0.295$).

Table 9: Multiple Comparison for Mean of Difference of post LSST 0^0 between Group A, B & C

Groups		Mean diff	STD Error	SIG	95% confidence interval	
					Lower bound	Upper bound
A	B	-.1200	0.0355	.004	-.205	-.035
	C	-.3250		0.00	-.410	-.240
B	A	.1200		.004	-.035	.205
	C	-.2050		.000	-.290	-.120
C	A	.3250		.000	.240	.410
	B	.2050		.000	.120	.290

Table 9 shows post-intervention LSST at 0° differences with significant differences between Groups A & C, B & C ($p = 0.000$), and A & B ($p = 0.04$).

Table 10: Multiple Comparison for Mean of Difference of post LSST 45⁰ between Group A, B & C

Groups		Mean diff	STD Error	SIG	95% confidence interval	
					Lower bound	Upper bound
A	B	-.3000	0.0622	0.00	-.450	-.150
	C	-.7150		0.00	-.865	-.565
B	A	.3000		0.00	.150	.450
	C	-.4150		.000	-.565	-.265
C	A	.7150		.000	.565	.865
	B	.4150		.000	.265	.565

Table 10 shows post-intervention LSST at 45° differences with significant differences between Groups A & C, B & C, and A & B (all p = 0.000)

Table 11: Multiple Comparison for Mean of Difference of post LSST 90 between Group A, B & C

Groups		Mean diff	STD Error	SIG	95% confidence interval	
					Lower bound	Upper bound
A	B	-1.5500	.0753	.000	-1.731	-1.369
	C	.3800		.000	.199	.561
B	A	1.5500		.000	1.369	1.731
	C	1.9300		.000	1.749	2.111
C	A	-.3800		.000	-.561	-.199
	B	-1.9300		.000	-2.111	-1.749

Table 11 shows post-intervention LSST at 90° differences with significant differences between Groups A & C, B & C, and A & B (all p = 0.000).

Table 12: Multiple Comparison for Mean of Difference of post SPADI between Group A, B & C

Groups		Mean diff	STD Error	SIG	95% confidence interval	
					Lower bound	Upper bound
A	B	-9.850	1.091	.000	-12.48	-7.22
	C	-15.350		.000	-17.98	-12.72
B	A	9.850		.000	7.22	12.48
	C	-5.500		.000	-8.13	-2.87
C	A	15.350		.000	12.72	17.98
	B	5.500		.000	2.87	8.13

Table 12 shows post-intervention SPADI differences with significant differences between Groups A & C, B & C, and A & B (all p = 0.000). The largest significant change was observed in Group C compared to Groups A and B.

DISCUSSION

The present study was designed to compare the effectiveness of muscle energy technique and proprioceptive neuromuscular facilitation on pain, scapular symmetry, and functional disability in scapular dyskinesis among computer office workers. 60 participants were allocated into three groups by random allocation using lottery method. Group A (n=20) was treated with conventional physical therapy, group B (n=20) with muscle energy technique along with conventional physical therapy, & group C (n=20) with proprioceptive neuromuscular facilitation along with conventional physical therapy. The dependent variables were intensity of pain measured by NPRS, scapular symmetry by LSST and functional disability by SPADI.

This study was the first to compare the effectiveness of muscle energy technique and proprioceptive neuromuscular facilitation on pain, scapular symmetry, and functional disability in scapular dyskinesis among computer office workers. The result of this study revealed significantly better outcomes in terms of pain intensity, scapular symmetry and functional disability after 4 weeks of proprioceptive neuromuscular facilitation along with conventional physical therapy in participants with scapular dyskinesis participants.

The results of statistical analysis showed that proprioceptive neuromuscular facilitation along with conventional physical therapy was more effective than muscle energy technique along with conventional physical therapy or Conventional Physical therapy alone in scapular dyskinesis among computer office workers.

Participants in Groups A, B, and C were aged 22-49 years, with mean ages of 35.80±7.38, 36.30±7.86, and 35.80±7.38, respectively, showing no significant age difference and confirming group homogeneity. The study included 34 males and 26 females. Baseline scores for NPRS, LSST, and SPADI showed no significant differences ($p > 0.05$), confirming homogeneity across groups.

Intragroup comparison of scores of NPRS through Wilcoxon signed rank test, LSST and SPADI were tested by parametric Paired t-test. Intra group analysis showed statistically significant improvement in all outcome measures across all groups (**$p < 0.05$**). NPRS scores decreased in Groups A, B, and C (**$p < 0.05$**). LSST scores at 0°, 45°, and 90° showed significant improvement in all groups (**$p < 0.05$**). SPADI scores also demonstrated significant reduction in Groups A, B, and C (**$p < 0.05$**).

Intergroup analysis using Kruskal Wallis test and One-way ANOVA showed a statistically significant difference between groups (**$p < 0.05$**). NPRS, LSST (0°, 45°, 90°), and SPADI mean differences across Groups A, B, and C were all statistically significant (**$p < 0.05$**).

Multiple comparisons of the 4th-week follow-up scores were performed for NPRS, LSST, and SPADI using post-hoc analysis with the Bonferroni test to assess differences between groups. The results showed that after 4 weeks of intervention, the PNF group demonstrated greater improvement in all three outcome measures (NPRS, LSST, and SPADI) compared to both the MET and conventional therapy groups.

The study hypothesized that PNF would have a superior effect ($p<0.05$) on pain, scapular symmetry, and functional disability. Results showed that PNF combined with conventional therapy (Group C) was more effective than MET with conventional therapy (Group B) or conventional therapy alone (Group A) over four weeks in participants with scapular dyskinesis, rejecting the null hypothesis of no significant difference among the treatments

The findings of this research are in agreement with few previous researches in scapular dyskinesis population. Myeungsik Hwang, Sangbin Lee, Chaegil Lim (2021) concluded that proprioceptive neuromuscular facilitation can be used as a rehabilitation intervention for scapula position and movement pain reduction, and functional improvement in office workers with scapula dyskinesis.

The pain reduction in PNF techniques may be explained by the gate control theory, where afferent inputs from muscles, joints, tendons, and capsules inhibit pain transmission in the spinal cord [21]. Patients with AC show altered scapular kinematics, disrupting normal scapula-humeral rhythm and limiting shoulder elevation[22]. These alterations restrict scapular depression, downward rotation, and posterior tilt due to tightness in muscles like the upper trapezius, rhomboids, serratus anterior, pectoralis minor, and joint capsules[23].

Group B showed significant improvement ($p<0.05$) in pain, disability, and scapular symmetry with MET plus conventional therapy.

This study aligns with Ganesh BR, Patil P, Rodrigues A. (2020), who found that Muscle Energy Technique (MET) significantly improved shoulder strength and range of motion in young swimmers with SICK Scapula Syndrome. The authors suggested that MET helps correct muscular imbalances around the scapula by strengthening the scapular muscles and improving shoulder mobility. These changes may contribute to better scapular control and more efficient shoulder movement during functional activities[11].

Gary Fryer reported that MET may reduce pain through central and peripheral mechanisms, including activation of muscle and joint receptors involving pathways like the periaqueductal grey and descending inhibitory systems, as well as increasing fluid drainage and reducing pro-inflammatory cytokines[24].

Group A received only conventional physical therapy (CPT), including moist heat, active shoulder ROM, scapular stabilization, and pectoral stretching. Pectoral stretching improves muscle length by transmitting stretch force through connective tissue, causing mechanical and neural changes in muscle fibers[25]. Heat reduces pain by increasing tissue temperature, promoting vasodilation, metabolism reduction, and inflammation removal [26].

This study used comprehensive scales to evaluate scapular dyskinesis and involved adults with high adherence across groups, eliminating adherence as a confounder. No adverse events occurred, supporting the safety of PNF plus CPT. Participants receiving PNF plus CPT showed significantly greater improvements in pain, scapular symmetry, and functional disability, with higher patient satisfaction compared to MET or CPT alone. No attrition bias was observed. Thus, PNF combined with CPT demonstrated superior clinical and statistical benefits for scapular dyskinesis.

CONCLUSION

The results of this study showed that all three treatments—conventional physical therapy alone, muscle energy technique combined with conventional therapy, and proprioceptive neuromuscular facilitation (PNF) combined with conventional therapy—helped reduce pain, improve shoulder function, and enhance scapular symmetry in people with scapular dyskinesis. However, the group receiving PNF along with conventional therapy experienced the greatest benefits, proving more effective than the other two approaches.

Declaration by Authors

Ethical Approval: Approved

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