Effect of thrower’s ten exercise program on scapular dyskinesia and throwing accuracy in cricket bowlers

Ketki Ponde Ponkshe *1, Ronika Agrawal 2, Fatema Rampurwala 3, Alfaiz Tamboli 4.

*1 Associate Professor M.A.Rangoonwala College of Physiotherapy and Research, Pune, India.
2 Principal and Professor M.A.Rangoonwala College of Physiotherapy and Research, Pune, India.
3 Intern M.A. Rangoonwala College of Physiotherapy and Research, Pune, India.
4 Intern M.A. Rangoonwala College of Physiotherapy and Research, Pune, India.

ABSTRACT

Background: 19.8–34.1% of Upper limb injuries are recorded of total injuries in cricket. Shoulder joint is the most affected joint in bowlers. Inadequate force generation due to improper position of scapula and less strength of shoulder muscle might affect the performance of the players. So the objectives of the study was to see the effect of Thrower’s Ten Exercise Program on scapular dyskinesia and throwing accuracy.

Methodology: 30 cricket bowlers (district and state level) with scapular dyskinesia were selected. Pre and post evaluation for scapular dyskinesia and Functional Throwing Performance Index (FTPI) was done post intervention. The intervention was carried out for 6 weeks.

Results: There was significant improvement seen in scapular dyskinesia (p=0.0001) and in throwing accuracy (p=0.0002).

Conclusion: This study concludes that the Thrower’s Ten Exercise Program when given for a period of 3dyas for 6 weeks showed highly significant improvement in scapular dyskinesia and throwing accuracy.

KEY WORDS: Scapular Dyskinesia, Cricket Bowlers, Throwing Accuracy, Thrower’s ten program.

Fast bowlers sustain 42% of the upper extremity injuries [3].

Catch-up phenomenon of throwing motion is referred to as a kinetic chain involving the entire body, whereby forces and kinetic energy are transmitted from the feet through the core and to the upper extremity. Inadequate force generation in the early parts of the kinetic chain alter the forces in the later segments predisposing them to injuries so as to attain the same
level of performance in terms of force, ball speed and accuracy [4].

Release components of throwing performance consist of implement velocity and accuracy, both of which contribute to successful performance [5]. A study done by Suzuki et al demonstrated that isolated scapular-muscle fatigue and resulting kinematic changes caused a disruption in kinetic energy transfer that led to a 26% decrease in accuracy [6].

Kibler et al defined alteration in the static position or motion of the scapula during coupled scapula-humeral movements as “scapular dyskinesis.” The position of the scapula in cricket bowlers during elevation show that the scapula is asymmetrically placed inferiorly and laterally, showing greater internal rotation, decreased upward rotation and excessive anterior tilt. This is usually associated with the weakness of scapular stabilizers (upper and lower trapezius, serratus anterior, deltoid, rhomboids) and rotator cuff muscles due to repetitive action of throwing [6,7]. DiGiovine et al found that all the scapular muscles are highly active during the arm acceleration phase and deceleration phase [8].

There is incidence of alteration of scapula position in bowlers without any functional disability at the shoulder joint [9].

The presence of scapular dyskinesis in asymptomatic overhead athletes indicated a 43% increased risk of developing shoulder pain [10]. The prevalence of scapular dyskinesis in healthy asymptomatic overhead athletes has been reported as 61% compared to 33% in non-overhead athletes [11].

Thrower’s 10 exercise program which was established in 1991 by Wilk et al based-on EMG studies was designed to improve strength, power and endurance of the musculature of the shoulder complex and has proved to be effective in rehabilitating and preventing injuries in overhead athletes [12]. So, the need was to check if Thrower’s ten exercise program would help in reducing the Scapular dyskinesia and improve throwing accuracy.

**METHODOLOGY**

Institutional ethics committee approval was taken before commencing the study. 30 asymptomatic cricket bowlers, engaged in bowling for a minimum of 2 years and having scapular dyskinesia were included. Written informed consent was taken from the subjects after the explanation of the procedure. Subjects with any history of upper limb or lower-limb fracture, any spine or shoulder surgery in the past 3 months were excluded. Subjects were evaluated pre and post the Thrower’s 10 exercise program.

**Table 1: Exercise protocol.**

| Exercise                                      | Week     | Theraband | Repetition | Sets |
|-----------------------------------------------|----------|-----------|------------|------|
| D2 flexion and extension                      | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Internal and external rotation at 90 degrees of abduction | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Supraspinatus and Deltoid strengthening        | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Prone shoulder abduction-D2 flexion           | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Prone shoulder extension                       | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Prone shoulder extension                       | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Biceps and triceps strengthening               | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Rowing                                         | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Wrist flexion and extension, Forearm supination and | 1st, 2nd | Red       | 8 reps     | 3    |
|                                               | 3rd-6th  | Green     | 10 reps    |      |
| Push-ups                                       | 5th-6th  | -         | 10 reps    | 3    |

**Table 1: Exercise protocol.**
post intervention for scapular dyskinesia and throwing accuracy using Lateral Scapular Slide Test and Functional Throwing Performance Index respectively.

Procedure: The thrower’s ten exercise program was given thrice a week for 6 weeks. All open chain exercises were performed with red theraband in the first two weeks. Progression was made by the use of green theraband for the next 4 weeks. Closed chain exercises were added in the last two weeks. All the exercises were performed bilaterally in 3 sets for 8-10 repetitions with a rest interval of 30 seconds between each set.

RESULTS

The data was analysed using MS Office Excel sheet and IBM - SPSS version 20. Paired t test was used for pre and post intervention comparison.

LATERAL SCAPULAR SLIDE TEST

| Position | Mean  | ±SD  | t-test | p-value |
|----------|-------|------|--------|---------|
| P1       | 1.11  | 0.34 | 2.3288 | 0.0234  |
| P2       | 1.26  | 0.33 | 2.4046 | 0.0194  |
| P3       | 1.70  | 0.15 | 4.744  | 0.0001  |

DISCUSSION

The lateral scapular slide test done pre and post training to evaluate scapular dyskinesia showed that the training has statistically highly significant improvement (p=0.0001) on scapular distance from the spinous process in position 3 on the dominant side. This could be due to the gain in strength of scapular stabilizers (upper and lower trapezius, rhomboids, serratus anterior) and the dynamic stabilizers (rotator cuff muscles).

Only position 3 showed a greater mean (>1.5cm) in the pre-training test conducted. So, we can infer that scapular dyskinesia is much more evident in position 3 of the test. EMG evaluation has shown that very few muscles are working in the first position, that the serratus and the lower trapezius muscles are working at low levels in the second position, and that the upper trapezius, lower trapezius, serratus, and rhomboid muscles are all working at approximately 40% of maximum in the third position [15]. Various studies done on individuals with scapular dyskinesia often show hyperactivity of the Upper trapezius with reduced and delayed Middle and Lower Trapezius muscle activation, which is associated with decreased amounts of scapular upward rotation, external rotation, and posterior tilt. The serratus anterior and the lower trapezius muscles appear to be the first muscles involved in inhibition-based muscle dysfunction [7].

In this study, throwing accuracy was evaluated using Functional throwing performance index (FTPI) which showed statistically significant improvement (P=0.0002) post training. The improvement could be associated to the improved muscle strength of scapular stabilizers which create a stable scapular base for efficient
transfer of kinetic energy to the distal segments through rotator cuff muscles and hence, improving the throwing accuracy. The cumulative effect would have resulted in scapular upward rotation, abduction and posterior tilting hereby influencing the improvement in throwing accuracy in the present study.

The results are well supported by the significant improvement (P= 0.0001) seen in throwing accuracy in a study conducted by Ujwal Yeole et al administering throwers 10 exercise programme in fast bowlers for 3 weeks [16].

The Throwers ten exercise given incorporates various scapular stabilization exercises and PNF pattern like throwing acceleration and deceleration phase of throwing. The increase in strength could be a result of increased neural response, increased motor unit recruitment, and synchronous motor unit firing after 6 weeks of training. PNF exercises are believed to enhance motor learning, increase dynamic stability and neuromuscular control [13,16].

Sakiko Oyama recommended that retraction exercises may be beneficial in improving scapular retractor strength and potentially scapular kinematics, and also have been shown to increase maximal voluntary isometric contraction (MVIC) of the medial scapular and rotator cuff muscle with these exercises [17]. A study done by Myers et al demonstrated that D2 flexion and extension, Internal Rotation(IR) and External Rotation(ER) at 90 degrees of abduction elicited at least moderate activation of all muscles except for the biceps and triceps muscles. Myers et al. suggested that exercises used in thrower’s ten program are most effective in activating the muscle important to the throwing motion and may be beneficial for athlete’s pre throwing warm-up routine [16,18].

Hawkes et al study reported that EMG measurements at 3 different shoulder IR exercises showed that at 90° abduction, the middle and lower trapezius muscles, the rotator cuff and deltoid muscles, as well as the serratus anterior and rhomboid major muscles, achieved highest activation level [19]. Hughes et al reported that external rotation exercises with theraband show 21-38% increase in electromyographic activation of scapular retractor muscle [20]. Reinold et al reported that the best exercise for supraspinatus muscle was the “full can” exercise [21]. Prone rowing exercises are clinically recommended to strengthen the scapular stabilizers while minimally activating the rotator cuff [22]. Push ups elicits high muscle activity in the serratus anterior (SA), triceps and pectoralis major, moderate activity of middle and lower trapezius and low activity in the upper fibers of the trapezius (UT), which may be helpful in restoring scapula-thoracic muscle dysfunction [23].

As throwing action is considered to be a series of events forming a kinetic chain, scapula helps in transferring kinetic energy and force generated by the core and lower-limbs to the upper extremity. Therefore, strengthening of serratus anterior, rhomboids, middle and lower trapezius muscle as well as the distal segment musculature is crucial for accurate kinematics of the scapula during the phase of bowling [4].

CONCLUSION

So, the study concludes that the thrower’s ten exercise program when given for a period of 6 weeks showed significant improvement in scapular dyskinesia and throwing accuracy in bowlers.

ACKNOWLEDGEMENTS

We would like to thank all our subjects and the cricket academy for allowing us to carry out the study. We would like to acknowledge all the authors and journal from where the references were taken.

Conflicts of interest: None

REFERENCES

[1]. Wilk KE, Meister K, Andrews JR. Current concepts in rehabilitation of the overhead throwing athlete. Am J Sports Med. 2002;30(1): 136–151.
[2]. Stretch, R.A., 2001. Epidemiology of cricket injuries. International SportMed Journal, 2(2):1-7.
[3]. Aginsky, K.D., Lategan, L. and Stretch, R.A. Shoulder injuries in provincial male fast bowlers-predisposing factors. South african journal of sports medicine, 2004;16(1):25-28.
[4]. Lin, D.J., Wong, T.T. and Kazam, J.K. Shoulder injuries in the overhead-throwing athlete: epidemiology, mechanisms of injury, and imaging findings. Radiology 2018;286(2):370-387.
[5]. Freeston, J., Ferdinands, R. and Rooney, K. Throwing velocity and accuracy in elite and sub-elite cricket players: A descriptive study. European Journal of Sport Science 2007;7(4):231-237.
Ketki Ponde Ponkshe et al., Effect of thrower’s ten exercise program on scapular dyskinesia and throwing accuracy in cricket bowlers.

[6]. Suzuki, H., Swanik, K.A., Huxel, K.C., Kelly, J.D. and Swanik, C.B. Alterations in upper extremity motion after scapular-muscle fatigue. Journal of Sport Rehabilitation, 2006;15(1):71-88.

[7]. Kibler, W.B., Thomas, S.J. and Sciaccia, A.D. The role of the scapula in the overhead athlete. In Mechanics, Pathomechanics and Injury in the Overhead Athlete. Springer, Cham. 2019;151-164.

[8]. Meyer, K.E., Saether, E.E., Soiney, E.K., Shebeck, M.S., Paddock, K.L. and Ludewig, P.M., 2008. Three-dimensional scapular kinematics during the throwing motion. Journal of applied biomechanics, 2008;24(1):24-34.

[9]. Tendulkar, S.S. and Mehta, N. Incidence of alteration of scapula position in bowlers. International Journal of Physical Education, Sports and Health 2020;7(4): 81-84.

[10]. Hickey, D., Solvig, V., Cavalheri, V., Harrold, M. and Mckenna, L. Scapular dyskinesis increases the risk of future shoulder pain by 43% in asymptomatic athletes: a systematic review and meta-analysis. British journal of sports medicine, 2018;52(2):102-110.

[11]. Malik, S.S., Jong, B., Neyton, L and MacDonald, P.B. Scapulothoracic Dyskinesis and Anterior Shoulder Instability. In 360° Around Shoulder Instability. Springer, Berlin, Heidelberg 2020;49-59.

[12]. Wilk, K.E., Yenchak, A.J., Arrigo, C.A. and Andrews, J.R. The advanced throwers ten exercise program: a new exercise series for enhanced dynamic shoulder control in the overhead throwing athlete. The Physician and sportsmedicine 2011;39(4):90-97.

[13]. Padua, D.A., Guskiewicz, K.M., Prentice, W.E., Schneider, R.E. and Shields, E.W. The effect of select shoulder exercises on strength, active angle reproduction, single-arm balance, and functional performance. Journal of Sport Rehabilitation, 2004;13(1):75-95.

[14]. Curtis, T. and Roush, J.R. The lateral scapular slide test: A reliability study of males with and without shoulder pathology. North American journal of sports physical therapy: NAJSPT, 2006;1(3):140.

[15]. Ben Kibler, W. The role of the scapula in athletic shoulder function. The American journal of sports medicine 1998;26(2):325-337.

[16]. Andhare, D.N., Yeole, U. and Salvi, M.A. Effect of Throwers Ten Program on Performance in Fast Bowlers “Randomized Control Trail”. JCMR. 2018;6(12).

[17]. Myers, J.B., Laudner, K.G., Pasquaule, M.R., Bradley, J.P. and Lephart, S.M. Scapular position and orientation in throwing athletes. The American journal of sports medicine, 2005;33(2):263-271.

[18]. Myers, J.B., Pasquaule, M.R., Laudner, K.G., Sell, T.C., Bradley, J.P. and Lephart, S.M. On-the-field resistance-tubing exercises for throwers: an electromyographic analysis. Journal of Athletic Training, 2005;40(1):15.

[19]. Gokalp, O. and Kirmizigil, B. Effects of Thrower’s Ten exercises on upper extremity performance: A randomized controlled study. Medicine, 2020;99(42).

[20]. Patel, H.A., Arunmozhii, R. and Arfath, U. Efficacy Of Scapular Retractor Strength Training Vs Thrower’s Ten Programme On Performance In Recreational Overhead Athletes-A Comparative Study. International Journal of Therapies and Rehabilitation Research, 2014;3(1):1.

[21]. Reinold, M.M., Macrina, L.C., Wilk, K.E., Fleisig, G.S., Dun, S., Barrentine, S.W., Ellerbusch, M.T. and Andrews, J.R. Electromyographic analysis of the supraspinatus and deltoid muscles during 3 common rehabilitation exercises. Journal of athletic training, 2007;42(4):464.

[22]. Noguchi, M., Chopp, J.N., Borgs, S.P. and Dickerson, C.R. Scapular orientation following repetitive prone rowing: implications for potential subacromial impingement mechanisms. Journal of Electromyography and Kinesiology, 2013; 23(6): 1356-1361.

[23]. Kowalski, K.L., Connelly, D.M., Jakobi, J.M. and Sadi, J. Shoulder electromyography activity during push-up variations: a scoping review. Shoulder & Elbow, 2021;17585732211019373.