



EFFECTS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUES AND SCAPULAR STABILIZATION EXERCISES ON SHOULDER RANGE OF MOTION AND SCAPULAR KINEMATICS IN OVERHEAD ATHLETES WITH SCAPULAR DYSKINESIS

Physiotherapy

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ABSTRACT

Background: Scapular dyskinesis-altered scapular positioning and motion-is found in association with most shoulder injuries. Overhead athletes will have a greater prevalence of scapular dyskinesis when compared with non-overhead athletes. This study aims to compare the effects of Proprioceptive Neuromuscular Facilitation Techniques with Scapular Stabilization Exercise and Scapular Stabilization Exercise on shoulder Range of motion and Scapular kinematics among overhead athletes with Scapular Dyskinesis. **Methods:** A quasi-experimental study design among 20 overhead athletes with 20-40 years were selected. Participants were divided into two groups: Group A (Proprioceptive Neuromuscular Facilitation Techniques with Scapular Stabilization Exercise) and Group B (Scapular Stabilization Exercise alone) for the duration of 6 weeks. Shoulder range of motion was assessed using Goniometer, and Scapular Kinematics was assessed using Scapular Dyskinesis Test (SDT). **Results:** Pre- and post-test values were analyzed using paired and unpaired t-tests. Group A demonstrated significantly greater improvement compared to Group B. **Conclusion:** Proprioceptive Neuromuscular Facilitation Techniques with Scapular Stabilization Exercise is more effective than Scapular Stabilization Exercise alone in improving shoulder Range of motion and Scapular kinematics among overhead athletes with Scapular

KEYWORDS

Scapular Dyskinesis, Proprioceptive Neuromuscular Facilitation Techniques, Range Of Motion, Scapular Kinematics, Goniometer.

INTRODUCTION

Scapular dyskinesis is defined as alteration in scapular movements due to the loss of strength in scapular muscles; tightness of the soft tissues around shoulder and postural problems. It alters the kinematics of the glenohumeral and acromioclavicular joints, resulting with reduce of periscapular muscles and rotator cuff muscle strength.

Overhead athletes have a greater prevalence of scapular dyskinesis when compared with non-overhead athletes. Shoulder pathologies are very common with the lifetime risk being between 40% and 60% in overhead athletes. In particular, athletes principally use their arm over their head (e.g. volleyball, handball, swimming, tennis) are at a higher risk of injuring one of the structures of the shoulder.

Proprioceptive neuromuscular facilitation (PNF) exercises are designed to facilitate the neuromuscular response of the proprioceptors and its diagonal patterns are in line with the topographic orientation of the muscles. PNF training proposed to facilitate muscle performance through its movement patterns. Research showed that scapular PNF patterns are effective in improving shoulder function and ROM.

Scapular Stabilization Exercise can be incorporated in exercise therapy for treating Scapular dyskinesis to improve Scapular Stability and shoulder function by inhibiting tight muscles and activating weak muscles to improve scapular force couples and muscle imbalances. This study focused on compare the effects of Proprioceptive Neuromuscular Facilitation Techniques and Scapular Stabilization Exercise on shoulder Range of motion and Scapular kinematics among overhead athletes with Scapular Dyskinesis.

Need for the study:

There is limited evidence on the combined effectiveness of Proprioceptive Neuromuscular Facilitation (PNF) techniques and scapular stabilization exercises in improving shoulder range of motion and scapular kinematics among overhead athletes with scapular dyskinesis. Overhead athletes are highly susceptible to altered scapular mechanics due to repetitive shoulder loading, leading to reduced mobility, impaired neuromuscular control, and increased injury risk. Although PNF techniques enhance neuromuscular coordination and flexibility, and scapular stabilization exercises improve scapular control and shoulder stability, their combined therapeutic effect remains unclear. Therefore, this study is needed to

determine whether integrating PNF with scapular stabilization exercises can more effectively restore shoulder function, improve scapular movement patterns, and enhance athletic performance in overhead athletes with scapular dyskinesis.

MATERIALS AND METHODOLOGY:

Study design: Quasi experimental study design. The study conducted in the department of physiotherapy, Sree Abirami college of physiotherapy Coimbatore.

Study sampling: 20 subjects were selected into two groups. Group A (Proprioceptive Neuromuscular Facilitation Techniques with Scapular Stabilization Exercise) and Group B (Scapular Stabilization Exercise) with 10 subjects in each group. The study treatment duration is 6 weeks.

Selection Criteria:

Inclusion criteria: Subjects between 20 to 40 years, Overhead athletes with Scapular dyskinesis, both males and females are included in this study, Subjects with Restricted shoulder movement (Flexion, Abduction, External Rotation).

Exclusion criteria: Other Sports activities, Fractures, dislocation and nerve Injuries, History of shoulder trauma or Surgery, Patients with scoliosis or acute cervical spondylosis, Patients with unremarkable body surface markers that interfere with the assessment, such as obesity, Systemic Inflammatory conditions like arthritis.

Procedure:

Group A (Proprioceptive neuromuscular facilitation techniques with Scapular Stabilization Exercise):

The exercise is given in progressive manner for the duration of 6 weeks. Treatment duration: 3 session/week, 40 minutes/session for both Group A and Group B.

Proprioceptive neuromuscular facilitation techniques:

1. Scapular pattern anterior elevation.
2. Scapular pattern posterior depression
3. Scapular pattern posterior elevation
4. Scapula pattern anterior depression

Scapular Stabilization Exercise:

1. Prone-T

2. Prone-Y
3. Wall push up

Exercise Progression: Weeks 1–2: 2 sets × 10 repetitions
Weeks 3–4 : 3 sets × 15–20 repetitions
Weeks 5–6 : 3 sets × 15–20 repetitions with mild resistance using resistance bands
Rest interval: 30 seconds between sets.

Warm up and cool down: 3 minutes - Active shoulder movements, Gentle stretching, and Mobility exercises.

Group B (Scapular Stabilization Exercise):
The following exercises were performed with progressive loading:

1. Prone T
2. Prone Y
3. Wall push-up
4. Shoulder squeeze
5. Serratus anterior punch
6. Prone W
7. Rhomboid major strengthening

- Progression**
- **Weeks 1–2:** 2 sets × 10 repetitions
 - **Weeks 3–4:** 3 sets, 15–20 repetitions
 - **Weeks 5–6:** 3 sets, 10 repetitions with mild resistance (resistance band)

Each contraction was maintained for 3–5 seconds with 30 seconds rest between sets.

Warm up and cool down: 3 minutes - Active shoulder movements, Gentle stretching, and Mobility exercises.
All Exercise were performed within pain free limits.

Data analysis:
The collected data were tabulated and analyzed using student 't' test. Paired "t" test is used to analyze the significant difference between pre-test and post-test values of Group A and Group B and Unpaired "t" test was used to analyze significant difference between two groups. p value< 0.05 was considered as statistically significant improvement between the groups

Table-1 Ppaired 't' test: ShoulderRange of motion Pre and Post test values of Group A

S.NO	GROUP A	RANGE OF MOTION	MEAN ± STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	PRE TEST	FLEXION	139.50 ± 5.99	23.50	18.0532
	POST TEST		163.00 ± 4.83		
2.	PRE TEST	ABDUCTION	120 ± 7.45	35.50	25.6422
	POST TEST		155.50 ± 5.99		
3.	PRE TEST	EXTERNAL ROTATION	53.50 ± 5.80	13	15.9217
	POST TEST		66.50 ± 5.80		

Graph-1 Paired 't' test-Range of motion Pre and Post test values of Group A

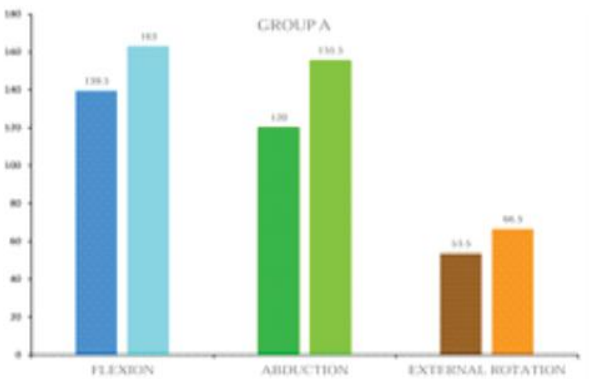


Table-2: paired 't' test: shoulder range of motion Pre and Post test values of Group B

S.NO	GROUP B	RANGE OF MOTION	MEAN ± STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	PRE TEST	FLEXION	140.50 ± 5.99	13.50	10.3710
	POST TEST		154.00 ± 5.68		
2.	PRE TEST	ABDUCTION	121 ± 8.10	18.50	14.2121
	POST TEST		139.50 ± 4.38		
3.	PRE TEST	EXTERNAL ROTATION	51.50 ± 5.30	13	15.9217
	POST TEST		59.00 ± 3.94		

Graph-2 Paired 't' test-Range of motion Pre and Post test values of Group B

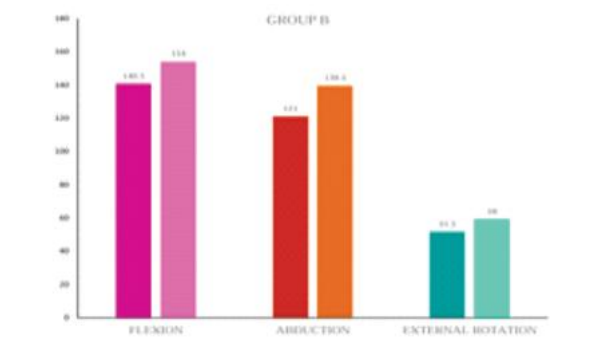


Table-3: Unpaired 't' test: Shoulder range of motion Post test values of Group A and B

S.NO	PRE TEST	RANGE OF MOTION	MEAN ± STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	GROUP A	FLEXION	139.50 ± 5.99	1	0.3735
	GROUP B		140.50 ± 5.99		
2.	GROUP A	ABDUCTION	120.00 ± 7.45	1	0.2873
	GROUP B		121.00 ± 8.10		
3.	GROUP A	EXTERNAL ROTATION	53.50 ± 5.80	2	0.8054
	GROUP B		51.50 ± 5.30		

Graph-3 Unpaired 't' test: shoulder range of motion Post test values of Group A and B

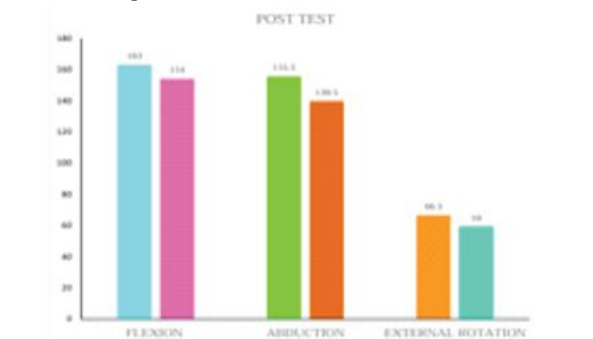
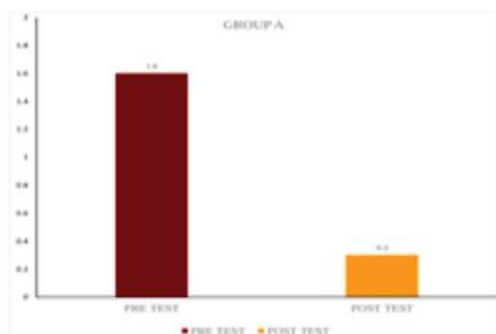
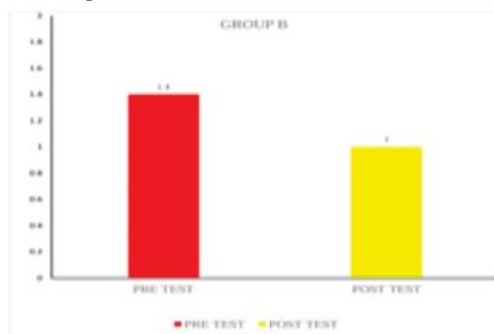


Table-4 Paired 't' test- Scapular Dyskinesia test (SDT) Pre test and Post test values of group A

S.NO	GROUP A	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	't' VALUE
1.	PRE TEST	1.60	0.52	1.30	8.5105
2.	POST TEST	0.30	0.48		

Graph-4 Paired 't' test- Scapular Dyskinesis Test (SDT) Graphical Representation of Pre test and Post test value of Group A**Table-5 Paired 't' test: Scapular Dyskinesis Test Pre and post test values of Group B**

S.NO	GROUP B	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	"t" VALUE
1.	PRE TEST	1.40	0.52	0.40	2.4495
2.	POST TEST	1.00	0.67		

Graph-5 Paired 't' test: Scapular Dyskinesis Test Pre and Post test values of Group B**Table-6 Unpaired 't' test-Scapular Dyskinesis Test (SDT) Post test values of Group A and Group B**

S.NO	POST TEST	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	"t" VALUE
1.	GROUP A	0.30	0.48	0.70	2.6888
2.	GROUP B	1.00	0.67		

Graph-6 Unpaired 't' test-Scapular Dyskinesis Test (SDT) Post test values of Group A and Group B**RESULTS:**

Paired *t*-test analysis showed significant improvements in shoulder range of motion and scapular kinematics within both Group A and

Group B following the treatment ($p < 0.05$).

Unpaired *t*-test analysis revealed a statistically significant difference between the groups in post-test values of shoulder range of motion, measured using a goniometer, and scapular kinematics, assessed using the Scapular Dyskinesis Test ($p < 0.05$).

Group A, which received proprioceptive neuromuscular facilitation techniques combined with scapular stabilization exercises, showed greater improvement compared to Group B (scapular stabilization exercises). Therefore, the alternate hypothesis was accepted and the null hypothesis was rejected.

DISCUSSION:

This study aims to compare the effects of Proprioceptive Neuromuscular Facilitation (PNF) combined with Scapular Stabilization Exercises (SSE) versus Scapular Stabilization Exercises in overhead athletes with scapular dyskinesis. 20 participants were randomly allocated into two groups ($n=10$ each) and underwent 40-minute treatment sessions. Outcomes included shoulder range of motion (ROM) (Goniometer) and scapular kinematics assessed using Scapular Dyskinesis Test (SDT).

The findings are consistent with previous studies. Meneghini et al. reported that scapular PNF patterns significantly reduced scapular dyskinesis in volleyball players by improving neuromuscular control and scapular coordination. Similarly, Balci et al. demonstrated that combining scapular PNF with conventional physiotherapy improved shoulder ROM, functional outcomes, and pain reduction in patients with adhesive capsulitis. Zhang et al. also found that scapular stabilization exercises effectively restored normal scapular positioning, enhanced shoulder movement, and reduced pain by improving scapulothoracic mechanics.

CONCLUSION:

The study concludes that PNF combined with Scapular Stabilization Exercises is more effective than Scapular Stabilization Exercises alone in improving shoulder ROM and scapular kinematics among overhead athletes with scapular dyskinesis. PNF enhances proprioceptive feedback, neuromuscular control, and coordinated muscle activation, while scapular stabilization exercises improve scapular stability by correcting muscle imbalances and optimizing scapular force couples. Combining these interventions contribute to improved shoulder function and scapulothoracic mechanics.

Limitations and Recommendations:

The study Limited with small sample size, short term follow-up, age group between 20 to 40 years. Only overhead athletes were included. Future studies should concentrate on large sample size, long duration study, includes individuals older than 40 years Overhead athletes can be with specific sports were conducted, Study recommended for multi-group comparative studies to further investigate treatment effectiveness across different age groups and sporting disciplines.

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