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RESEARCH ARTICLE

EFFECT OF SCAPULAR STABILIZATION EXERCISES ALONG WITH PECTORALIS MINOR STRETCHING ON THROWING VELOCITY OF BASEBALL PLAYERS HAVING SCAPULAR DYSKINESIA

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ABSTRACT

The repetitive overhead activity in players cause imbalance in scapular musculature, alteration in scapular static positioning and scapular force couple production. This manifest in form of shoulder pain or scapular dyskinesis. Scapular dyskinesis is one of the leading causes of affecting performance (throwing velocity) in players involved in overhead activities. There are numerous factors predisposing players to scapular dyskinesis and out of them Pectoralis minor shortening along with scapular muscle weakness can lead to alteration in scapular kinematics and thereby affecting their performance. The purpose of the present study was to study the effect of scapular stabilization exercises along with pectoralis minor stretching on throwing velocity in baseball players having scapular dyskinesis.20 Baseball players (Mean age = 20.75±1.65 years) were selected as per inclusion criteria (PMI ≤ 7.5). Further players were randomly divided into two groups, group A (Experimental group) and group B (Control group), having 10 players in each group. Scapular stabilization exercises along with pectoralis minor stretching were administered in group A whereas generalized shoulder exercises along with self-stretching of shoulder muscles were performed in group B. The primary outcome measure was throwing velocity which was assessed using pocket radar at baseline and after one month of intervention in both groups. Unpaired t- test was performed to compare changes in throwing velocity of players along with Pectoralis minor shortening using SPSS 19.0 version. The level of significance was set at $p< 0.05$.Before starting the intervention no significant differences were observed between two intervention groups for PMI ($t=0.0$; $p>0.05$) and throwing velocity ($t=0.13$; $p>0.05$) among baseball players. Following one month intervention, significant differences in Pectoralis minor length ($t=2.25$; $p<0.001$) and throwing velocity ($t=2.25$; $p<0.05$) of involved shoulder was found in Experimental group as compared to control group. Hence, Scapular stabilization exercises along with Pectoralis minor stretching is effective measure in improving throwing velocity in baseball players having scapular dyskinesis.

INTRODUCTION

Scapulothoracic kinematics plays a key role in the normal function of the upper extremity since it affects shoulder stability, the integrity of the superior labrum, the dimension of acromiohumeral space, function of the rotator cuff and the motion of acromioclavicular and sternoclavicular joints (Postacchini and Carbone, 2013). Normal scapular orientation at rest maintains the glenoid surface in an upward tilt which enhances passive stability of the glenohumeral joint. During elevation of the arm, the scapula must follow the humeral head with a lateral or upward rotation in order to facilitate congruency of the glenohumeral joint and thus, maximize stability. It is also imperative that the acromion process elevate and rotate in relation to the greater tuberosity of the humerus in order to avoid impingement of soft tissues in the subacromial space. In addition to demands for mobility, the scapula must also be capable of dynamic stability during arm elevation in order to afford the movers of the glenohumeral joint a stable base with which to position the arm. (Gibson *et al*., 1995).

Overhead athletes such as throwers, swimmers, tennis and volleyball players are predisposed to developing scapula thoracic and glenohumeral pathologies due to the repetitive overhead movement patterns inherent to athletic activity (Fleisig*et al*., 1999; Laudner*et al*., 2010; Kawasaki *et al*., 2012;

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Ellenbecker *et al*., 2012; De May *et al*., 2013). These repetitive overhead motions are believed to apply extreme stresses to both active and passive structures of the shoulder (Burkhart, Morgan *et al*., 2003). Athletes may develop alterations in scapular static positioning, scapular kinematics, or scapular force couple production and this condition of altered scapular mechanics and motion is called scapular dyskinesis (Postacchini and Carbone, 2013).Scapular dyskinesis is not a pathological term and it may be found either in asymptomatic subjects or patients with pain in shoulder girdle (Uhl*et al*., 2009; Silva *et al*., 2010; Juul-Kristensen *et al*., 2011; Seitz *et al*., 2012). Multiple factors may cause dyskinesis (Kibler *et al*, 2013) such as bony causes (thoracic kyphosis, clavicle fracture non-union), joint causes (AC instability, glenohumeral joint internal derangement), neurological causes (cervical radiculopathy, long thoracic nerve palsy) and soft tissue mechanisms (tightness/ inflexibility, scapular muscle activation). Adaptive shortening of the pectoralis minor muscle has been identified as a contributor to abnormal scapular kinematics and implicated as a contributor to shoulder impingement syndrome (Borstad and Ludewig, 2005). Hence, optimal rehabilitation of scapular dyskinesis requires addressing all of the causative factors that can create the dyskinesis and then restoring the balance of muscle forces that allow scapular position and motion (Kibler and McMullen, 2003).

Multiple clinical trials have incorporated scapular exercises within their rehabilitation programs and have found positive patient rated outcomes in patients with impingement syndrome (Kromer *et al*., 2009). Only two randomized clinical trials have examined the effects of a scapular focused program by comparing it to general shoulder rehabilitation, and the findings indicate the use of scapular exercises result in higher patient related outcomes (Baskurt *et al*., 2011; Struyf *et al*., 2013). Furthermore studies showing the effect of pectoralis minor stretching along with scapular exercises on patient related outcomes were not found. Kibler *et al* (2013) has emphasized that more information is required regarding the precise role of scapula in each sport and this would help in determining specific evaluation and treatment strategies. Thereby present study is an attempt to characterize the effects of scapular stabilization exercises along with pectoralis minor stretching on throwing velocity among baseball players in comparison to general shoulder exercises and stretching.

MATERIALS AND METHODS

In the present experimental study, 20 male baseball players of age group between 18-25 years were included from Madhya Pradesh Baseball Association, Indore. According to study by Borstad (2008), PMI lower than 7.44 (Mean PMI -1SD) was considered to have relatively short pectoralis minor. There by players who were playing baseball for last two years and having pectoralis minor shortness (PMI≤ 7.5) were included in the present study. All players were informed about the procedure in detail before taking written consent. On the other hand players who were having history of shoulder or neck surgery, cervical spine pathology, rotator cuff tear etc. were excluded from the study.

Based on the intervention administered, two groups were formed, which were Group A (Experimental group) and Group B (Control group). Each group consisted of10 players. Detailed evaluation of PMI and throwing velocity of players was done with the help of Vernier calipers and pocket radar respectively, before and after completion of intervention. Evaluation of pectoralis minor index (PMI) involves measurement of dominant side pectoralis minor length. Surface markings on coracoid process and fourth rib were done. Distance between these landmarks was captured using vernier calipers with player standing in normal, relaxed posture during data collection. Further pectoralis minor index (PMI) was calculated by dividing the mean pectoralis minor muscle length by the subject height and multiplying by 100 (Borstad, 2008). The mean throwing velocity of baseball players was measured from pocket radar (©2009 Pocket Radar™, Inc). Throwing velocity was measured by examiner standing at the distance of 120 feet behind the player. The examiner will press and release the red button of radar as soon as the ball was pitched by the player. Three readings were taken and their average was noted.

Protocol followed in group A include strengthening exercises for scapular stabilizers(Deltoid, Rotator cuff muscles, Upper trapezius, Middle trapezius, Lower trapezius, Serratus anterior, and Rhomboids). Total duration of intervention was one month and exercises were administered 6 days in aweek. Two sets were performed by resistance band (Page *et al*., 2000) for each muscle group with 10-15 repetitions in each set and intermittent rest in between. Self-stretching for pectoralis minor muscle was given along with strengthening for 20-30 sec / 3 times in one session, for six days in a week. For group B generalized shoulder exercises along with self-stretching of Shoulder muscles (Biceps, Triceps, Pectoralis major, Deltoid) were given. Throwing velocity and PMI were evaluated before starting the intervention and one month following the intervention. Unpaired t- test was performed to compare changes in throwing velocity of players along with Pectoralis minor shortening using SPSS 19.0 version.

RESULTS

Before starting the intervention no significant differences were observed between two intervention groups for PMI (t=0.0; p>0.05) and throwing velocity (t=0.13; p>0.05) among baseball players as shown in Table 1. The study found that players receiving strengthening of scapular stabilizers along with pectoralis minor stretching had statistically significant improvement in pectoralis minor length (t=2.25; p<0.001) and throwing velocity (t=2.25; p<0.05) at the end of one month intervention than those receiving general shoulder strengthening exercises and stretching (Table 2) .

Table 1 Comparison of measurement of Pectoralis Minor Index and Throwing Velocity at baseline.

Outcome Variables	Experimental group (Mean ± SD)	Control group (Mean± SD)	Mean Difference	t-value
Pectoralis Minor Index (PMI)	7.34±0.19	7.34±0.18	0.0	0.0 (p >0.05)
Throwing Velocity (TV) m/sec	98.04±9.47	97.6±5.71	0.44	0.13 (p >0.05)

p<0.05 = Significant; p>0.05 = Non-Significant

Table 2 Comparison of measurement of Pectoralis Minor Index and Throwing Velocity one month post intervention.

Outcome Variables	Experimental group (Mean ± SD)	Control group (Mean± SD)	Mean Difference	t-value
Pectoralis Minor Index (PMI)	7.76±0.108	7.36±0.207	0.40	5.43 (p <0.001)
Throwing Velocity (TV) m/sec	106.40±7.291	100.38±4.321	6.02	2.25 (p <0.05)

p<0.05 = Significant; p>0.05 = Non-Significant

DISCUSSION

Present study was conducted to determine the effectiveness of scapular stabilization exercise along with pectoralis minor stretching in improving performance as compared with generalized exercise in patient having scapular dyskinesis. The subjects in experimental group and in control group were assessed by pectoralis minor index values and throwing velocity before and following completion of intervention. The results suggested that scapular focused exercise program along with pectoralis minor stretching results in progressive improvement of throwing velocity as compared to general shoulder strengthening exercises.

There is substantial evidence suggesting that pectoralis minor tightness alters three-dimensional scapular kinematics in healthy subjects only and creates a position of scapular protraction at rest and may limit scapular posterior tilt or external rotation upon arm motion, potentially predisposing patients to impingement symptoms (Borstadand Ludewig, 2005). An algorithm guideline has been proposed that is based on restoration of soft tissue inflexibilities and maximizing muscle performance (Ellenbecker and Cools, 2010) which advocates that flexibility in the muscles and joints is usually required first because the tight muscles and capsules inhibit strength activation. The results in above stated studies were strengthened by the findings in the present study indicating 0.42 units increase in Pectoralis Minor Index (PMI) in experimental group whereas in control group only 0.02 units increase was evident.

Studies have advocated that the aim of rehabilitation is to restore scapular muscle control and balance (Rubin and Kibler, 2002) and scapular dyskinesis implies a higher activation of upper trapezius and a decreased control of the lower trapezius, middle trapezius and serratus anterior. In the literature (Escamilla *et al*., 2009; Cricchio and Frazer, 2011), numerous exercises are reported with aim of activating not only the trapezius and serratus anterior, but also the rhomboids, supraspinatus, infraspinatus and deltoid without or with weight bearing upper extremity under physiotherapist's supervision. Before starting the intervention the values of throwing velocity in group A and B were 98.04±9.47 m/sec and 97.6±5.71 m/sec respectively which showed no significant difference in the present study. Following 1 month intervention, players receiving scapular stabilization exercises along with pectoralis minor stretching have more increase in throwing velocity (106.40± 7.291 m/sec) as compared to players receiving general shoulder exercises along with stretching exercises (100.38±4.321 m/sec). This has established the role of proximal stability to prevent postural perturbations and force generation and maximizing action sequencing for scapular retraction muscles (McMullen and Uhl, 2000; Sciascia and Cromwell, 2012) and hence justifying the results.

CONCLUSION

The present study concluded that scapular stabilization exercises along with Pectoralis minor stretching is an effective measure in improving throwing velocity in baseball players having scapular dyskinesia. Results have emphasized that rehabilitation protocols for scapular dyskinesia should include pectoralis minor lengthening along with scapular setting exercises. However there are few limitations in the study such as small sample size and duration of study was limited to one month only. Future research should focus on seeing the long term efficacy of this protocol along with stretching of posteroinferior glenohumeral capsule and biceps muscle among baseball players.

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