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Research article

An experimental study on scapulothoracic and glenohumeral kinematics following a rotator cuff fatigue trotocol in tennis professionals

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ABSTRACT

This study aimed to find out the effect of rotator cuff fatigue on humeral head migration during dynamic shoulder external rotation activity (combination of flexion, abduction, external rotation) in tennis players. The purpose for physiotherapist in sports performance enhancement assessment of shoulder kinematics provides a reliable tool for studying kinematics during arm elevation. And also understand the importance of external rotation strengthening on clearing superior glenohumeral joint migration for tennis professionals. A total of 20 men of tennis players without shoulder disorders were recruited in the study. The study was conducted in the Tamilnadu tennis association (TNTA) and Gandhi nagar tennis club (GNC adayar). Pre and post tests were performed. The data was analyzed using SPSS. The experimental group (who received external rotator fatigue protocol) showed significance with (p=0.001) value when compared with the control group. Also, the post-test mean value of the experimental group showed a significant improvement after the protocol. External rotators stretching and strengthening protocol showed significant improvement in functional status of glenohumeral joint than conventional traditional coaching program alone on tennis professionals.

Keywords: Shoulder kinematics, Rotator cuff fatigue, Tennis professionals, Glenohumeral instability.

INTRODUCTION

Shoulder muscle fatigue is one of the common sequel of repetitive arm use and this has been proposed as a possible link to explain the association between repetitive arm use and the development of various rotator cuff disorders[1,2,3]. Repetitive arm movements are a major component of several workplace tasks as well as many sporting and leisure activities[4,5]. Coordinated motion of the humerus, clavicle, and scapula were essential for normal function of the shoulder girdle and has been studied with 2-dimensional and 3-dimensional techniques[6,7,19].

The generally accepted pattern of motion during arm elevation is as follows: Humeral elevation and external rotation, clavicular elevation and retraction and scapular upward rotation, posterior tilt, and external rotation[6-9]. This motion is produced and controlled generally by the neuromuscular and capsulo-ligamentous systems associated with the shoulder girdle. Impairments in either one of these

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systems could result in altered kinematics of the humerus, clavicle, and/or scapula, which could lead to the development of abnormal stress and strains on the tissues of the shoulder girdle. Associations between altered scapula thoracic kinematic patterns and shoulder pathology have been identified in Impingement syndrome[6,12], rotator cuff tears, and glenohumeral instability[10,11,12].

The infraspinatus and teres minor muscles contribute to the formation of the rotator cuff and are collectively referred to as the external rotators of the shoulder. These muscles have also been shown to contribute to arm elevation, glenohumeral joint stability, and the production of normal glenohumeral kinematics[9]. Previous studies have shown that fatigue of the shoulder girdle musculature results in altered scapulothoracic kinematics. Recently, we demonstrated that shoulder girdle muscle fatigue following the performance of a repetitive elevation task resulted in altered scapulothoracic and glenohumeral kinematics[13].

While electromyographic (EMG) signs of local muscle fatigue were apparent for several shoulder girdle muscles, we found that the infraspinatus muscle demonstrated the greatest change, which suggested that this muscle was fatigued to a greater extent than any of the other muscles[13].

A study by Tsai et all[14] (l966) depicts that the effects of infraspinatus muscle fatigue on scapular kinematics. In that study, healthy subjects performed shoulder external rotation against the resistance of a green Thera-Band until they could no longer perform the task. Shoulder external rotation force measurements were taken before and after the task and subjects performed the task until their force measurements decreased by at least 25% from their baseline measurement. They reported decreased amounts of scapular posterior tilt, upward rotation, and external rotation during arm elevation after the external rotator muscles were fatigued.

Our hypothesis states that external rotator muscle fatigue would result in altered scapulothoracic and glenohumeral kinematics and the pattern of change would be similar to that noted following the performance of a general fatigue protocol. The primary purpose of this study was to determine the effects of shoulder external rotator muscle fatigue on scapulothoracic and glenohumeral kinematics on tennis professionals who are untrained versus trained.

METHODS & METHODOLOGY

A total of 20 men of tennis players with age group of 14 to 36 years and weight of 55 to 80 kgs, without shoulder disorders were recruited for the study. Players with permission from Tamilnadu tennis association (TNTA) and Gandhi nagar tennis club (GNC adayar) were selected randomly to enter into the experimental (n=10) and controlled groups (n=10). Informed consent was given by the players. The study was conducted for 5 days at Gandhi nagar tennis club and gym area (gnc adayar) Chennai. The exclusion criteria's were History of Shoulder pain, previous diagnosis of shoulder impingement syndrome, history of shoulder dislocation, fracture or subluxation, cervical radiculitis or radiculopathy, Physical therapy or chiropractic treatment for cervical, shoulder, or upper back problems in the last 12 months and history of systemic or neurologic disease. Ethical committee approval was obtained.

PROCEDURE

Both the groups were assessed with shoulder flexion, abduction, external rotation range of motion using knee rating scale, activities of daily living and hop test was noted as a pre test reading.

Group A - Controlled group players has undergone warm up exercise, followed by traditional coaching program which includes forearm, backhand, twisting movements and cool down exercise. The duration of the fatigue protocol was 20 min per session in 1 day for 5 days.

Group B - Experimental group players has undergone External rotation stretching & strengthening protocol which includes stretching of posterior deltoid, serratus anterior, triceps with 30 sec hold twice a day for 5days followed by strengthening of External rotators of shoulder in a regime of muscular endurance done with 15 repetition/twice a day for 5 days. The total duration of fatigue protocol for experimental group was 40 minutes.

Followed by their exercise session, post test reading was taken with goniometry.

NOTE: Group A none of these players' performs strengthening exercises for their shoulder muscles. They were under a traditional game training under their coaches. None of the players are diseased.

RESULTS

As per Table(1), the mean value of pre-test and post-test measures in the experimental group for normal warm up using knee rating scale was 75.13 was increased after the intervention with a mean of 94.40, also the external rotators fatigue protocol using activities of daily living scale showed a pre-test mean of 87.07 was increased after the intervention with a mean of 92.93 respectively. The cool down measurement using hop test scale with a mean of 91.00 was increased to a mean of 105.60 after the intervention.

TABLE 1.1 – PAIRED "t" TEST ANALYSIS OF EXPERIMENTAL GROUP

VARIABLES	PRE TEST				POST TEST					
	Mean	**SD**	**Range**	**SEM**	**Mean**	**SD**	**Range**	**SEM**	**"t" test**	**Significant**
Warm up normal goniometric measurement	75.13	3.815	68-81	.985	94.40	3.661	88-100	.945	15.077	.000
External rotators fatigue protocol	87.07	4.350	80-95	1.123	92.93	3.615	87-98	.933	4.363	.001
Cool down gonio -metric measurement	91.00	5.264	83-100	1.359	105.60	3.158	98-109	.815	9.159	.000

SD – Standard deviation SEM – Standard error of mean

TABLE 1.2 – PAIRED "t" TEST ANALYSIS OF CONTROL GROUP

VARIABLES	PRE TEST				POST TEST					
	Mean	**SD**	**Range**	**SEM**	**Mean**	**SD**	**Range**	**SEM**	**"t" test**	**Significant**
Warm up normal goniometric measurement	76.80	3.821	70-83	.987	86.00	4.226	80-94	1.091	7.023	.000
Traditional gaming protocol	84.73	3.575	79-91	.923	89.80	3.321	84-95	.857	3.604	.003
Cool down goniometric measurement	94.13	4.257	89-102	1.099	100.47	4.172	94-109	1.077	10.867	.000

SD – Standard deviation SEM – Standard error of mean

From Table (2), the mean value of pre & post test measures for the control group on warm up measures using knee rating scale with a mean of 76.80 was increased after the intervention with a mean of 86.00. The traditional gaming protocol using activities of daily living scale with a pretest mean of 84.73 was increased to a mean of 89.80 after the intervention. The post-test p value p=0.003 which is not significant. The cool down measurement using hop test with a mean of 94.13 was increased with a mean of 100.47 after the intervention.

TABLE 3 – COMPARISON OF POST-TEST SCORES OF GONIOMETRIC READING BETWEEN EXPERIMENTAL GROUP AND CONTROL GROUP

Groups	Mean	SD	SEM	Mean difference	95% of CI difference	"t" test	Results
Experimental group	94.40	3.661	.945	8.400	11.357-5443	5.819	.000 (2 tailed) Significant
Control group	86.00	4.226	1.091				

Note:'* - Significant at 1% level i.e. (p<0.001), in degrees
SD – Standard deviation, SEM – Standard error of mean, CI – Confidence interval

From Table (3), the statistical outcome for the post-test scores comparison of knee rating scale for experimental group and control group showed that the experimental group has a mean of 94.40 with SD of 3.661 and SEM of .945 when compared to the control group mean of 86.00 with SD of 4.226 and SEM of 1.091, also with the mean difference of 8.400. Although, both the groups post test measure showed significant result in their mean values. But, it was very clear that the "t" value of 5.819 showed significant results in experimental group.

DISCUSSION

In this study, 20 players were taken in which 10 players were to find out the efficacy of traditional coaches for training on the functional status of the shoulder. The statistical analysis showed that external rotation strengthening on experimental Group B showed significant improvement in the functional status of the shoulder complex than conventional training program on control Group A alone.

Adding the external rotation strengthening on current players shows more predictably returns by the sports person to their sports activity in the form of injury prevention and performance enhancement.

- The amount of superior GH migration pre-fatigue was also similar to that measured in individuals without RTC fatigue.
- There is a notable improvement on range of motion (ROM) particularly in shoulder external rotators and flexors for players on experimental group compared to control group.
- Shoulder stretching and strengthening protocol shows improvement on range of motion (ROM) in all 3 combined patterns of external rotation movements.
- A collection of palpation assessment from the testing group on analyzing there is some proof over superior migration of glenohumeral joint was decreased.
- Although migration is a multidimensional phenomenon, this magnitude of superior migration may represent a 6% to 40% reduction in subacromial space, which is reported to be between 2 mm and 14 mm.
- Subacromial space on palpation across glenohumeral was decreased after performing stretching and strengthening protocol.

The above mentioned statements also support this study.

CONCLUSION

From this study, it was concluded that external rotators stretching and strengthening protocol showed significant improvement in functional status of glenohumeral joint than conventional traditional coaching program alone on tennis professionals. There is also a significance difference on humeral head aligning towards inferior migration on dynamic shoulder stretching and strengthening exercises.

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