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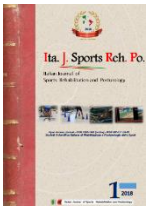

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A study to examine the effectiveness of sleeper's stretch on shoulder horizontal adduction and internal rotation range of motion in male cricket bowlers.

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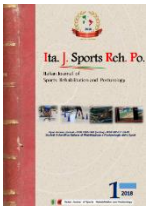

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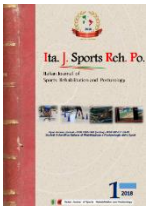
Abstract

Background: Alteration in glenohumeral range of motion including increase posterior shoulder tightness and glenohumeral internal rotation deficit that exceeds the accompanying external rotation gain are suggested contributors to throwing related shoulder injuries such as internal impingement, shoulder dislocation and SLAP lesion. Many studies have been done to evaluate the effects of sleeper stretch in tennis players and baseball pitchers. Yet these contributors have not been identified in cricketers. **Purpose:** This study examines the effects of sleeper stretch on shoulder horizontal adduction and internal rotation in male cricket bowler. **Methodology:** 60 male cricket bowlers were selected from Ahmedabad. Glenohumeral joint horizontal adduction and internal rotation ROM was measured in two groups by digital inclinometer on a period of pre and post treatment week 1, week 2, week 3. Sleeper stretch was given to the affected shoulder for 30 sec hold, and 15 second rest is given between each stretch on alternate days, three times in week for 3 consecutive weeks. **Results:** This study has identified effects of sleeper stretch on glenohumeral internal rotation and horizontal adduction ROM was insignificant. **Conclusion**: sleeper stretch is highly effective in gaining glenohumeral horizontal adduction and internal rotation ROM in male cricket bowlers.

Key words – Internal rotation, horizontal adduction, male bowlers, posterior shoulder tightness, and sleeper stretch.



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Introduction

Cricket is one of the major international sports played in more than 60 countries. In India, cricket has always been much more than a sport. Although a non contact sport, injuries in cricket are common.[1] In the sport of cricket, bowler can be categorized a fast bowlers and spin bowlers.[2] All bowlers propel a 5.5 oz ball towards a batsman or his wickets, but a spin bowler imparts rotation to the cricket ball deviates from its original direction of flight when it hits the ground.[3] Where fast bowler beat the batsman by combination of speed of the delivery and deviation in flight of the ball.[4] **(**Photo 1)

Photo 1

Shoulder joint biomechanics

Shoulder joints the links the upper extremity to the trunk and acts in conjunction with the elbow to position the hand in space for efficient function. It comprises many articulations, each contributing to the movement of the arm through coordinated joint action. Glenohumeral joint is the final articulation of shoulder joint.

The articular surface of the glenohumeral joint is formed by the large head of humerus and a shallow glenoid fossa, this difference in the size of the articular surface and lack of bony limitation allows a large degree of mobility. Numerous muscles act on shoulder complex to provide mobility and dynamic stability. Dynamic stabilization occurs by several mechanism via passive muscle tension, or via barrier effect of the contracted muscle, compressive forces brought about by muscular contraction, joint motion that induces tightening of the passive or ligamentous constrains or via redirection of joint force towards the center of the glenoid. As the arm is externally rotated, anterior capsule tightens and in the internal rotation posterior shoulder tightens. Abduction induces tightening of capsule inferiorly and with adduction the capsule is taut superiorly and lax inferiorly.[5]

Bowling mechanics

During the acceleration phase of bowling there are concentric contractions of the shoulder internal rotators and during the deceleration phase there are the eccentric contractions of the shoulder external rotators.[6] During the Deceleration phase of throwing motion of overhead athletes, large compressive forces are created on the shoulder joint, resulting in the development of the contracture of the posterior shoulder capsule. The posterior capsule tightness causes an adaptive increase in humeral retroversion and results in increased external rotation range of motion, associated soft tissue adaptation causes decreased internal rotation range of motion of the shoulder joint. A Further increase in posterior

capsule tightness and an imbalance between the agonist and antagonist forms one of the major risk factor for the development of shoulder injuries like the subacromial impingement, shoulder dislocations and the internal impingement syndrome in the cricket bowlers.[7]

Bowling action consists of four phases namely Run-up phase, Pre- delivery phase, delivery stride and follow through phase.[8]

1. **Run- up phase** – this stage commences when the bowler walks or jogs over his approach marker by gradually increasing speed on his approach to wicket, and ends as he leaps into the air. [8]

2. **Pre-delivery stride** (Photo 2)– this stage separates run - up from the delivery stride and begins, for a right- handed bowler, with a jump off the left foot and is completed as the bowler lands on the right or back foot and with the shoulders pointing down the wicket, the right foot passes in front of left with the right foot turning to land parallel to the bowling crease. [8]

Photo 2. The pre-delivery stride

Delivery stride – this is considered the most technical stage of the bowling action. The delivery stride can be discussed under three events: the back foot strike, front foot strike and ball release**.** [8]

- **Back foot strike**- At the start of the delivery strike, the bowlers weight is on the previously planted back foot with the body leaning away from the batsman (Photo 3)

Photo 3. Back foot strike

- **Front foot strike:** As the delivery stride proceeds, the front foot strikes the ground. According to Bartlet et al.[9] the angle of front knee during the delivery stride has received much importance, not only with regards to its effect upon ball release speed but also its role in the attenuation of impact forces. [8,9] (Photo 4)

Photo 4. Front foot strike: 'straightleg' technique vs 'flexedknee' technique

There are three main types. The first is the straight leg technique where the bowler lands with a fully or almost fully extended front limb at front foot strike and remains at, or near, to this release at ball release. This is thought to be advantageous in terms of maximizing ball release speed as it provides a lower body fulcrum that the bowler may use as an effective lever. The second type of front knee activity bowlers land with a flexed knee (approximately 150 degrees) and either maintain this angle, or flex the knee still further following foot strike. Knee flexion on impact provides apparent benefit in terms of force attenuation, but the lack of subsequent knee flexion fails to provide the beneficial aspects of bowling over the front straight leg. [8]

The third type of the front knee action involves the knee flexion slightly on landing (thus attenuating the impact forces) and subsequently) extending to a near straight or straight

front leg, thus providing the benefits of bowling over a straight front leg**.** [8]

- **Ball release**: (Photo 5) The laws of cricket limit the action of bowling arm to circumduction of the upper arm about the glenohumeral joint and extension and flexion of the wrist and finger joints. Initiation of upper arm circumduction usually occurs between the back foot and front foot strike. [8]

Eliot and Foster suggested that the arm should be almost vertical release and the angle between the trunk and the arm approximately 200 degree. The wrist and fingers are more distal joints of the body to add velocity to the ball.

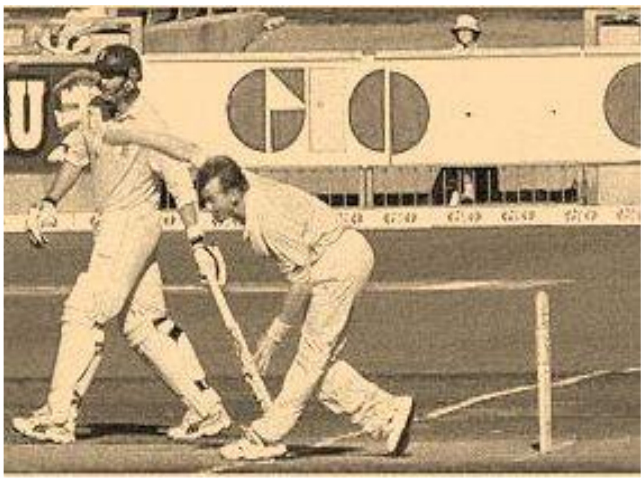


Photo 5. Ball release

3. **Follow Through phase-** (Photo 6) limited data available on follow through phase, as most analyses stop shortly after ball release. Bartlett et al. suggested that the bowler should ensure that the bowling arm follow through down the outside of the left thigh allowing a gradual reduction in the bowlers speed and that the first stride of the

follow through should be behind the line of the ball, before running off the wicket for a further two to three strides. [8]

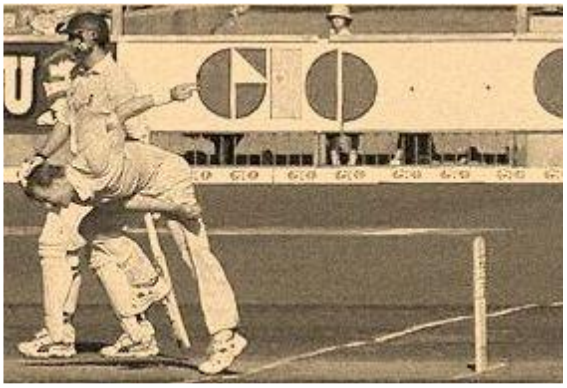


Photo 6. Follow-through

Review of literature

It is being found that fast bowlers have a high incidence of shoulder injuries as much as 42% of the upper extremity injuries**.**[4,10] According to England and Wales cricket Board (ECB) reported 5.3% of shoulder injuries among first class country cricketers during 2001 and 2002 session, 5.2% in South Africa and 7% in first class Australian team.[11]

Craig Ranson [12] in his study reported that among 35 shoulder injured players 7 of the bowlers had often or always negative impact on bowling.[12] Bell Jenje in his study stated that 165 injuries amongst 96 cricketers of those which 40 were shoulder injuries. In these 40 shoulder injuries 37% were of glenohumeral rotation deficit which was assessed prior to injury. The risk factors associated with these injuries were weak scapular stabilizers, postural influence, limb length discrepancies and GIRD**.**[13]

Posterior shoulder tightness

In past decade, shoulder joint has been given a considerable attention in over head athletes. [14] Shoulder joint consists of five articulations; glenohumeral joint is one of the most important joint among them, which is known for increased mobility and lack of stability.[5] During acceleration phase of bowling internal shoulder rotators are involved through concentric contraction and external rotators involved during deceleration phase.[15]

In deceleration phase of bowling, the repetitive large forces accumulate at shoulder joint lead[16] to posterior shoulder contracture[17] which in turn results in alteration of shoulder range of motion with decreased internal range of motion.[18] Furthermost increase in posterior shoulder tightness and decrease in internal rotation ROM has been clinically and empirically linked to several conditions such as SLAP lesions,[19] internal impingement,[17] and shoulder dislocations [11] in cricket bowlers which interfere with their performance and result in absenteeism from sport.

Glenohumeral Internal Rotation Deficit or GIRD

An operational definition of Glenohumeral Internal Rotation Deficit: - Overhand throwing places high loads and stresses on the joints and tissues of the shoulder and arm. As a result, throwing athletes regularly demonstrate altered shoulder internal and external ranges of motion where internal rotation (IR) is decreased and external rotation is increased in the dominant arm when compared with the no dominant arm. This alteration can exist as a result of alterations to the bones (humeral retroversion), capsule (posterior thickening), or muscle (passive stiffness known as thixotropy). When the amount of IR or total arc of

motion difference reaches a certain threshold (typically 20 or more degrees of IR or 8 degrees total arc difference), it is known as glenohumeral internal rotation deficit or total arc of motion deficit.[20]

Stretching

Stretching is a general term used to describe any therapeutic maneuver designed to increase mobility of soft tissue and subsequently increase range of motion by elongation of structures that have adaptive shortened and have become hypo - mobile over a period of time.[21]

Athletes as a routine participate in a variety of stretching techniques before and after the training which include the static, dynamic, and ballistic and PNF stretching techniques. Results have shown stretching to be beneficial in improving flexibility,[22] increasing the range of motion, [23] and reducing the risk of injuries,[24] thus helping in enhancing the athletic performance.

Recently a new technique of stretching is adopted by clinician and athletes to isolate the soft tissue of the posterior aspect of the shoulder, this technique is known as sleeper stretch. It is given in side lying position as it enables the stabilization of scapula against the upper body and the treatment table which thereby enables more isolation of posterior glenohumeral joint, sleeper stretches are administered easily without assistance.[25]

The acute effects of sleeper stretch in baseball players was studied by Kevin G [25] et al who measured the internal rotation , horizontal adduction and external rotation before and after the application of stretch and found that sleeper stretch produced statically significant acute increase in posterior flexibility.[25]

Material and Methods

Sixty male cricketers, 50 fast bowler and 10 spin bowler with a mean age of 20±2.94, Mean BMI 21.57±2.60, mean weight 60.38±7.85, mean height 1.70±0.06 having a minimum 6 month of experience of bowling and presenting with glenohumeral internal rotation deficit associated with posterior shoulder tightness of bowling arm were included in the study. Participants were recruited from different school and academy. The participants with a history of shoulder or upper arm pain during 48 hour period prior to shoulder measurement, any previous upper limb fractures and surgeries, previous shoulder injuries, those suffering from any other neurological disorders and those suffering from any other neurological disorders and those regularly participating in other overhead sports other than cricket were excluded from the study.

The participants were clearly instructed about the study before obtaining written consent. The measurement were taken during on season training sessions in may and June 2017. Cricketers demographic details were collected using pre- participation evolution tool. This tool was designed to collect data related to the upper limb demands of cricket, including hand dominance, bowling type, GIRD (Glenohumeral Internal Rotation Deficit) side and age, height, weight and BMI. All bowlers were measured for glenohumeral internal rotation in both bowling and non bowling arm using digital inclinometer and if a reduction in glenohumeral internal rotation ≥4 degrees was found in bowling arm when compared with non bowling arm, they were considered to be having GIRD and included in the study. Every 4 degrees of glenohumeral internal rotation deficit was equal to 1 degree of posterior shoulder tightness .

Procedure

Description of Tools for data collection -

Measurement of glenohumeral internal rotation ROM –

To measure internal shoulder rotation, the examiner positioned the participant supine with the shoulder andelbow in 90 degree of abduction and flexion and with the humerus supported to ensure a neutral horizontal position (humerus level with acromion process). With one hand, therapist keeps digital inclinometer across the patient's forearm and other hand at the lower end of the humerus. (Photo 7). At this position, the digital inclinometer was aligned with the ulna (using the olecranonprocess and the ulnar styloid for reference), providing anangle between the forearm and a perpendicular plane to the examination table and moved the humerus into internal rotation. At the end range of internal rotation, therapist recorded the amount of motion present.[25]

Photo 7. Measurement of glenohumeral internal rotation ROM

Measurement of shoulder horizontal adduction ROM –

To assess GH horizontal adduction, we placed participants in a supine position with both shoulders flush againsta standard examination table. The therapist stood at the beside of the examination table and positioned the test shoulder and elbow into 90degree ofabduction and flexion, respectively. The therapist place digital inclinometer across the upper arm whichwas alignedwith the ventral midline of the humerus and moved the humerus into horizontal adduction. Atthe end range of horizontal adduction, therapist recorded the amount of motion present. The angle created by the end position of the humerus with respect to 0 degree of horizontal adduction (perpendicular plane to the examinationtable, as determined by the digital inclinometer)(Photo 8) .then was recorded as the total amount of GH horizontal adduction motion.[25]

Photo 8. Measurement of Glenohumeral horizontal adduction ROM

- **Description of treatment procedure**

Sleeper stretch -

The therapist applied sleeperstretches to all participants who were in the side-lyingposition on the dominant side. Participants' shoulders andelbows were positioned into 90 degree of flexion with the lateralborder of the scapula positioned firmly against thetreatment table. Next, the therapist passively internallyrotated each participant's shoulder by grasping the distalforearm and moving the arm toward the treatment table (Photo 9).Pressure was held constant at the end range of motion for 30second, which was given 3times with 15seconds of rest between each stretch [25]

Photo 9. Sleeper stretch performed in side-lying position with passive internal rotation.

- **Procedure**

After taking the written consent and explaining the study procedure to the participants, Pre participation details regarding age. Height, weight, hand dominance, number of years of experience in bowling, type of bowling, level of participation and injury profile was taken using a questionnaire

Measurement of the baseline data which included shoulder internal rotation and horizontal adduction range of motion was measured for all the participants. The affected side shoulder was given sleeper stretch and again measured for the glenohumeral internal rotation and horizontal adduction on the first day of stretching program using digital inclinometer.

Then sleeper stretch was given to the affected shoulder of all the participants on alternate days thrice in a week for consecutive 3 weeks. Glenohumeral internal rotation and horizontal adduction ROM was measured before and after the stretch on the last session of each week.

Data analysis

Descriptive statistics was used to calculate the mean, Standard deviation and standard error for age, height, weight, BMI analysis for the difference in levels. To know the overall effect of sleeper stretch on shoulder horizontal adduction and internal rotation Repetitive measures ANOVA was carried out.

Results

Table – 1.1. Descriptive statistics of cricket bowlers

Characteristics	Mean	Std. Deviation
Age	20	2.94008
Height	1.70	0.06488
Weight	60.38	7.85912
BMI	21.57	2.60621

Table–1.2. Comparison of Internal rotation range of motion (Overall) between Baseline, 1st week, 2nd week and 3rd week of treatment

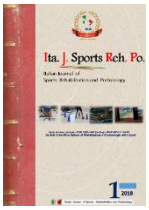
Level	Mean	Std. Deviation
Baseline	97.3333	9.18301
post stretch week 1	105.8	6.62507
post stretch week 2	109	5.81057
post stretch week 3	122	4.65778

Table- 1.2 : shows the Overall comparison of internal rotation range of motion between Baseline, 1st week, 2nd week and 3rd week in all the subjects. The mean values for baseline, week 1, week 2 and week 3 are 97.33±9.18, 105.8±6.62, 109±5.81, and 122±4.65 respectively.

Table–1.3. Pair wise comparison of internal rotation range of motion

Pair level	Mean difference	Standard error	P level	95% Confidence interval for difference	
				Upper limit	Lower limit
Baseline Vs week 1	-8.4667	1.4618	0.8629	-5.5430	-11.3903
Baseline Vs week 2	-11.6667	1.4029	0.1606	-8.8609	-14.4725
Baseline Vs week 3	-24.6667	1.3293	0.1837	-22.0081	-27.3253
Week1Vs week 2	-3.2	1.1376	0.2553	-0.9248	-5.4752
Week 1 Vs week 3	-16.2	1.0455	0.2958	-14.1089	-18.291
Week 2 Vs week 3	-13	0.9614	0.3364	-11.0772	-14.9228

Table- 1.3: table represents, pair wise comparison of internal rotation range of motion between all the levels in all the subjects. Mean difference of IR ROM in between Baseline vs week 1; Baseline vs week 2; Baseline vs week 3; week 1 vs week 2; week 1 vs week 3; and week 2 vs week 3 are -8.4667,-11.6667,-24.6667,-3.2,-16.2,and -13. and respective standard errors are 1.4618, 1.4029, 1.3293, 1.1376, 1.4055 and 0.9614. IR ROM has increased significantly over a period of time.



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Table–1.4. Overall comparison of horizontal adduction range of motion between baseline, 1st week, 2nd week and 3rd week.

	Mean	Std. Deviation
Baseline	85.3666	8.4351
post stretch week 1	94.05	8.6464
post stretch week 2	97.33	6.8955
post stretch week 3	100.1833	5.9617

Table-1.4 : shows overall comparison of Horizontal Adduction range of motion between baseline,1 st week, 2nd week, 3rd week in all the subjects. The mean values for Baseline, week1, week2, and week3 are85.36±8.43, 94.05±8.64, 97.33±6.89 and 100.18±5.96. Significant increase in horizontal adduction ROM was found between all the levels. Each level wise comparison is presented in table 1.4

Table–1.5. Level wise (pair wise) comparison of horizontal adduction range of motion

Level	Mean Difference	Standard Error	P Value	95% Confidence Interval for difference	
				Upper Limit	Lower Limit
Baseline vs week 1	-8.6833	1.5583	0.8576	-5.5833	-11.78
Baseline vs week 2	-11.9633	1.4058	0.9065	-9.1517	-14.7749
Baseline vs week 3	-14.8166	1.3328	0.9283	-12.1510	-17.4822
Week 1 vs week 2	-2.83	1.4268	0.6635	-0.0236	-5.6836
Week 1 vs week 3	-6.1333	1.3550	0.8252	-3.4232	-8.8434
Week 2 vs week 3	-2.8533	1.1761	0.6803	-0.5011	-5.2055

Table- 1.5 : represents level wise comparison of Horizontal Adduction range of motion between all the levels among the subjects. The mean difference of horizontal adduction ROM in between Baseline vs week1; Baseline vs week2; Baseline vs week3; week1 vs week2; week1 vs week3 and week2 vs week4 are -8.6833,-11.9633,-14.8166,-2.83,-6.1333 and -2.8533. The respective standard errors are1.5583, 1.4058, 1.3328, 1.4268, 1.3550 and 1.1761 .The horizontal adduction ROM has increased significantly (.000) over a period of time.

Discussion

Glenohumeral Internal Rotation Deficit (GIRD) and posterior shoulder tightness are interrelated [27] and well documented in many overhead athletes[28,29,30] which simply responds to stretching. Previous studies reported acute effect of sleeper stretch on shoulder internal rotation, Horizontal Adduction ROM in overhead athletes [25,31] but very less literature available reporting long term effects of sleeper stretch on shoulder Internal rotation and Horizontal Adduction ROM specifically in male cricket bowlers. This study was intended to examine the effects of sleeper stretch on shoulder IR and Horizontal Adduction ROM in male elite cricket bowlers.

Effect of stretching

Stretching is thought to increase ROM [32,33] and restore flexibility of the tightened structures. This is supported by many researchers. Corrao Melissa[34] et al recommended stretching exercises and exercise techniques which were designed to isolate posterior structure and to maintain flexibility of posterior shoulder structure which serves as preventive tool for maintaining normal mobility. [34]

W B Kibler[33] found that experimental group participated in a specific conditioning program showed significant improvement in ROM in areas tested.[33] Rancour Jessica et al found that intermittent stretching is sufficient to maintain ROM gain acquired from a prior static stretching [35]

Effect of sleeper stretch on shoulder internal rotation ROM

Paired t test was performed to determine the initial effects of sleeper stretch on shoulder IR range of motion, The results showed no significant difference in IR ROM (P=0.319) before and immediately after stretching. However, the studies done by Sakiki Oyama [36] et.al have quoted the quite opposite findings in which acute changes were evaluated in 15 collegiate baseball pitchers on GH IR, ER, horizontal adduction range of motion following 3 on field types of stretching (Horizontal cross arm stretch, standing sleeper stretch at 90degree and standing sleeper stretch at 45degree) which were administered for 3 sessions at least 2 days apart, each stretch was repeated 3 times and held for 30 seconds. Results showed an increase in ROM and they speculated that this increase was due to the combined effect of 3 types of stretches given to the subjects [36]. The differences in the results of our study might be due to the fact that only one stretch i.e., the sleeper stretch which was repeated for 3 times in a session with 30 seconds hold and 15 seconds rest between each stretch incorporated in our study which might not have been sufficient to produce the immediate effect on the extensibility of the soft tissues.

Kevin G Launder [25] et al. also found statistically significant (p=0.003) increase in IR range of motion after the application of sleeper stretch. The stretch was repeated for 3 times in session, held for 30 seconds with 15 seconds rest between each stretch, but when assessed for clinical significance it showed no significant result, **[25]**

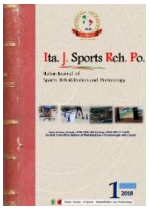
One important finding in the above mentioned studies is that they all incorporated a small sample size of 15 and 33 respectively, and both the studies were done in baseball pitchers with internal rotation, Horizontal adduction ROM being the variables recorded by a digital inclinometer. Whereas the present study included 60 cricket bowlers where internal rotation, Horizontal adduction ROM was measured by using digital inclinometer. The

difference in the results might be due to difference in the reliability of the equipments used, as reliability of digital inclinometer was found to be(0.98)in comparison with the reliability of mechanical inclinometer (0.90-0.96) which has a lesser degree of reliability. This difference might have confounded the outcome of the results.[25].

Summary

The present study was conducted to examine the effects of sleeper stretch on glenohumeral internal rotation and horizontal adduction range of motion in 60 male cricket bowlers with posterior shoulder tightness.

In our Results we find that after giving sleeper stretch there was significant improvement seen clinically in both horizontal adduction and internal rotation. But statically analysis showed that the initial effects of sleeper stretch on internal rotation and horizontal adduction ROM were insignificant. Overall comparison of internal rotation and horizontal adduction ROM between baselines, 1st week, 2nd week and 3rd week in all the subjects were found to be highly significant clinically. Pair wise comparison of internal rotation and horizontal adduction ROM between baseline to 1st week, baseline to 2nd week, baseline to 3rd week, 1st week to 2ndweek, 1st week to 3rd week and 2nd week to 4th week in all subjects was also found to be highly significant clinically.



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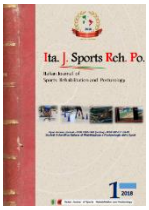

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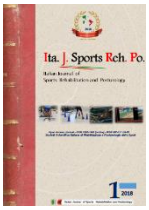

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