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Effect of Blackburn Exercises v/s Rhythmic Stabilization on Scapular Dyskinesis in Guitarists

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Abstract

Objective: Blackburn exercises and Rhythmic stabilization technique is effective to stabilize and control scapular movements. The study compares the effects of Blackburn exercises and Rhythmic Stabilization on scapular dyskinesis in guitarists. **Methods:** A total of 40 acoustic guitarists of both genders with scapular dyskinesia, aged 18-35 years, with an experience of minimum 2 years playing for at least 20 hours/week were included in the study. The subjects were allocated in two groups- Group A and Group B. Both the groups were given Pectoralis minor stretching. Along with that, the guitarists in Group A were given Blackburn exercises while in the Group B were given Rhythmic Stabilization 3 times/week for 4 consecutive weeks. Scapular dyskinesis was measured by Lateral Scapular Slide Test, the tightness in the pectoral muscles with Pectoralis Minor Muscle Length test, functional assessment was done by Shoulder Pain and Disability Index and pain with Algometer. Outcome measures used pre intervention were remeasured and compared in two groups using SPSS 21.0 version. **Findings:** Homogeneity was maintained with regards to gender and age in both the groups. The result of the study for both the groups post intervention showed a significant improvement in all the outcome measures with p value <0.05. Blackburn exercise and Rhythmic Stabilization were advantageous individually for all the outcome measure suggestive of improvement on scapular dyskinesia; however, when comparing the post-test results, Blackburn's intervention outperformed Rhythmic stabilization by a substantial margin (p value <0.005) for scapular dyskinesia in guitarists. Thereby concluding that both Blackburn exercises and Rhythmic Stabilization is effective in improving scapular dyskinesis in guitarists, with Blackburn exercises being more effective than Rhythmic Stabilization. **Novelty:** This work has established the efficacy of Backburn exercises over the age-old technique of Proprioceptive Neuromuscular Facilitation as a new approach for shoulder dyskinesia treatment.

Keywords: Blackburn exercises; Rhythmic stabilization; Scapular dyskinesis; Lateral scapular slide test; Guitarists

1 Introduction

The scapulothoracic joint is a functional joint rather than a true synovial joint that serves as a link in the kinetic chain, offering a secure foundation for the initiation of rotator cuff contraction, enabling coordinated scapular rotation during humeral movement.[1] A proper scapulohumeral rhythm to achieve shoulder motion, is the core mechanism underlying efficient shoulder function along with the rhomboid and serratus anterior muscles working in conjunction with the trapezius to move and stabilize the scapula on thorax.[1]

Amongst the shoulder dysfunctions that have lately been identified are playing-related musculoskeletal disorders (PRMDs), that are characterized as any discomfort, weakness or abnormal sensations that impairs one's capacity to play a musical instrument to a musician's usual standard.[2] A substantial proportion of professional musicians exhibit this with scapular dyskinesia being one such condition- Scapular dyskinesis, also known as the SICK scapula syndrome (scapular malalignment, inferior and medial border protrusion, coracoid discomfort, and dyskinesis), involves the dysfunction of the scapular kinematics and movement. The etiology of scapular dyskinesis can be divided into three major groups: Pathologies related to (1) Shoulder, (2) Neck or (3) Posture. Winging or dysrhythmia are the signs of scapular dyskinesis.[3] Professional guitarists must maintain correct posture that can be challenging throughout the prolonged practice sessions, which if not done can lead to more injuries and dysfunctions.[4] The prevalence of scapular dyskinesia has been established in the guitarists along with the upper quarter injuries.[5]

Blackburn exercises and Proprioceptive Neuromuscular Facilitation (PNF) has proven to be efficient interventions for scapular stabilization. One of the earliest methods of PNF is Rhythmic Stabilization (RS) which consists of alternating isometric contractions against resistance with no purpose of moving.[6] Blackburn et al. designed an exercise protocol for scapular dyskinesia which is a relatively new program that focuses on retraction of the scapula and activation of scapula stabilizers. They are corrective exercises that assist in maintaining the shoulder in the correct posture for good functioning.[7] The goal of these stretching and strengthening exercises is to improve kinesthesia and muscle strength.

Although the literature review shows that the PNF technique is effective for dyskinesia, but the Rhythmic stabilisation has not been studied extensively.[8] Also there is paucity of studies comparing the said two protocols. For this reason, the motive of this study is to compare and identify which of the two interventions—Blackburn exercises and Rhythmic stabilization of PNF is more effective in treating scapular dyskinesis in professional guitarists.

2 Methodology

The ethical committee of Krupanidhi College of Physiotherapy provided the approval with letter no. SC-MPT/23/PHY/-016 dated 07/06/2023. The subjects from various music institutes across Bangalore were screened and 40 guitarists were selected on the grounds of the inclusion criteria (male or female acoustic guitarists with scapular dyskinesia between the ages of 18 and 35 years with an experience of minimum 2 years for at least 20 hours/week) and subjects with a history of fractures or shoulder pathologies, rheumatoid arthritis, ankylosing spondylitis, neck disability, cervical radiculopathy, any pulmonary illness, trauma, injury or a recent (min period of 1 year) cervical or shoulder surgery were excluded[9]. All the subjects were educated regarding the intent and procedure of the study. The client information sheet was given to each participant and a written consent for participation was obtained.

2.1 Study Design

Study was designed as an experimental study, wherein the subjects were allocated into Group A and Group B by computer-based randomization and the treatment was given in the outpatient department of Krupanidhi College of Physiotherapy, Bangalore. Pre-treatment tests for scapular dyskinesis, Pectoralis minor muscle tightness, disability and pain were done using Lateral Scapular Slide Test (LSST), Pectoralis minor length test (PML), SPADI and Pressure Algometer (PPT) respectively[10]-[11]. Both the groups were given Pectoralis minor muscle stretching in standing position with 30 seconds hold for 3 repetitions[12]. One group (Group A) performed Blackburn exercises & the other group (Group B) performed Rhythmic Stabilization exercises. The treatment sessions were done for 3 day per week for 4 weeks.

2.1.1. Interventions[13],[14]

Group A- Blackburn exercises included the following in prone position- Prone T exercises with the shoulder in neutral position with respect to rotation, Prone T exercises with the shoulder in full external rotation, Prone Y exercises with shoulder in neutral, Prone Y exercises with arm externally rotated, Prone horizontal external rotation with the shoulder in 90° abduction and elbows

flexed to 90º, Prone horizontal extension with the shoulder in 60º of abduction. Each position was held for 10 seconds and 10 repetitions with a 10 seconds rest after each exercise.

Group B- Rhythmic Stabilization was given in supine with co contraction of agonists and antagonists-Manual rhythmic stabilization for rotations with arm abducted to 90º first in neutral rotation and then with 90º external rotation, manual rhythmic stabilization shoulder with arm raised to approximately 100º , manual rhythmic stabilization for shoulder flexion and extension for strumming shoulder in weight bearing quadruped position with weight shifts anteriorly and posteriorly, wall rhythmic stabilization was done with the subject standing facing the wall and the arm in 90 degrees abduction and outward rotation on a small ball in closed chain, while compressing and releasing the pressure on the ball alternatively, with the subject in half kneeling position performing outward rotation with the shoulder 90º abducted against a resistance band, rhythmic stabilization was included at the end range, wherein stability was to be maintained against the resistance band held by the therapist. Each contraction was held for 10 seconds with a 20 seconds rest in between given for10 repetitions.

Post intervention, the LSST, PML and SPADI and PPT was measured for both the groups

2.1.2. Statistical analysis

The study data was collected in MS Excel and analysis was conducted using SPSS 21.0. The pre and post-test measurements were statistically analysed with paired t-test in both the groups, whereas Mann Whitney U test was employed to determine statistical difference in scapular dyskinesia between both the groups.

3 Results and Discussion

Gender distribution in both the groups are found to be comparable and shows that both the groups displayed similar gender ratios, mean ages, ensuring sample homogeneity and reducing potential confounding factors (Table 1). When LSST scores was compared with pre-intervention (Blackburn exercises) to post-intervention, it was found to be significantly improved at all the angles. Post Blackburn exercises, group A showed statistically significant improvements in the LSST scores at 0°, 45° and 90°. This implied that a better position of muscles enhanced scapular stability due to improved muscle control following Blackburn exercises (Table 1). These results are supported by previous studies that proved the efficacy of Blackburn exercises in enhancing scapular muscle strength. These alike results in the current study could be attributed to the activation of Golgi tendon organs (GTOs), which promote muscle relaxation and hence preventing overactivity in the muscles, providing stability to the scapula [15]. LSST scores significantly improved post Rhythmic Stabilization at all angles. The differences in LSST scores at 0°, 45°, and 90º angles post-intervention were also significant for those who received Rhythmic Stabilization intervention. The improved LSST scores is indicative of the enhanced scapular stability and neuromuscular control. As per the literature review the three PNF principles of autogenic inhibition, reciprocal inhibition and the stretch reflex may have facilitated these improvements [16].

Table 2 shows that the PML, SPADI and PPT scores were significantly improved post Blackburn exercises. The significant reductions in the SPADI scores post-intervention underscored improvements in pain and functional disability levels among participants. This aligns with previous research done in 2023 highlighting Blackburn exercises' efficacy in reducing pain and improving function [17]. Moreover, PPT scores significantly increased post-intervention indicating heightened muscle tolerance to pressure and reduced pain sensitivity. These results collate with the studies that have found the probable influence of the activation of the mesolimbic dopaminergic network and the stimulation of type I collagen synthesis on the pain [17]. These corresponding results in the current study could be credited to the strengthening of the scapular muscles with the help of Blackburn exercises which adds to the stability of the scapula and a marked reduction in muscle weakness and tightness, leading to a reduction in pain and disability.

In the group administered with Rhythmic Stabilization exercises, there was a statistically significant difference found post intervention. The significant decrease in SPADI scores indicated better quality of life after Rhythmic Stabilization which is also consistent with past reports where PNF interventions were applied successfully for pain and disability reduction outcomes by Desai et al., 2021. This may be due to the improvement in the neuromuscular balance and the scapular orientation by the stimulation of proprioceptive myoreceptors of the muscles and tendons, activating the GTO and relieving pain and discomfort [16]. Similarly, PPT scores significantly increased post-intervention, indicating improved pain tolerance and functional status among participants. Similar results secured in studies of 2021 and 2023 were attributed to the increase in the circulation of blood as well as tissue fluid, pain gate theory and afferent inputs from the muscle spindles, joints and capsules [16], [18].

Table 3 depicts that the LSST scores showed more significant improvement in the group performing Blackburn exercises when compared to the group given Rhythmic Stabilization. A comparative analysis between the groups in Table 4 revealed

Table 1. Gender, Age Distribution, and LSST Scores of Guitarists with Scapular Dyskinesis in Both Groups, and Association of Pre-Test Clinical Judgement Skills with Demographic Variables (n = 41)

Gender	**Groups**				**Chi-Square test**
	Group A (Blackburn exercises)		**Group B (Rhythmic stabilization)**		
Males	15 (75.0%)		14 (70.0%)		0.125 df = 1, p = 0.723
Females	5 (25.0%)		6 (30.0%)		
Age (years)	**Group A (Blackburn exercises)**		**Group B (Rhythmic stabilization)**		**Unpaired t-test**
	22-35	29.75 ± 4.36	21-35	29.80 ± 3.41	t = 0.407, p = 0.968, NS
	Group-A: Blackburn exercises				
LSST	**Pre intervention**		**Post intervention**		
	Range	**Mean ± SD**	**Ranges**	**Mean ± SD**	**Paired t-test, p-value**
Neutral	0.6-1.5	1.13 ± 0.23	0.2-1.2	0.532 ± 0.30	t = 7.923*, 0.0001*
45 Degree	1.7-2.7	2.31 ± 0.25	0.4-1.2	0.731 ± 0.25	t=24.565*, 0.0001*
95 Degree	2.0-3.2	2.60 ± 0.38	0.9-1.5	1.152 ± 0.19	t = 22.342*, 0.0001*
	Group-B: Rhythmic stabilization				
LSST	**Pre intervention**		**Post intervention**		
	Range	**Mean ± SD**	**Ranges**	**Mean ± SD**	**Paired t-test, p-value**
Neutral	0.9-2.0	1.17 ± 0.28	0.10-1.8	0.762 ± 0.40	t = 3.123, 0.008*
45 Degree	1.7-3.3	2.23 ± 0.34	0.60-2.2	1.092 ± 0.35	t = 9.569, 0.0001*
90 Degree	2.0-3.2	2.51 ± 0.30	1.20-2.40	1.660 ± 0.28	t = 8.210, 0.0001*

Table 2. PML, SPADI and PPT scores of Guitarists with Scapular Dyskinesia in group-A

Other outcome measures	**Group-A: Blackburn exercises**					
	Pre treatment		**Post treatment**		**Paired t-test/ Wilcoxon test**	**p-value**
	Range	**Mean ± SD**	**Ranges**	**Mean ± SD**		
Pectoralis minor muscle length (PML)	6.2-8.0	7.02 ± 0.32	3.4-6.2	4.77 ± 0.86	t = 12.553*	0.0001*
Shoulder Pain and Disability Index (SPADI)	48-85	66.90 ± 9.18	11-25	17.75 ± 4.11	z = 26.765*	0.0001*
Pain Pressure threshold (PPT)	1.80-2.43	2.15 ± 0.19	2.4-4.5	3.68 ± 0.51	t = 10.886*	0.0001*

that there is a statistically significant differences in the treatment outcomes. Group A demonstrated superior enhancements in LSST scores at all tested angles, PML, SPADI and PPT scores, suggesting that Blackburn exercises offer additional benefits in managing scapular dyskinesia among guitarists. Myeungsik Hwang et al. in 2021 proved that PNF was marginally more effective than Blackburn exercises, but this could be accredited to the fact that they used the diagonal patterns of PNF in their study which involves isotonic muscle contraction contrary to the Rhythmic stabilization that functions on isometric contractions[19]. The results can be attributed to GTO activated muscle reflex inhibition. Blackburn exercises, as studied earlier, train the upper extremity at and above 90 degrees of glenohumeral elevation, by stimulating usual patterns of scapulohumeral rhythm and imitating the typical physiological patterns of the rotator cuff and scapular stabilizers[20]. This could be the possible reason why, in the present study, Blackburn exercises appear to yield superior improvements compared to Rhythmic stabilization in guitarists with scapular dyskinesia.

In a nutshell, this research demonstrated that both the Blackburn exercises and the Rhythmic stabilization improved all the outcome measures, with p values less than 0.05. When the outcomes following the intervention were compared across the two groups, Blackburn exercises revealed statistically improved outcomes than Rhythmic Stabilization with a p value of less than 0.05. In LSST, PML, SPADI, and PPT, Blackburn exercise and Rhythmic Stabilization were advantageous individually; however,

Table 3. PML, SPADI, and PPT Scores of Guitarists with Scapular Dyskinesia in the Rhythmic Stabilization Group, and Comparison of LSST Scores Among Guitarists with Scapular Dyskinesia Across Groups

Other outcomes	Group-B: Rhythmic stabilization				Paired t-test/ Wilcoxon test	p-value
	Pre treatment		Post treatment			
	Ranges	Mean ± SD	Ranges	Mean ± SD		
Pectoralis minor muscle length (PML)	6.5-8.2	6.99 ± 0.42	5.8-7.2	6.48 ± 0.54	t=6.530*	0.0001*
Shoulder Pain and Disability Index (SPADI)	52-85	67.10 ± 8.10	20-35	24.20 ± 4.53	z = 3.642*	0.0001*
Pain Pressure threshold (PPT)	1.75-2.50	2.17 ± 1.97	0.21-4.1	3.12 ± 0.52	t = 8.133*	0.0001*
	Pre test		Post test			
LSST	Group A	Group B	Group A	Group B		
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD		
Neutral	1.13 ± 0.23	1.17 ± 0.28	0.532 ± 0.30	0.762 ± 0.40		
45 Degree	2.31 ± 0.25	2.23 ± 0.34	0.731 ± 0.25	1.092 ± 0.35		
90 Degree	2.60 ± 0.38	2.51 ± 0.30	1.152 ± 0.19	1.660 ± 0.28		
Between group comparisons: Unpaired t-test	• Neutral: t = 0.423, p = 0.675 • 45 Degree: t = 0.800, p = 0.429, • 90 Degree: t = 0.889, p = 0.380,		• Neutral: t = 1.822, p = 0.044, S • 45 Degree: t = 3.675, p = 0.001, S • 90 Degree: t = 6.417, p = 0.0001, S			

Table 4. Comparison of PML, SPADI and PPT scores of Guitarists with Scapular Dyskinesia between groups

Outcome measures	Pre intervention		Post intervention	
	Group A	Group B	Group A	Group B
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Pectoralis minor muscle length (PML)	7.02 ± 0.32	6.99 ± 0.42	4.77 ± 0.86	6.48 ± 0.54
Shoulder Pain and Disability Index (SPADI)	66.90 ± 9.18	67.10 ± 8.10	17.75 ± 4.11	24.20 ± 4.53
Pain Pressure threshold (PPT)	2.15 ± 0.19	2.17 ± 1.97	3.68 ± 0.51	3.12 ± 0.52
Between group comparisons: Unpaired t-test	• PML: t = 0.076, p = 0.938, • SPADI: z = 0.860, p = 0.767, • PPT: t = 0.298, p = 0.767,		• PML: t = 7.529, p = 0.000, S • SPADI: z = 3.943, p = 0.000, S • PPT: t = 3.247, p = 0.002, S	

when comparing the post-test results, Blackburn's intervention outperformed Rhythmic stabilization by a substantial margin for scapular dyskinesia in guitarists.

4 Conclusion

Rhythmic Stabilization and Blackburn exercises both were effective in improving LSST, PML, SPADI and PPT scores, but Blackburn exercises were more effective than Rhythmic Stabilization in the treatment of scapular dyskinesis in guitarists; thus, these are recommended as a treatment regime for the same. Future studies could benefit from expanded sample sizes and extended follow-up periods to deepen understanding and validate findings. Blackburn exercises and Rhythmic Stabilization could be incorporated as an essential part of broader injury prevention programs, with ongoing evaluation of their effects on scapular dyskinesia.

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