Effect of scapula stability exercises on muscle power and functional performance among scapular dyskinesia individuals

Efecto de los ejercicios de estabilidad escapular sobre la potencia muscular y el rendimiento funcional entre personas con discinesia escapular

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Abstract

Introduction: Scapular dyskinesia, an alteration in scapular position and movement, can lead to decreased muscle power and impaired shoulder function.
Objective: The objective of this research was to assess the effect of scapula stability exercises on muscle power and functional performance in scapular dyskinesia individuals using a Seated medicine ball throw and the DASH questionnaire.
Methodology: A closed-envelope experimental study was conducted with 32 participants assigned to the scapula stability exercise group (n = 16) and scapular mobilization group (n = 16).
Results: The scapula stability exercise group showed statistically significant improvements in all measured outcomes. SMBT score improved from 1.60 ± 0.20 to 3.95 ± 0.35 ($p < 0.001$). DASH score decreased from 39.68 ± 5.32 to 20.51 ± 3.76 ($p < 0.001$), indicating improvement in both muscle power and functional performance.
Discussion: Our study shows significant improvement in scapular dyskinesis when treated with scapular stability exercises for 6 weeks, thereby indicating that stabilization exercises can improve scapular kinematics.
Conclusions: The result supports incorporating scapular stability exercises into rehabilitation programs to improve muscle power and functional performance in individuals with scapular dyskinesia.

Keywords

Scapular dyskinesis; scapular mobilization; scapular rehabilitation; scapula stabilization exercise.

Resumen

Introducción: La discinesia escapular, una alteración en la posición y el movimiento de la escápula, puede provocar una disminución de la potencia muscular y un deterioro de la función del hombro.
Objetivo: El objetivo de esta investigación fue evaluar el efecto de los ejercicios de estabilidad escapular sobre la potencia muscular y el rendimiento funcional en personas con discinesia escapular mediante un lanzamiento de balón medicinal sentado y el cuestionario DASH.
Metodología: Se realizó un estudio experimental de sobre cerrado con 32 participantes asignados al grupo de ejercicios de estabilidad escapular (n = 16) y al grupo de movilización escapular (n = 16).
Resultados: El grupo de ejercicios de estabilidad escapular mostró mejoras estadísticamente significativas en todos los resultados medidos. La puntuación del SMBT mejoró de 1,60 ± 0,20 a 3,95 ± 0,35 ($p < 0,001$). La puntuación DASH disminuyó de 39,68 ± 5,32 a 20,51 ± 3,76 ($p < 0,001$), lo que indica una mejora tanto en la potencia muscular como en el rendimiento funcional.
Discusión: Nuestro estudio muestra una mejora significativa de la discinesia escapular al tratarse con ejercicios de estabilidad escapular durante 6 semanas, lo que indica que los ejercicios de estabilización pueden mejorar la cinemática escapular.
Conclusiones: Los resultados respaldan la incorporación de ejercicios de estabilidad escapular en los programas de rehabilitación para mejorar la potencia muscular y el rendimiento funcional en personas con discinesia escapular.

Palabras clave

Discinesia escapular; movilización escapular; rehabilitación escapular; ejercicio de estabilización escapular.

Introduction

The scapula performs multiple functions to ensure normal shoulder movement. All these functions are essential for optimal movement of the arm and depend on maintaining the integrity of the surrounding shoulder anatomy. Efficient shoulder function relies on normal scapulohumeral rhythm. The alteration in scapular position and movement is referred to as scapular dyskinesia. Several factors can contribute to scapular dyskinesia. Bony causes include non-union of a clavicle fracture, shortened malunion, and thoracic kyphosis (Kibler & Sciascia, 2010). Joint-related causes involve high-grade acromioclavicular instability, acromioclavicular arthrosis, and internal derangement of the glenohumeral joint. Neurological causes include cervical root disorder, as well as palsy of the long thoracic nerve or spinal accessory nerves (Kibler et al., 2013). Soft tissue factors include muscle tightness and intrinsic muscle dysfunction. Scapular dyskinesia and variation in glenohumeral motion are two common factors that keep the shoulder at risk (Kibler & Sciascia, 2016). People with scapular dyskinesis are at an increased risk of ergonomic complications (Ozdemir & Toy, 2021). Due to individual adaptation, scapular dyskinesis can occur in both symptomatic and asymptomatic individuals. Those with symptomatic scapular dyskinesia often experience nonspecific shoulder pain and exhibit asymmetry in scapular motion. It has been reported that most of the individuals with scapular dyskinesia are asymptomatic, like 42% of them are asymptomatic athletes and 58% of them are asymptomatic general orthopedic population (Salamh et al., 2023). Over a follow-up period of 9 to 24 months, the initial presentation of scapular dyskinesis was associated with a 43 percent increased risk of shoulder pain event (Hickey et al., 2018). There is evidence that establishes the prevalence of scapular dyskinesia in young adults around the age group of 18 to 25 (Patel & Purohit, 2021). There are various ways to evaluate the presence of scapular dyskinesis (Jildeh et al., 2021). In the present study scapular assistance test is used. Previous studies conclude that dry needling combined with manual therapy is more effective in alleviating pain and enhancing function than using manual treatment by itself (Kheradmandi et al., 2021). Proprioceptive neuromuscular facilitation is said to be a practical rehabilitation approach for improving scapular positioning and motion, reducing pain, and enhancing function in office workers with scapula dyskinesia (Hwang et al., 2021).

The combination of electrical stimulation and exercises for scapular dyskinesis resulted in improved spine-to-scapula distance at 120° of shoulder abduction (Walker et al., 2017). Both kinetic chain training and conventional shoulder exercise training programs can alleviate shoulder pain and enhance scapular and trunk movement. However, the kinetic chain training program proved to be more effective in improving 3 scapular movement consistency and upper trunk rotation with volleyball players with dyskinesis (Chang et al., 2022). Treatment for scapular dyskinesia can be categorized into two types: exercises designed to enhance flexibility and exercises aimed at improving scapular stabilization (Jildeh et al., 2021). It is essential to determine whether scapular dyskinesia is caused by poor muscle performance or reduced flexibility in the surrounding soft tissue. If the primary cause is inadequate muscle control, the patient is recommended to engage in strengthening exercises. These exercises help to enhance proprioception and muscle strength, ultimately improving scapular stability. Suppose the primary cause is a lack of or decreased soft tissue flexibility. The patient is recommended to engage in stretching the muscles of the shoulder blade, the muscles of the glenohumeral joint, and the glenohumeral capsule. Stretching focuses on the pectoralis minor, rhomboids among the scapular muscles.

For the glenohumeral muscles, key structures targeted include the posterior capsule, infraspinatus, and latissimus dorsi (Giuseppe et al., 2020; Cools et al., 2007). The objective of this study is to assess the effect of scapula stability exercises on muscle power and functional performance within scapular dyskinesia individuals using the Seated Medicine Ball Throw (SMBT) and Disability of the Arm, Shoulder, and Hand (DASH) questionnaire.

Method

In this experimental study, the effectiveness of scapula stability exercises on improving muscle power and functional performance in individuals with scapular dyskinesis was assessed. A convenient sampling technique was used, and Epi Info Software was used to calculate the sample size. A two-sided 95% confidence interval and a statistical power of 80% were employed to detect a mean difference of 10.33 between the groups.

Participants

A total of 40 participants were included, of whom 32 matched the inclusion criteria. These 32 participants were taken from Saveetha College of Physiotherapy and placed in the Scapular Stability Exercise (SSE) group (Experimental group) (n = 16) and Scapular Mobilization (SM) group (Control group) (n = 16) using the closed-envelop method.

Inclusion criteria

- Participants exhibited a positive response to the scapular assistance test.
- Participants aged 18 to 25 years.
- Both males and females.
- Disability of the Arm, Shoulder and Hand (DASH) questionnaire score >30.
- Participants who are able to throw a medicine ball at less than 2m in a seated position.

Exclusion criteria

- Injury to the upper limb.
- Neurological disorder.
- Fracture of the upper limb.
- Concurrent therapy includes Kinesio taping, electrical stimulation, ultrasound therapy, proprioceptive exercises, and instrument-assisted soft tissue mobilization.

Procedure

The intervention used in the study lasted for 6 weeks, and both SSE and SM groups participated in the supervised exercise sessions twice a week. Each session lasted 1 hour.

Scapula Stability Exercise (SSE) group: There were two sections to the training protocol, as shown in Table 1. The participants performed scapula stability exercises, comprising the following:

Static Stretching: comprising,

- Cross - body adduction
- Sleeper stretch
- Corner stretch

Strength training: comprising,

- Prone-T
- Prone-Y
- Ceilings punch
- Bilateral external rotation
- Standing dynamic hug
- Lawnmower
- Blackburn
- Push-ups

Table 1. Scapula Stability Exercises Protocol

	First Day	T/Reps	Sets	Second Day	T/Reps	Sets
Week 1	•Sleepers stretch • Prone T • Prone Y	10s 8 8	3 3 3	• Cross body adduction • Ceiling punch • Prone T	10s 8 10	3 3 3
Week 2	• Sleepers stretch	15s	3	• Cross body adduction	15s	3

	• Bilateral external rotation • Prone Y	8 10	3 3	• Blackburn exercise • Bilateral external rotation	8 10	3 3
Week 3	• Sleepers stretch • Bilateral external rotation • Standing dynamic hug	15s 10 8	4 4 4	• Corner stretch • Blackburn exercise • Prone Y	15s 12 12	3 3 3
Week 4	• Sleepers stretch • Bilateral external rotation • Prone T	20s 12 12	4 4 4	• Corner stretch • Blackburn exercise • Standing dynamic hug	20s 12 12	3 3 3
Week 5	• Sleepers stretch • Lawnmower exercise • Blackburn exercise	25s 12 12	4 4 4	• Corner stretch • Push-ups • Bilateral external rotation	25s 12 12	3 3 3
Week 6	• Cross body adduction • Lawnmower exercise • Blackburn exercise	30s 15 15	4 4	• Corner stretch • Standing dynamic hug • Lawnmower exercise	30s 15 15	3 3 3

NOTE: T= Time; Reps = Repetitions.

Scapular Mobilization (SM) group: Every participant in the SM group engaged in scapular mobilization twice a week for six weeks, with each session lasting for one hour. Grade I or II mobilization was utilized (Aytar, A et al., 2015).It includes superior and inferior glides to the scapula, upward and downward rotations to the scapula, and scapular distraction. Each mobilization was applied in three sets of ten repetitions, with one cycle completed every six seconds and a 30-second rest period between sets.

Instrument

Outcome measures

- Seated medicine ball throw was used to assess upper body muscle power. The subjects were asked to throw the medicine ball forward in a seated position on the floor. They held a 2 kg medicine ball against their chest. Upon receiving a verbal cue from the researcher, subjects perform a chest-pass motion, pushing the medicine ball forward as forcefully as possible. At the same time, their back and head remained in contact with the wall. A measuring tape was placed on the ground, starting at the ball's resting position (2 cm from the participant's pelvis) and extending outward. The tape records the distance in meters, measuring from the starting point to the ball's first contact with the floor. Each participant was given three attempts to throw the medicine ball, with a two-minute rest between attempts. Subjects were included if they threw the medicine ball within 2 meters.
- Disability of the arm, shoulder, and hand questionnaire, a thirty-item self-reported measure that evaluates any difficulty in performing upper extremity activity over the past week. Each item offers five response options. The DASH score is calculated by summing all the completed (n) responses and dividing them by the total number of completed responses (n) to obtain an average score. From the average, subtract one, and the resulting value is multiplied by 25 to get the final DASH score. The score cannot be calculated if there are more than three missing responses. The score ranges from 0 (no disability) to 100 (most severe disability).

Statistical analysis

- SPSS (Version 22) was used for the statistical analysis.
- A paired t-test was used to determine the significant difference between pre- and post-test within a group.
- An unpaired t-test estimated significant differences between the groups.
- A level of significance of $p \leq 0.001$ was considered.

Results

This study's findings demonstrated the effect of scapula stability exercises on muscle power and functional performance in scapular dyskinesia individuals. All the participants completed the six weeks of intervention, and no adverse events were reported.

Demographic data

The study presented the findings of 32 participants with scapula dyskinesis. According to the participants' demographic information, the age groups of 18 were 3 (9.4%), 19 were 5 (15.6%), 20 were 8 (25%), 21 were 6 (18.8%), 22 were 4 (12.5%), 23 were 5 (15.6%), and 24 were 1 (3.1%), respectively. Both sexes are represented in the study population: 13 (40.6%) were female, and 19 (59.4%) were male.

Scapula stability exercise (SSE) group: In the scapula stability exercise group, notable changes were observed in the DASH questionnaire and SMBT from pretest to post-test assessment, as shown in Table 2. The DASH questionnaire, which assesses impairments and limitations in activities, showed a decreased value from a pretest mean to a post-test mean, indicating increased functional performance. The SMBT, which measures distance thrown by participants, showed an increased value from a pretest mean to a post-test mean, indicating increased muscle power.

Table 2. Pre-test and Post-test values of scapula stability exercise (SSE) group

Outcome Measures	Test	Mean ± SD	t- value	p- value
Disability of the Arm, Shoulder, and Hand Questionnaire	Pre-Test	39.68 ± 5.32	24.01	<0.001
	Post-Test	20.51 ± 3.76		
Seated Medicine Ball Throw	Pre-Test	1.60 ± 0.20	-24.77	<0.001
	Post-Test	3.95 ± 0.35		

Scapular Mobilization (SM) group: In the scapular mobilization group, notable changes were observed, but not as SSE group in DASH questionnaire and SMBT from pretest to post-test assessment, as shown in Table 3.

Table 3. Pre-test and Post-test values of scapular mobilization (SM) group

Outcome Measures	Test	Mean ± SD	t- value	p- value
Disability of the Arm, Shoulder, and Hand Questionnaire	Pre-Test	39.50 ± 5.69	29.53	<0.001
	Post-Test	31.33 ± 5.17		
Seated Medicine Ball Throw	Pre-Test	1.59 ± 0.20	-11.18	<0.001
	Post-Test	2.29 ± 0.35		

A comparison of post-values between SSE group and SM group revealed significant differences in DASH questionnaire and SMBT as shown in Table 4. For DASH questionnaire, SSE group recorded a mean score of 20.51 ± 3.76. In contrast, the SM group recorded a greater mean score of 31.33 ± 5.17 with a t value of –6.76 and p value of <0.001, which indicates SSE group showed increased functional performance than SM group. Similarly, in terms of SMBT, SSE group recorded a mean score of 3.76 ± 0.54. In contrast, the SM group recorded a lower mean score of 2.29 ± 0.35 with a t value of 9.08 and p value of <0.001, which indicates the SSE group showed increased muscle power than the SM group.

Table 4. Post-test value comparison between groups (SSE group and SM group)

Outcome Measures	Group	Mean ± SD	t- value	p- value
Disability of the Arm, Shoulder, and Hand Questionnaire	SSE group	20.51 ± 3.76	-6.76	<0.001
	SM group	31.33 ± 5.17		
Seated medicine ball throw (SMBT)	SSE group	3.76 ± 0.54	9.08	<0.001
	SM group	2.29 ± 0.35		

Summary of findings

- SMBT score showed statistically significant improvement in SSE group, suggesting improved muscle power.
- DASH score showed a significant decrease in the SSE group, suggesting improved functional performance.

The result suggests that the findings are statistically significant with the p-value <0.001. This demonstrated that scapula stability exercises improve muscle power and functional performance among scapula dyskinesia individuals.

Discussion

The purpose of this study is to assess the effect of scapula stability exercises on muscle power and functional performance among individuals with scapular dyskinesia. It is an experimental study conducted for 6 weeks, involving a total of 32 participants: 16 participants in the scapula stability exercise (SSE) group and 16 participants in the scapula mobilization (SM) group. The study utilizes SMBT to assess muscle power, which evaluates the muscle power of the upper body. To assess functional performance, the study employs the DASH Questionnaire, which is a standardized tool used to examine impairments and limitations in activities of the upper extremity. The findings of this study show a significant difference between the SSE group and the SM group. The scapula stability exercises improve both muscle power and functional performance among scapular dyskinesis individuals. In contrast, scapular mobilization shows relatively less improvement in muscle power and functional performance among scapular dyskinesis individuals, indicating the superiority of stability exercises. This finding aligns with previous studies demonstrating that combining scapular stabilization exercises with strengthening and stretching routines is more effective in enhancing muscle strength, improving joint position sense, and reducing scapular dyskinesis (Başkurt et al., 2011). Similarly, in the present study, scapula stability exercises, which solely focus on stretching and strengthening, showed a significant improvement in muscle power and functional performance in individuals with scapular dyskinesia. Our findings also align with those of (Tang et al., 2024), which shows that participants who perform targeted scapular stabilization exercises experience more significant improvements in shoulder function, pain reduction, and scapular stability compared to those who follow a conventional exercise regimen.

Tailoring scapular stabilization exercises to the specific type of scapular dyskinesis appears to be an effective intervention and holds clinical value in the rehabilitation program. Additionally, the results we obtain align with those of (Hibberd et al., 2012), which shows that implementing a strengthening and stretching program did not lead to significant changes in muscle strength and scapular kinematics, and the addition of stretching exercise is needed, which provides a foundation for developing future training protocols. Our study protocol uses similar exercises (scapular stability exercise) along with some additional exercises for improving muscle power and functional performance. The SSE group showed significant improvement in scapular dyskinesia. Turgut et al. (2017) conclude that exercise therapy is a safe and practical approach to reduce pain and improve disability status. However, the addition of scapular stability exercises to a shoulder girdle strengthening and stretching program results in minimal improvements in scapula kinematics at 6 weeks and 12 weeks, which are unlikely to be of clinical significance. In contrast, our study shows significant improvement in scapular dyskinesis when treated with scapular stability exercises for 6 weeks, thereby indicating that stabilization exercises improve scapular kinematics. Gorji et al. (2022) conclude that stabilizing exercises enhance the strength of the shoulder girdle and range of motion, resulting in appropriate scapula kinematics and function. Momenpour et al. (2023) suggest that the prescribing of corrective exercises (strengthening and stretching) effectively improves scapular dyskinesis and increases external shoulder rotation strength in male boxers with scapular dyskinesis.

Consequently, these exercises can be utilized by trainers, athletes, and therapists to reduce symptoms linked to scapular dyskinesis. Alshami & AlSadiq (2021) conclude that incorporation of scapulothoracic mobilization with movement did not lead to additional benefits beyond those achieved with exercise and corrective taping alone over the 3-week intervention period. Similarly, in our study, scapular mobilization does not improve muscle power and functional performance among scapular dyskinesis individuals as scapula stability exercises do. Kamonseki et al. (2023) conclude that scapular movement training does not demonstrate superiority over standardized exercise programs in enhancing scapular biomechanics, behavioral outcomes, and clinical measures in people with shoulder pain and scapular dyskinesis. Similarly, in our study, scapular mobilization does not show superiority over scapula stability exercises in improving muscle power and functional performance among scapular dyskinesis individuals.

Limitations

This study has certain limitations, including a minimal sample size. It focuses exclusively on individuals with scapular dyskinesis aged 18–25, which limits its applicability to other age groups. Participants weren't selected based on the specific type of scapular dyskinesis. Convenient sampling limits the study's capacity to be applied to a larger group.

Conclusions

This study demonstrated that individuals with scapular dyskinesia have significant improvement in their muscle power and functional performance following 6 weeks of scapula stability exercises. Participants who took part in scapula stability exercises demonstrated a more substantial reduction in DASH questionnaire scores and improved SMBT scores compared to scapular mobilization, indicating improved functional performance and muscle power, respectively. The results of this study contributed to the growing evidence supporting scapula stability exercises as a more effective intervention for improving upper body muscle power and functional performance in individuals with scapular dyskinesis. The findings of this study suggested that rehabilitation programs for scapular dyskinesis should emphasize scapular stability exercises. Further research with a larger sample size will be needed to validate these findings, enhance therapy strategies for people with this illness, and determine the optimal combination of these interventions for holistic rehabilitation. Participants need to be selected according to the type of scapular dyskinesis to provide optimal treatment. Future studies can extend the intervention period from 6 weeks to observe the substantial changes in scapular dyskinesis in individuals.

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Conflicts of Interest

All authors clearly stated that they have no conflicts of interest.

Data availability

Usually, the data sets are created during and/or analyzed throughout the entire study and are available from the corresponding author upon reasonable request.

Ethics approval

027/10/2024/ISRB/UGSR/SCPT

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