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PREVALENCE OF SUPRASPINATUS WEAKNESS IN ADULTS WITH SCAPULAR DYSKINESIS: A CROSS-SECTIONAL STUDY

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ABSTRACT Background: Scapular dyskinesis (SD) is defined as any scapular resting position or movement pattern that is abnormal and is recognized as a clinically important factor in shoulder dysfunction. Supraspinatus is also a major stabilizer of the glenohumeral joint and is biomechanically susceptible to being impaired if the normal kinematics of the scapula are altered. Although there is an increasing understanding of this correlation, the prevalence of supraspinatus weakness in young adults with SD is not fully understood. Method: The prevalence of supraspinatus weakness was assessed in adults (aged 18-30 years) with a diagnosis of scapular dyskinesis and its relation to pain severity and shoulder functional status was determined. The study was a cross-sectional observational study with 110 subjects (60% male, mean age 24.5±3.2 years) under the Orthopedics Department at Teerthanker Mahaveer University Hospital, Moradabad. The Lateral Scapular Slide Test (LSST) was used to measure scapular dyskinesis at 0°, 45° and 90° of shoulder abduction. The strength of the supraspinatus muscle was assessed clinically and the pain in the shoulder measured by the Visual Analogue Scale (VAS). Chi-square test and Pearson correlation coefficient (p value < 0.05) were used as statistical analysis. Results: Of 110 participants, 78 (70.9%) had scapular dyskinesis. Of these, 65 (83.3%) had a positive supraspinatus test. The most common pattern (42.3%) was type I SD. There was a statistically significant relationship between SD and supraspinatus weakness ($\chi^2 = 18.45$, $p < 0.001$), and a moderate positive correlation between the magnitude of SD and supraspinatus weakness ($r = 0.64$, $p < 0.001$). Conclusion: Scapular dyskinesis is a very common condition in young adults and supraspinatus weakness is a significant component of this condition, highlighting the need for a more holistic approach to the assessment and rehabilitation of both the rotator cuff and scapular stability.The lateral scapular slide test may be useful in detecting lateral scapular slide, a condition commonly referred to as scapular dyskinesis, supraspinatus weakness and shoulder dysfunction.

KEYWORDS : Scapular Dyskinesis, Supraspinatus Weakness, Shoulder Dysfunction, Rotator Cuff, Lateral Scapular Slide Test, Prevalence

INTRODUCTION

Scapula is a structurally complex triangular bone, anchored to the posterior thoracic cage from T2-T7 which forms the anatomical and biomechanical basis of the shoulder girdle. It has four essential mechanical functions: it serves as the pivot around which the humerus moves, it attaches the humerus to the axial skeleton, it protects the acromion from obstruction when the arm is raised overhead and it transfers the kinetic energy from the trunk to the upper limb (Panagiotopoulos & Crowther, 2019). A disturbance to these coordinated functions may have a domino effect on the entire shoulder complex. Scapular dyskinesis (SD) refers to an alteration of the resting posture or dynamic motion pattern of the scapula that is clinically observed and that is different from typical scapular/normal biomechanical norms (Kibler et al., 2013). It is not a standalone condition, but rather a symptom of deeper neuromuscular imbalances, skeletally structural issues or soft tissue dysfunction. There is epidemiological evidence that SD can occur in the symptomatic and asymptomatic population, especially in overhead and contact sports players (Burn et al., 2016). It is divided into three main types: Type I (inferior-medial scapular border prominence); Type II (medial scapular border winning); and Type III (supero-medial scapular border protrusion), which are a reflection of different patterns of muscular imbalance and scapular mispositioning (Sanchez & Sanchez, 2018).

Supraspinatus is one of the components of rotator cuff, which is very important for maintaining the stability of glenohumeral joints by compressing the head of the humerus against the glenoid fossa and initiating the motion of abduction of the glenoid humerus (Malani & Patil, 2024). During normal conditions the scapula will dynamically reposition to ensure the supraspinatus is optimally positioned for length-tension relationship as it moves through the shoulder's range of motion. An aberrant mechanical loading of the supraspinatus can gradually start to decrease the force generating capacity of the tendon as the scapular dyskinesis changes this positioning (Reuther et al, 2015). The biomechanical relationships are suggestive of a causal or co-existent association between SD and supraspinatus weakness, but its exact prevalence in young adults is under-characterized.

Previous studies have reported the prevalence of SD between 8.5% in asymptomatic elite swimmers (Preziosi Standoli et al., 2018) and much higher in clinical populations with symptoms (Rajpurohit & Anap, 2021). There are some studies that have investigated SD in overhead athletes (Kibler & Sciascia, 2019; Sonnier et al., 2023) and subacromial impingement syndrome (Lopes et al., 2015), but to date, there are not many studies that have quantified how common supraspinatus weakness is in a general young adult athletic population. Moreover, the impact of the two conditions of SD and supraspinatus weakness together on the function, especially pain intensity, has not been fully clarified. This study, therefore, aimed to establish the prevalence of supraspinatus weakness in adults (18–30 years) with diagnosis of scapular dyskinesis and to explore the relationship between the severity of scapular dyskinesis, supraspinatus weakness and shoulder pain. Findings are aimed to help physiotherapists with the clinical algorithm used to assess shoulder dysfunction in active young adults and rehabilitation strategies employed.

MATERIALS AND METHODS

Study Design and Setting: Cross sectional observational study was done on department of Orthopedics, Teerthanker Mahaveer University hospital, Moradabad, Uttar Pradesh. This study was approved by the institutional review board, and informed written consent was obtained from all of the participants before their enrollment.

The number of participants was 110, aged 18–30 years, were recruited by stratified random sampling. Inclusion criteria included clinical diagnosis of SD, recreational and/or professional athlete, and informed consent. The participants were excluded if they had a previous history of surgery or fracture of the shoulder, neuromuscular diseases affecting upper limb function, cervical radiculopathy (Dhami & Sharma, 2015; Khare & Deshmukh, 2015).

The Lateral Scapular Slide Test (LSST) was utilized for assessing SD and is a clinically measured tool for scapular asymmetry when shoulder joints are positioned statically. Three shoulder abduction positions (0°, 45°, and 90°) were used for measurements. A maximum inter-side asymmetry of >1.5 cm at any location was taken as a sign of SD (Ravichandran & Janakiraman, 2016). Then the SD type was determined by trained physiotherapists based on a set of visual observation criteria while the arm was swinging freely while active. Evaluation of Supraspinatus Weakness: The Empty Can Test (Jobe's Test) was used to assess the strength of the supraspinatus muscle, which is a widely used clinical test to detect supraspinatus weakness. Weaknesses were confirmed when the subjects complained of pain, did not maintain resistance or showed a decrease in force as measured in comparison to the unaffected limb. Test was conducted bilaterally in the standing position with shoulder at 90° abduction and 30° horizontal adduction with shoulder in internal rotation (Cools et al., 2014).

Assessment of pain: Intensity of pain in the shoulder was measured by the Visual Analogue Scale (VAS), a continuous rating scale ranging from 0 to 10 cm with 0 representing no pain at all and 10 the worst imaginable pain. Participants were asked to rate their current shoulder pain of the shoulder at rest and during active shoulder movement. Data Analysis: SPSS version 26.0 was used for statistical analysis. All the demographic variables and outcome variables were subjected to descriptive statistics which included mean, standard deviation, frequency and percentage. The chi-square test was used to investigate the relationship between SD and weakness of the supraspinatus, and the Pearson's correlation coefficient was calculated to assess the strength of the relationship between the quadrants of dyskinesis and supraspinatus weakness. A p value of < 0.05 was considered as significant.

RESULT

Demographic Profile: 110 participants (mean age: 24.5 ± 3.2 years) were enrolled. Sixty percent of the cohort was male and 40% female. 65% were considered as recreational athletes and 35% as professional athletes.

Overall prevalence of SD was 70.9% (78 out of 110 participants). SD was the most common pattern with 42.3% of patients having Type I (infero-medial border prominence), 31.7% Type II (medial border winning), and 26.0% Type III (supero-medial border prominence).

Supraspinatus Weakness: Of 78 that were confirmed as having SD, 65 had supraspinatus weakness on clinical evaluation, which was 83.3%. The LSST showed statistically significant asymmetry at 45° (mean asymmetry 2.1 ± 0.7 cm) and 90° (mean asymmetry 2.4 ± 0.8 cm) of shoulder abduction in participants who also had supraspinatus weakness and SD.

Chi-square analysis showed that SD was associated with supraspinatus weakness and this difference was statistically significant ($\chi^2 = 18.45$, $p < 0.001$). There was a moderately positive correlation between the magnitude of muscle force deficit and the severity of dyskinesis, with $r = 0.64$ and $p < 0.001$, using Pearson correlation analysis, suggesting that the higher the degree of scapular positional deviation, the higher the degree of muscle force deficit.

The difference in pain scores (measured using VAS) between the participants with both SD and supraspinatus weakness and those with SD alone was statistically significant ($p < 0.001$), with those who had both SD and supraspinatus weakness having significantly higher pain scores (mean VAS = 6.2 ± 1.8) than those with SD alone (mean VAS = 3.4 ± 1.2).

DISCUSSION

The current study found an 83.3% incidence of supraspinatus weakness in young adults with scapular dyskinesis, which is clinically significant and exceeds the rates in some of the previous studies. This higher prevalence could be attributed to the athletes studied, as an athletic population is likely to experience conditions that promote the development of SD alongside rotator cuff impairment (Burn et al., 2016; Sonnier et al., 2023).

The high number of Type I SD (42.3%) is in line with the known biomechanical literature. In this pattern, the reduction in subacromial space during arm elevation with posterior scapular tipping and anterior shoulder tightness, allows the supraspinatus tendon to undergo recurrent compressive and tensile loads which progressively decrease its capacity to generate forces (Sanchez & Sanchez, 2018). This effect is corroborated by Reuther et al. (2015), who performed experiments on rats that showed that scapular dyskinesis negatively affected the healing of the supraspinatus tendon after repair; this suggests that the biomechanics of the scapula impose a chronic biological and biomechanical disadvantage to rotator cuff tissue.

We noted moderate positive correlation between the severity of dyskinesis and supraspinatus weakness ($r = 0.64$, $p<0.001$), which is in line with the findings of Malani and Patil (2024) in whom they found a significant correlation between SD severity and rotator cuff strength deficits. Biomechanically, this association makes sense – as the scapula malpositions, the line of pull of the supraspinatus decreases from the optimal vector thus decreasing the mechanical efficiency and increasing the likelihood of fatigue-related weakness (Kibler et al., 2013). Additionally, the supraspinatus muscle may be inhibited by pain, which is also observed when patients suffer from subacromial impingement (Lopes 2015), thus further reducing its activation because of the neuromotor dysfunctions caused by scapulothoracic abnormalities.

The significantly higher pain score in individuals affected by SD and supraspinatus weakness (VAS 6.2 ± 1.8 vs. 3.4 ± 1.2) indicates the additional symptomatic burden of the presence of SD and supraspinatus weakness. This discovery supports the clinical model of Kibler and Sciascia (2019), who believed that SD is more of a multiplier of shoulder disease than a harmless adaptive response. This pain amplification that we saw in our cohort could represent pain related to impingement, amplified by glenohumeral instability caused by the supraspinatus (Jung & Kim, 2021; Ozturk et al., 2021). The results of the present study have direct implications for the practice of physiotherapy. The fact that 83.3% of the SD individuals showed supraspinatus weakness, this should be evaluated at the same time as scapular kinematic evaluation in all protocols of assessment for shoulder dysfunction. In isolation, rehabilitation focusing on either scapular stabilizer strengthening or rotator cuff rehabilitation alone is likely ineffective and may be expected to produce better functional outcomes with combined protocols of both strengthening the scapular stabilizers and the rehabilitation of the rotator cuff, as proposed by Cools et al. (2014) and Nowotny et al. (2018). Scapular upward rotation correction using adjunctive interventions, such as kinesiotaping (Ozer et al., 2018), might allow for better supraspinatus unloading during the early rehabilitative phase and thus be used to strengthen the rotator cuff during the later stages of rehabilitation.

The prevalence of SD in the present study is more than Preziosi Standoli et al (2018) reported in asymptomatic elite swimmers who reported 8.5% but is the same as that observed in symptomatic clinical populations of 70.9% (Preziosi Standoli et al., 2018) and 70% (Rajpurohit & Anap, 2021; Amin, 2023). This difference highlights the need for population characteristics (symptom status, sport specificity and intensity of overhead loading) to be considered when estimating prevalence of SD. The development of SD and supraspinatus weakness over time should be further explored in future multicenter studies with longitudinal designs to better clarify the temporal sequence of these changes, as well as to test the efficacy of early intervention strategies to prevent progression to more complicated shoulder pathologies (Laura et al., 2020).

CONCLUSION

This cross-sectional study demonstrates that supraspinatus weakness is very common among young adults (18-30 years) diagnosed with scapular dyskinesis (83.3%) and confirms that this relationship is moderate and statistically significant. There is a significant increase in pain intensity when there is weak supraspinatus in addition to SD, indicating that the presence of weak supraspinatus in conjunction with SD has a strong clinical impact. The results support the use of standard evaluation protocols for the shoulder that include assessment of scapular motion as well as the assessment of the rotator cuff strength and the use of integrated rehabilitation programs that focus on both the scapular motion and the rotator cuff strength to optimize functional recovery and to avoid chronic shoulder pathology in active young adults.

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