International Journal on Science and Technology (IJSAT)

E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Effects of Eccentric Scapular Strengthening On Scapular Stability Among Regular Gym-Goers with Scapular Dyskinesis

Giriprasath T[1], Arvind M[2]

[1] Student, Srm College Of Physiotherapy,Srm Institute Of Science And Technology, Srm Nagar, Kattankulathur 603203, Kanchipuram, Chennai, Tamilnadu, India.

[2]assistant Professor, Srm College Of Physiotherapy, Faculty Of Medicine Health And Science Srm Institute Of Science And Technology, Srm Nagar, Kattankulathur 603203, Kanchipuram, Chennai, Tamilnadu, India.

ABSTRACT

BACKGROUND:

Scapular dyskinesia involves visible changes in the scapula's position and movement due to altered activation of stabilizing muscles, leading to instability and shoulder injuries. Important scapular stabilizers include the upper and lower trapezius and serratus anterior. Dyskinesia results from weakness in the lower trapezius and serratus anterior and hypertrophy in the lower trapezius, causing muscle function reduction and shoulder injuries like impingement and rotator cuff tears.Eccentric exercises, which emphasize muscle lengthening, effectively target scapular stabilizers, improving muscle strength and tendon stiffness. This training is more effective than concentric exercises and enhances the muscles' ability to transmit force. However, current gym protocols often neglect stabilizing muscles such as the lower trapezius, serratus anterior, rhomboids, and shoulder rotators, focusing instead on major muscles like the deltoid, pectoralis major, and upper trapezius. This imbalance in training leads to scapular instability.

OBJECTIVE:

To assess the efficacy of eccentric scapular muscle strengthening in stabilizing the scapula.

METHODS:

It is a Quasi-experimental study of the pre and post type with a sample of 34 gym-goers with scapular dyskinesis . Subjects with inconsistent to the gym are excluded. Samples are assesed with LSST for inclusion. They were underwent eccentric trianing for 8 weeks.The study setting was SRM gym ,Nitro gym, BB fittness, Royal gym.

RESULTS:

The result shows a mean difference of 0.323,0.280 and 0.311 at the position of 0 degree, 45 degree and 90 degree with a significance of $p<0.05$.

CONCLUSION:

Eccentric scapular strengthening for 8 weeks had a significant effects on scapular stability in regular gym-goers with scapular dyskinesia

KEYWORDS: Gym-goers, eccentric training, scapular dyskinesia, Lateral scapular slide test.

1. INTRODUCTION

The scapula, commonly known as the shoulder blade, is a flat, triangular-shaped bone located in the upper back that connects with the collarbone. In shoulder joint humerus connects with the clavicle and scapula with help of lot of surrounding structures around the joint. The coordinated activities of those surrounding musculature gives stability for glenohumeral joint. Trapezius, serratus anterior, levator scapula, rhomboid major and minor which are commonly called as scapular stabilizers and also rotator cuff muscles should work properly to maintain the biomechanics and position of the scapula and shoulder joint. Looking on to the biomechanics of the scapula, no articulation takes place in scapulothoracic joint and so it allows variety of movements in various directions which are retraction and protraction, elevation and depression, anterior and posterior tilt, rotations in internal, external, upward and downward directions[1].

The proper interaction between kinematics of scapula and humerus is commonly known as scapulo-humeral rhythm. Scapulohumeral rhythm plays a major role in maintaining the function of shoulder joint. When flexion is performed there will be 100" to 120° range done by glenohumeral joint and then the combined kinematics of scapula and humerus will increase the flexion range from 150° to 180° and in case of abduction 40° to 60° will be produced by glenohumeral joint and then the humerus and scapula movement combines to produce maximum of 150 to 180° elevation[2].

While doing humeral elevation, there will be a downward rotation of scapula in the range between 0 to 30° followed by upward rotation in range between 30° to 120°[3]. In abduction there will be a scapular muscle contraction when there is stressing of arm. There will be difference in kinematic of scapula between the people who has high and low BMI. The scapular upward rotation is more while doing arm elevation in case of high BMI. When comparing children with adults, there will be increased upward rotation between the range of 25° to 125° in children with increased scapulohumeral rhythm[3].

Scapular dyskinesia is defined as visible changes in the position and movement pattern of the scapula and appears to result from changes in the activation of the scapular stabilizing muscles[4].Therefore, repetitive muscle fatigue can directly affect scapular rhythm, leading to increased compensatory rotation or instability of the shoulder blade.[5] These changes in shoulder blade position have the effect of reducing muscle function, which can lead to shoulder injuries[6,8] .The important scapular muscles that help stabilize and move the scapula are the UT and LT muscles and SA.The muscular factors of scapular dyskinesia are weakness of the LT and SA muscles and hypertrophy of the LT muscle[7,8].

Scapular stability is important for overall shoulder function.This involves the ability of the scapula to maintain a stable foundation during movements of the upper limbs[9].When the scapula is unstable, the risk of acute and chronic shoulder injuries increases, such as impingement or rotator cuff tears[10].Dyskinesia (abnormal shoulder blade movements) is often associated with instability and weak or unbalanced shoulder muscles[11].

Eccentric exercises focus on lengthening muscles. For example, during a squat, the quadriceps extend as the person lowers their body. This type of contraction occurs when an individual exerts more force than their muscles can produce. The added power comes from the combination of body weight, gravity, and any additional weight being used during the squat. As a result, the muscles absorb energy from the external load. This process is sometimes referred to as "negative work"[12,13].

Eccentric exercises target specific stabilizing muscles of the scapula, such as the lower and middle trapezius and the serratus anterior.Proper timing of muscle recruitment is essential.For example, overhead athletes may recruit the upper trapezius before the lower or middle trapezius, thus influencing the movement of the scapula[14,18].

Eccentric training improves muscle strength more effectively than concentric training.It also increases the stiffness of tendons, making them stronger and more efficient at transmitting force from muscle to bone[15,16].

Studies have shown the effectiveness of eccentric rotator cuff training with subacromial impingement showing pain reduction and improved function[17]. According to a study by Kibler, type 1 scapular dyskinesia (seen in 68% of subjects), characterized by the scapula protruding at a lower angle or tilting forward, is more common than type 2 scapula dyskinesia (present in 32% of subjects), characterized by prominence of the medial edge or wing of the scapula [19].

Modern gym routines tend to focus on strengthening muscles such as the triceps, pectoralis minor, upper trapezius, latissimus dorsi, biceps brachii, and deltoid. However, muscles that play a crucial role in stabilizing the shoulder joint, like the rotator cuffs, lower trapezius, serratus anterior, and rhomboids major and minor, often receive less attention. This uneven training of different muscle groups leads to imbalance. As primarily the gym goers focus on those major muscles, the stabilizing muscles of scapula leads to instability. So the need of the study is to improve the stability of the scapula[20,21]. The objective of the study is to evaluate the efficacy of eccentric scapular muscle strengthening for stabilization.

2. METHODS

This study was a quasi-experimental study lasting six weeks and was conducted among 34 participants selected through convenience sampling. Ethical approval was obtained from INSTITUTIONAL ETHICS COMMITTEE OF SRM MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE on 25.04.2024. The Ethical Clearance number is **SRMIEC-ST0224-1123**.

Subjects aged 18–35 years, male, who are regular gym-goers with at least one year of consistent training experience. Participants who tested positive in the Lateral Scapular Slide Test (LSST) and are asymptomatic were included in the study. Subjects with recent upper limb soft tissue injuries (such as muscle strains or ligament sprains), recent fractures, or any pain or discomfort were excluded. Additionally, individuals who are non-volunteers or have any condition preventing regular participation in gym sessions were excluded from the study. Prior to the study, the informed consent was obtained from the individuals after explaining about the procedure. The demographic data were recorded at beginning of exercise protocol.

Pre readings were assessed with lateral scapular test at three angles of shoulder at 0 degree, 45 degree, 90 degree.

Lateral scapular slide test

The lateral scapular slide test is a physical examination maneuver used to assess scapular stability and identify abnormalities or dysfunctions in scapular movement patterns.

The test measures the amount of scapular protraction in 3 positions of shoulder joint abduction, by measuring the distance from the midline to the medial boarder of the scapula.

The test is done in 3 positions:

Position 1: The shoulder is in neutral position, with the arms relaxed at the sides.

Position 2: The humerus is placed in medial rotation and 45 degrees abduction, by positioning the patient's hands around the waist.

Position 3: The humerus is placed in maximal medial rotation and 90 degrees abduction.

The test is positive when there is a difference of 1.5 cm or more when measurements are compared bilaterally.

Before starting the exercise, the warm up, which include breathing, shoulder rotation, stretches was instructed to the subjects. After the warm up, the subjects followed the exercise protocol as prescribed for 4 sessions per week for 8 weeks (8 weeks×4 days = 32 sessions). Once the exercise protocol was finished, a cool down exercises was provided to participants, which included static stretches. Post test was done at the end of 8 weeks using the same method.

TABLE I
EXERCISE PROTOCOL:

WEEKS	EXERCISES	FREQUENCY	INTENSITY	TYPE	TIME
1-3	Eccentric Internal Rotation in elbow 90 degree	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (50% OF 10 RM)	Eccentric strengthening	10 mins
	Eccentric External Rotation in elbow 90 degree	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (50% OF 10 RM)	Eccentric strengthening	10 mins
	Eccentric Phase of	4 times a week	3sets ×10 reps with speed of 6	Eccentric strengthening	10 mins

	Scapular Abduction		seconds per rep (50% OF 10 RM)		
	Eccentric reverse fly	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (50% OF 10 RM)	Eccentric strengthening	10 mins
4-6	Eccentric Internal Rotation in lying	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (75% OF 10 RM)	Eccentric strengthening	10 mins
	Eccentric External Rotation in lying	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (75% OF 10 RM)	Eccentric strengthening	10 mins
	Eccentric Phase of Scapular Abduction	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (75% OF 10 RM)	Eccentric strengthening	10 mins
	Eccentric reverse fly	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (75% OF 10 RM)	Eccentric strengthening	10 mins
	Eccentric Internal Rotation in shoulder 90degree abduction	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (90% OF 10 RM)	Eccentric strengthening	10 mins
	Eccentric External Rotation in	4 times a week	3sets ×10 reps with speed of 6 seconds per	Eccentric strengthening	10 mins

7-8	shoulder 90 abduction		rep (90% OF 10 RM)		
	Eccentric Phase of Scapular Abduction	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (90% OF 10 RM)	Eccentric strengthening	10 mins
	Eccentric reverse fly	4 times a week	3sets ×10 reps with speed of 6 seconds per rep (90% OF 10 RM)	Eccentric strengthening	10 mins

RESULTS

TABLE II

DEMOGRAPHIC DATA

DEMOGRAPHIC VARIABLES	MINIMUM	MAXIMUM	MEAN	SD
AGE	18	35	25.82	5.024

Table II shows the mean age of 34 population is 25.82 ± 5.024.

TABLE III

PRE AND POST TEST VALUES OF LSST AT 0 DEGREE

OUTCOME (LSST)	TEST	MEAN	SD	MD	t VALUE	p VALUE
AT 0 degree	**PRE TEST**	2.04	0.31	0.32	24.16	0.00
	POST TEST	1.72	0.33			

Table III shows the mean and standard deviation value of pre and post values of LSST at 0 degree is 2.04 ± 0.31 and 1.72 ± 0.33. The t value and significance is 24.16 and <0.05.

BAR DIAGRAM I

PRE AND POST TEST VALUES OF LSST AT 0 DEGREE

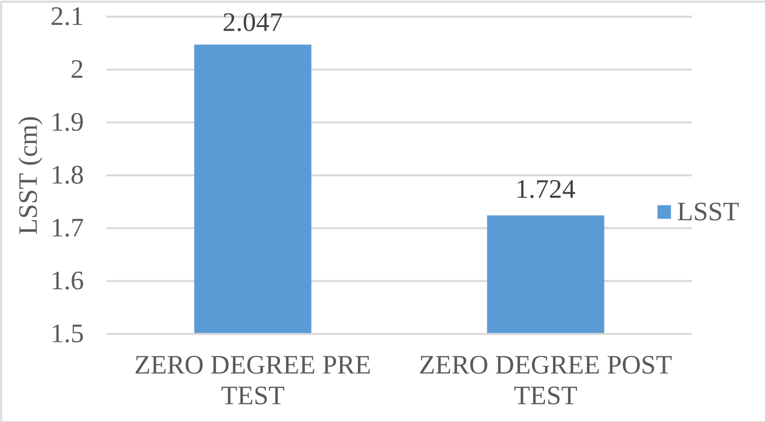


TABLE IV

PRE AND POST TEST VALUES OF LSST AT 45 DEGREE

OUTCOME (LSST)	TEST	MEAN	SD	MD	t VALUE	p VALUE
AT 45 degree	PRE TEST	1.81	0.27	0.28	25.41	0.00
	POST TEST	1.53	0.28			

Table IV shows the mean and standard deviation value of pre and post values of LSST at 45 degree is 1.81 ± 0.27 and 1.53 ± 0.28. The t value and significance is 25.41 and <0.05.

International Journal on Science and Technology (IJSAT)

E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

BAR DIAGRAM II

PRE AND POST TEST VALUES OF LSST AT 45 DEGREE

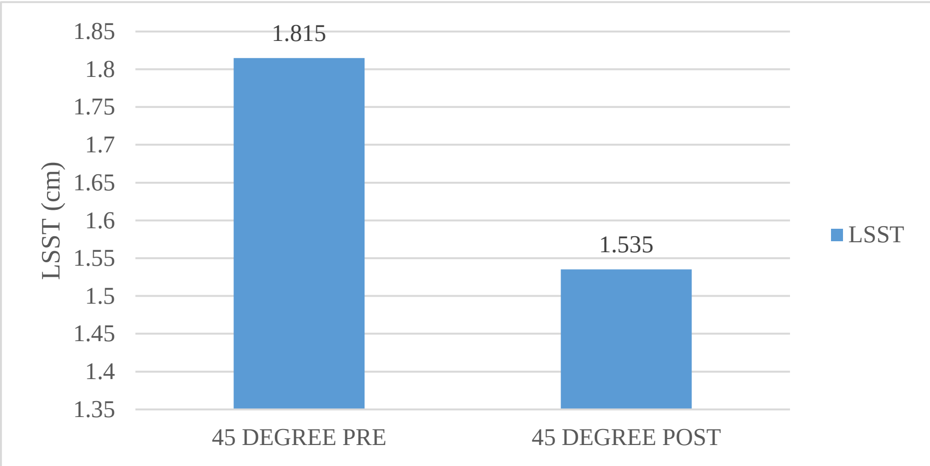
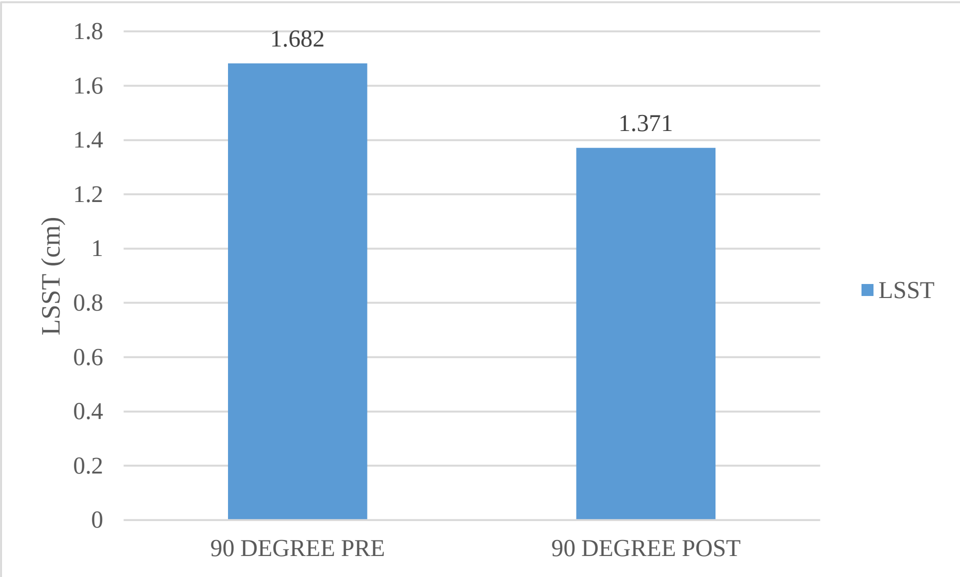


TABLE V
PRE AND POST TEST VALUES OF LSST AT 90 DEGREE

OUTCOME (LSST)	TEST	MEAN	SD	MD	t VALUE	p VALUE
AT 90 degree	PRE TEST	1.68	0.22	0.31	22.50	0.00
	POST TEST	1.37	0.24			

Table V shows the mean and standard deviation value of pre and post values of LSST at 90 degree is 1.68 ± 0.22 and 1.37 ± 0.24. The t value and significance is 22.50 and <0.05

BAR DIAGRAM III
PRE AND POST TEST VALUES OF LSST AT 90 DEGREE



3. DISCUSSION

The aim of the study is to find out the effects of eccentric scapular strengthening exercises on scapular stability among regular gym-goers with scapular kinesis. This research seeks to determine whether targeted eccentric training can improve scapular function, reduce kinesis symptoms, and enhance overall shoulder stability. By focusing on this specific exercise modality, the study aims to provide evidence-based recommendations for gym enthusiasts struggling with scapular kinesis.

In this study, the pre-test and post-test comparisons of scapular stability at 0 degrees of shoulder abduction among participants with scapular dyskinesis demonstrated a significant improvement following the intervention. The pre-test scores had a average of 2.04 with a SD of 0.31, while the post-test scores had a average of 1.72 with a SD of 0.33. The average difference was 0.32, and the t-test yielded a t-value of 24.16 with a statistically significant p-value of 0.00.

This significant improvement can be attributed to the role of the scapula in establishing a solid base for shoulder movements. At 0 degrees of abduction, known as the "setting phase," the scapula aims to achieve a stable position in relation to the humerus.. Strengthening the scapular stabilizers, such as the serratus anterior, lower trapezius, and rhomboids, helps maintain this stability. A study by **Kibler and McMullen (2010)** highlighted that scapular dyskinesis often involves weak serratus anterior muscles, leading to inferior angle prominence (Type I dyskinesis)[4]. Enhanced stability at 0 degrees suggests improved activation and coordination of these muscles, reducing dyskinesis symptoms.

The comparison at 45 degrees of shoulder abduction also showed significant improvements. Pre-test scores had a average of 1.81 with a SD of 0.27, while post-test scores had a average of 1.53 with a SD of 0.28. The average difference was 0.28, and the t-test yielded a t-value of 25.41 with a statistically significant p-value of <0.05.

At 45 degrees, the scapula starts moving more dynamically to facilitate shoulder abduction. This phase relies on both static and dynamic stabilizers to maintain control. Weakness in scapular stabilizers, such as the serratus anterior and lower trapezius, combined with over-strengthening of shoulder mobilizers, can lead to dyskinesis. The significant improvement in post-test scores suggests that targeted interventions successfully enhanced the strength and coordination of scapular stabilizers. This aligns with findings by **Kendall et al., (2005),** who noted that weak serratus anterior muscles are more prevalent than generally realized and can lead to scapular dyskinesis during shoulder movements[6] .

Finally, at 90 degrees of shoulder abduction, significant improvements were also observed. The pre-test scores had a average of 1.68 with a SD of 0.22, while the post-test scores had a average of 1.37 with a SD of 0.24. The average difference was 0.31, and the t-test yielded a t-value of 22.50 with a statistically significant p-value of <0.05.

At 90 degrees, the scapula undergoes considerable upward rotation, posterior tipping, and external rotation.The main stabilizer of the scapula's inferior angle and medial border, the SA, plays a crucial role in these movements. Weakness in this muscle, often due to overuse or improper training techniques, can result in scapular dyskinesis. The post-test improvements suggest that interventions focusing on the serratus anterior and other stabilizing muscles effectively reduce dyskinesis. This is supported by the work of **Kibler and McMullen (2010),** who emphasized the importance of the serratus anterior in maintaining scapular stability during shoulder movements[4] .

Overall, the significant improvements observed at all three angles (0, 45, and 90 degrees) highlight the effectiveness of targeted interventions in enhancing scapular stability and reducing dyskinesis in gym-goers. This study underscores the importance of balanced training and the role of scapular stabilizers in maintaining proper shoulder function.

4. CONCLUSION

Eccentric scapular strengthening over an 8-week period significantly enhanced scapular stability in regular gym-goers with scapular dyskinesis. This finding emphasizes the importance of targeted eccentric exercises in improving scapular stability and function.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICAL APPROVAL

Ethical approval was obtained from INSTITUTIONAL ETHICS COMMITTEE OF SRM MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE on 25.04.2024. The Ethical Clearance number is **SRMIEC-ST0224-1123**.

REFERENCES

1. Paine R, Voight ML. The role of the scapula. International journal of sports physical therapy. 2013 Oct;8(5):617.
2. Ravichandran H, Janakiraman B. Assessment and rehabilitation of scapular dyskinesis: A case study. Archives of Medicine and Health Sciences. 2016 Jul 1;4(2):244-7.
3. JJ W. Scapulothoracic motion in normal shoulders and shoulders with glenohumeral instability and impingement syndrome. Clin Orthop Relat Res. 1992;285:191-9.
4. Ben Kibler W, SCIASCIA A. Current concepts: scapular dyskinesis. British journal of sports medicine. 2010;44(5):300-5.
5. Kibler BW, McMullen J. Scapular dyskinesis and its relation to shoulder pain. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2003 Mar 1;11(2):142-51.
6. Kendall FP, McCreary EK, Provance PG, Rodgers MM, Romani WA. Muscles: testing and function with posture and pain. Baltimore, MD: Lippincott Williams & Wilkins; 2005 Feb 24.
7. Khare D, Deshmukh SV. To study the prevalence of scapular dyskinesia in gymers and non gymers. International Journal of Science and Research. 2015;6(6):911-5.
8. McQuade KJ, Borstad J, De Oliveira AS. Critical and theoretical perspective on scapular stabilization: what does it really mean, and are we on the right track?. Physical therapy. 2016 Aug 1;96(8):1162-9.
9. Mottram SL. Dynamic stability of the scapula. Man ther. 1997 Aug 1;2(3):123-31.
10. Go SU, Lee BH. Effects of scapular stability exercise on shoulder stability and rehabilitative ultrasound images in office workers. Journal of physical therapy science. 2016;28(11):2999-3002.
11. Douglas J, Pearson S, Ross A, McGuigan M. Eccentric exercise: physiological characteristics and acute responses. Sports Medicine. 2017 Apr;47:663-75.
12. Singh H, Moore BA, Rathore R, Reed WR, Thompson WR, Fisher G, Lein DH, Hunter GR. Skeletal effects of eccentric strengthening exercise: a scoping review. BMC musculoskeletal disorders. 2023 Jul 25;24(1):611.
13. Kirithika G, Kamalakannan M, Ramana K, Anitha A. Efficacy of Scapular Strengthening Exercise and Eccentric Forearm Exercise on Functional Recovery in Subjects with Lateral Epicondylitis. Indian Journal of Physiotherapy & Occupational Therapy. 2024 Jan 2;18.
14. Dejaco B, Habets B, van Loon C, van Grinsven S, van Cingel R. Eccentric versus conventional exercise therapy in patients with rotator cuff tendinopathy: a randomized, single blinded, clinical trial. Knee Surgery, Sports Traumatology, Arthroscopy. 2017 Jul;25:2051-9.
15. Couppé C, Svensson RB, Silbernagel KG, Langberg H, Magnusson SP. Eccentric or concentric exercises for the treatment of tendinopathies?. journal of orthopaedic & sports physical therapy. 2015 Nov;45(11):853-63.
16. Maenhout AG, Mahieu NN, De Muynck M, De Wilde LF, Cools AM. Does adding heavy load eccentric training to rehabilitation of patients with unilateral subacromial impingement result in better outcome? A randomized, clinical trial. Knee surgery, sports traumatology, arthroscopy. 2013 May;21(5):1158-67.
17. Beatty NR, Félix I, Hettler J, Moley PJ, Wyss JF. Rehabilitation and prevention of proximal hamstring tendinopathy. Current sports medicine reports. 2017 May 1;16(3):162-71.

18. Kibler WB, Ludewig PM, McClure PW, Michener LA, Bak K, Sciascia AD. Clinical implications of scapular dyskinesis in shoulder injury: the 2013 consensus statement from the 'Scapular Summit'. British journal of sports medicine. 2013 Sep 1;47(14):877-85.
19. McQuade KJ, Dawson J, Smidt GL. Scapulothoracic muscle fatigue associated with alterations in scapulohumeral rhythm kinematics during maximum resistive shoulder elevation. Journal of Orthopaedic & Sports Physical Therapy. 1998 Aug;28(2):74-80..
20. Ben Kibler W. The role of the scapula in athletic shoulder function. The American journal of sports medicine. 1998 Mar;26(2):325-37.
21. Camargo PR, Alburquerque-Sendín F, Avila MA, Haik MN, Vieira A, Salvini TF. Effects of stretching and strengthening exercises, with and without manual therapy, on scapular kinematics, function, and pain in individuals with shoulder impingement: a randomized controlled trial. journal of orthopaedic & sports physical therapy. 2015 Dec;45(12):984-97.