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Effect of rotator cuff strengthening exercises along with sleeper stretch versus traditional exercises program in baseball player having Glenohumeral internal rotation deficit (gird): A comparative study

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Abstract

Background: Due of the constant force placed on the dominant (throwing) hand during the cocking phase, upper extremities in overhead athletes are more vulnerable to injuries than lower ones. Baseball is a sport with a high level of physical exertion, and swinging a bat and tossing a ball both require rotational movement. It heavily relies on the stability and range of motion of the shoulder. Due to the throwing and catching motions, a baseball player's shoulder joint and rotator cuff muscle are constantly subjected to higher repeated stress and strains, which increases their risk of injury. According to other research, 20–70% of shoulder injuries in athletes who perform overhead occur. The soft tissue and skeletal alterations brought on by the shoulder complex's repetitive movements and stresses may modify the ROM of the GH joint by increasing ER and decreasing IR. GIRD might result from an extreme drop in IR in the throwing hand. Due to the recurrent cocking phase, this causes stiffness in the rotator cuff and posterior capsule.

Objective/Aim: The aim of the present study was to compare the effect of rotator cuff strengthening exercise along with sleeper stretch vs traditional exercise program in baseball player having glenohumeral internal rotation deficit (GIRD).

Method and Materials: To perform this study, 60 baseball players in the age range of 15-25 years were selected and randomized to two categories – rotator cuff strengthening exercise along with sleeper stretch (group A) and traditional exercise program (group B) each with 30 participants. The study was conducted at the Chiman Bagh ground, an outdoor facility located in Indore, Madhya Pradesh, India. The pre and post testing measured two outcome range of motion and shoulder's muscular strength.

Result: After 6 weeks of treatment, Mean values of range of motion of Internal rotation in right shoulder in post condition of group A and group B are 64.13 and 56.40. There is a significant difference between mean values of range of motion of Internal rotation in right shoulder in post condition of group A and group B. Calculated t value is 3.66 which is significant at degree of freedom 58 and 0.05 level of significance because calculated t-value is greater than tabulated t-value 2.02. there was a significant increase in ROM (external rotation and internal rotation) and muscular Strength (flexor, extensor, abductor, adductor, internal rotator and external rotator) and also decrease GIRD (internal range of motion) in group A.

Conclusion: The results indicates the positive effect of the rotator cuff strengthening exercise along with sleeper stretch in baseball player having glenohumeral internal rotation deficit (GIRD).

Keywords: Baseball, GIRD, Sleeper Stretch, Strengthening, Sphygmomanometer

1. Introduction

Overhead throwing move is a complex activity necessitating a good deal of skilfulness and it puts too much strain on the shoulder joint system. The performance stability of the shoulder is the result of the mutual relationship between static and dynamic stabilizers. Baseball, a high-intensity game, is characterized by three actions, namely, sprint, hitting and pitching. Being one of the most physically demanding and explosive sports, this game demands quite a number of fitness components like shoulder stability, strength, high speed, agility or quickness, rotatory power, anaerobic energetics, body balance arm control, high power or force and fine motor skills to make the baseball skillful. Among these, the pitching involves an extreme large range of motion (ROM) and very high angular velocities in the pitching cycle.

Internal rotation deficit, which negatively affects the glenohumeral joint's biomechanics during throwing and overhead throwing exercises, is the difference in the range of motion between the dominant and non-dominant glenohumeral joints' internal rotation. The rotator cuff play an important protective role when throwing, resolving the internal rotation deficit is important in preventing shoulder injuries.

Baseball was widely recognized as the national sport of the United States. Baseball on the professional, amateur, and youth levels is now popular in North America, parts of Central, South America, Caribbean, and parts of East Asia. A bat and ball sport called baseball is played between two teams of nine players each. The object of the game is to score runs by hitting a thrown ball with a bat and reaching a line of bases that are spaced four apart in the corners of a diamond-shaped field that is 90 feet in diameter. To win the game, baseball player must score more than their opponent team. baseball game also known as hardball, was introduced in India in early 1980s through the establishment of the Amateur Baseball Federation of India.

2. Need of study

Across the globe, baseball is played at a professional as well as at an amateur or beginner's level. The baseline requirement of throwing baseball is pain – free range of motion, adequate muscle power and adequate muscle resistance to fatigue. Besides in baseball, proper body mechanics, specifically, the mechanics of throwing is very important. Glenohumeral Internal Rotation Deficit (GIRD), a very common condition typically found in overhead throwers, is thought to be caused by continuous glenohumeral movement creating an imbalance between the anterior and posterior capsule of the glenohumeral joint. GIRD is a self-adaptive process in which the dominant arm gradually loses internal rotation range of motion. The most frequent way to define GIRD is by a $>20^\circ$ IR loss when compared to the opposite shoulder. Due to the recurrent cocking that takes place with the overhead throwing motion, posterior capsular and rotator cuff stiffness is the most common pathogenic condition in GIRD. Though different training programs such as resistance training, all the players of baseball including pitchers can improve the biomechanics of throwing and increase of throwing velocity as well as reduce the chances of risk or injury or fatigue to arm by increasing the resistance of the arm.

Significance of the study

The findings of the present comparative study will explain the incorporation of a much required rotator cuff strengthening program along with sleeper stretch to build muscular strength and maintain range of motion of baseball players. In addition, the coaches can use the data to understand the principles of these strengthening program to improve the baseball performance of baseball player. The strengthening and stretching (sleeper stretch) program can be used for baseball players across different state level teams of India. Further, through these strengthening with sleeper stretch program players will improve or maintain their ROM as well strength of the shoulder and this program will also help in improving internal range of motion due to which their performance will also be improved as well as keep them conditioned during the offseason periods.

3. Review of Literature

Haag *et al.* in (2018) studied the effect of stretching, considered as a part of intensive athletic training on the performance of baseball players depending upon their positions. The population comprised of equal number of pitchers as well as position players (n=6 each). The results revealed that statistically significant variations existed between the pitcher and position players in terms of accuracy of strikes that have released out of 10 pitches. However, there was no difference between the type of players in terms of average and maximum velocity.

Busch *et al.* at (2017) in a recent studied the influence of stretching and dynamic tubing on the rotation of movement and range of motion was reviewed. The result showed there is a statistically significant difference in internal and external rotation as well as range of motion between the two types of stretching. Improvement was observed from the stretching exercises more in comparison to dynamic tubing.

Moharrami *et al.* in (2015) show that theraband exercises significantly improve the postural senses of the shoulder external and internal rotator muscle groups made up of male athletes with shoulder impingement syndrome, researchers examined the effect of theraband exercises on these muscles.

Hibberd *et al.* in (2014) performed a study on youth and adolescent baseball players and ultimately concluded that an age-related increase in GIRD is primarily due to humeral retrotorsion instead of soft tissue tightness.

4. Material and Methods

A total of N=60 baseball player having GIRD were selected in this study, by the means of randomized sampling technique. All the subjects were included according to their inclusion criteria after proper signing of the consent form. Those who did not fulfilled the inclusion criteria were excluded from the study. Pre and post interventional data was calculated, such that the test for ROM and strength was conducted on each participants. For assessing ROM we used Goniometer and for strength – sphygmomanometer is used. At the sampling stage, random allocation of N=60 participants, such that N=30 in each group. Group A and Group B. Initially 1RM was calculated for each subject to decide the poundage for the interventions. The poundage given was 50-70% resistance of 1 RM during the interventional program of both the group A and group B. For six week interventional program Group A undergoes rotator cuff strengthening exercise by the means of resistive band with sleeper stretch and Group B undergoes rotator cuff strengthening exercise by the means of weight cuff and triceps stretch.

Study design: Comparative study

Study site: The study was conducted at the Madhya Pradesh Baseball Association

Chiman-Bagh ground, located in Indore

Study population: Baseball player having GIRD (Glenohumeral Internal Rotation Deficit).

Sample size: N=60 baseball player having GIRD

Study tools

1. Paper and pen, pencil
2. Goniometer
3. Sphygmomanometer

4. Measuring tape
5. couch

Study participants

Based on the inclusion and exclusion criteria presented in section, N=60 baseball player were selected for the study. Further the participants were randomized into two group based on the type of training undertaken by baseball players, with thirty in each group. Group 1 player were assigned to rotator cuff strengthening exercises with resistive band and sleeper stretch and Group 2 were assigned to rotator cuff strengthening exercises with weight-cuff and triceps stretch. The procedure, risk, contraindications and benefits of the study and their rights were clearly explained to the participants included in this study. Prior to conducting the study, the participants and those who were minors so there parents/ guardians were asked to fill and signed the consent form. In addition were also requested to notify in case of any discomfort.

Sampling method

Since the study is from the perspective of a physiotherapist, the samples were chosen based on the judgement of the researcher. Therefore, purposive sampling method was used for selection of the samples.

5. Data Analysis and Result

Study have demonstrated the effectiveness of different exercise regimes on baseball players. In the present study, two different type of Rotator Cuff strengthening exercises with Sleeper Stretch and Traditional exercises were chosen to train the baseball players. The comparative effect of these trainings on baseball players performances variables, mainly muscular strength (flexor, extensor, abductor, adductor, internal rotator and external rotator) and ROM (internal rotation and external rotation) and GIRD (Glenohumeral Internal Rotation Deficit) in the pre and post training program was performed by paired t-test.

Demographic data of the study population

Table 1: Age, Weight, Height and BMI of the study population Group A and Group B

N=60		
	GROUP A (n=30)	GROUP B (n=30)
VARIABLES	Mean ± SD	Mean ± SD
AGE(Years)	17.6 ± 2.34	18.9 ± 4.0
HEIGHT(cm)	158.1 ± 5.74	157.6 ± 6.0
WEIGHT(kg)	46.7 ± 5.74	48.7 ± 4.0
BMI(kg/m ²)	18.6 ± 0.82	19.51 ± 1.48

In this study, (N=60) participants with age group 15-25 years were recruited. Table 1 illustrated the demographic characteristics Mean and SD value of Group A and Group B variables for group A age (17.6 ± 2.34) years and group B age (18.9 ± 4.0) years. For group A height (158.1 ± 5.74) cm and group B height (157.6 ± 6.0) cm, For group A weight (46.7 ± 5.74) kg and group B weight (48.7 ± 4.0) kg and for group A BMI (18.6 ± 0.82) kg/m² and group B (19.51 ± 1.48) kg/m² respectively of the baseball players having Glenohumeral internal rotation deficit (GIRD) in the study.

Table 2: Distribution of players according to age

	Group A	Group B
AGE (Years)	n(%)	n(%)
15-17	16(53.3%)	9(30.0%)
18-20	9(30.0%)	15(50.0%)
21-25	5(16.7%)	6(20.0%)

Table 2 showed the Age ranges of Group A and Group B in the study population. In age group between 15-17 for group A (n=16; 53.3%) and for group B (n=9; 30%), in 18-20 for group A (n=9; 30%) and for group B (N=15; 50%) and in 21-25 for group A (n=5; 16.7%) and for group B (n=6; 20%) participations respectively out of frequency (n=30; 100%) each.

Table 3: Distribution of players according to gender

	Group A	Group B
Gender	n(%)	n(%)
Female	15 (50.0 %)	21(70.0%)
Male	15 (50.0 %)	9 (30.0%)

Table 3 showed the distribution of baseball player according to gender and it is formed that almost 50% male and 50% female are present in Group A in symmetrical manner but control group 70% is male.

Table 4: Distribution of players according to Hand Dominance

	Group A	Group B
DH	n(%)	n(%)
Left	3 (10.0%)	2 (6.7%)
Right	27 (90.0%)	28 (93.3%)

Table 5: Effect of Group A and Group B on Range of Motion of Internal Rotation in Baseball Players having Glenohumeral internal rotation deficit (GIRD)

N=60 (30 in each group)				
Side	Group	Condition	Mean ±S.D.	t-value p-value
Right	Group-A	Pre	53.10 ±7.99	5.64>0.00001
		Post	64.13 ±7.14	
Left	Group-A	Pre	47.67 ±7.61	6.00> 0.00001
		Post	58.93 ±6.92	
Right	Group-B	Pre	53.23 ±9.36	1.31< 0.195
		Post	56.40 ±9.19	
Left	Group-B	Pre	49.53 ±8.20	1.70< 0.195
		Post	52.90 ±7.06	

The pre and post interventional ROM of right and left IR on Group A and Group B is illustrated in Table 5 and fig 5. The mean ± SD value of right shoulder for Group A(pre= 53.10 ± 7.99 ; post= 64.13 ±7.14) and Group B (pre= 53.10 ± 7.99 ; post=56.40 ±9.19) and left shoulder for Group A (pre=47.67 ±7.61 ; post=58.93 ± 6.92) and Group B (pre=49.53 ±8.20 ; post= 52.90 ±7.06) was significant (for right side group A(t = 5.64, p>0.001) and for group B(t = 1.31, p <0.19) and for left side group A(t = 6.00, p>0.001) and for group B(t = 1.70, p <0.19). The data suggested improvement in Group A than Group B.

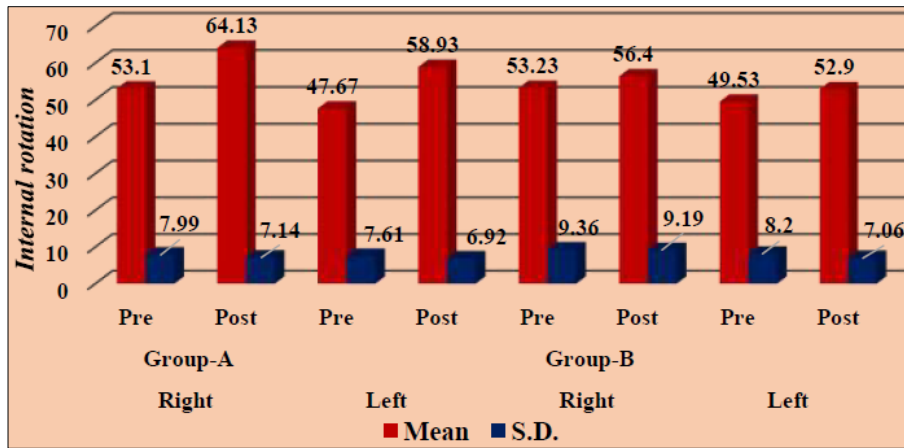


Fig 1: Effect of Group A and Group B on Range of Motion of Internal Rotation in Baseball Players having Glenohumeral internal rotation deficit (GIRD)

Table 6: Effect of Group A and Group B on Range of Motion of External rotation in baseball players having Glenohumeral Internal Rotation Deficit (GIRD)

N=60 (30 in each group)					
Side	Group	Condition	Mean ±S.D.	t-value	p-value
Right	Group-A	Pre	70.73±10.47	2.07	>0.042
		Post	75.57 ±7.30		
Left	Group-A	Pre	72.17 ±9.51	1.76	<0.083
		Post	76.03 ±7.39		
Right	Group-B	Pre	70.93 ±6.67	1.31	<0.195
		Post	73.00 ±5.47		
Left	Group-B	Pre	71.87 ±6.52	0.83	<0.409
		Post	73.10 ±4.80		

The pre and post interventional ROM of right and left ER on Group A and Group B is illustrated in Table 6 and fig 6. The mean ± SD value of Group A, and Group B right shoulder in pre (70.73 ± 10.47, 70.93 ± 6.67) and post value (75.74 ±7.30, 73.00 ± 5.47) and left shoulder pre (72.17±9.51,

71.87 ± 6.52) and post (76.03 ± 7.39, 73.10 ± 4.80) was significant (for right side t = 2.07, p> 0.042, t = 1.31, p >0.19 and for left side t = 1.76, p>0.083, t = 0.83, p >0.40) respectively. The data suggested that only Group A right side is significant

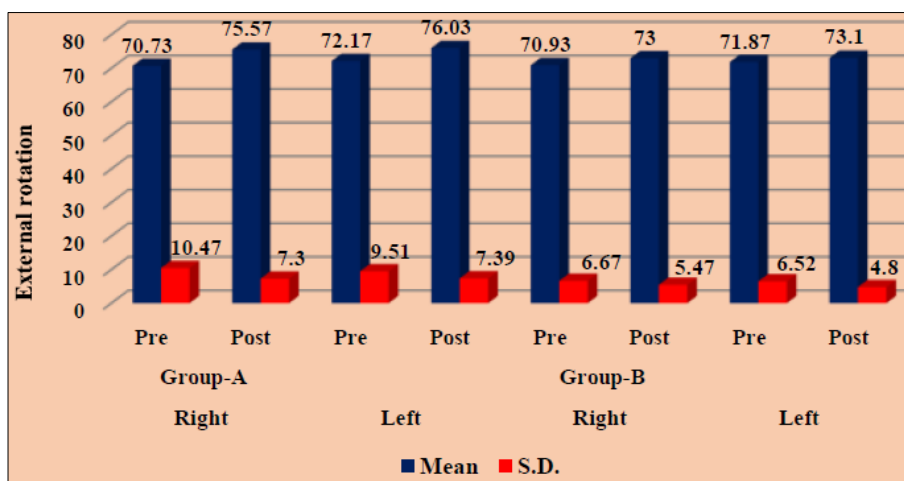
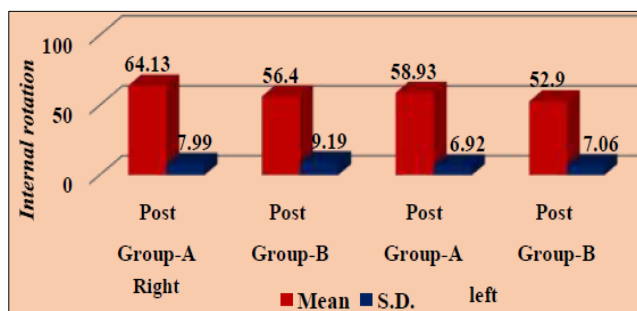


Fig 2: Effect of Group A and Group B on Range of Motion of External rotation in baseball players having Glenohumeral Internal Rotation Deficit (GIRD)

Table 7: Comparison between Group A and Group B on Range of Motion of Internal rotation in baseball players having Glenohumeral Internal Rotation Deficit (GIRD)

N=60 (30 in each group)					
Side	Group	Condition	Mean \pm S.D.	t-value	p-value
Right	Group-A	Post	64.13 \pm 7.99	3.66	>0.0005
	Group-B	Post	56.40 \pm 9.19		
Left	Group-A	Post	58.93 \pm 6.92	3.34	>0.0005
	Group-B	Post	52.90 \pm 7.06		

The post comparison between Group A and Group B on IR, ROM is illustrated on table 7 and fig 3. The Mean \pm S.D. of both the groups for right side group A (post=64.13 \pm 7.99) and group B (post=56.40 \pm 9.19) and for left side group A (post=58.93 \pm 6.92) group B (post= 52.90 \pm 7.06). For right side IR ROM (t = 3.66, p >0.0005) and for left side (t = 3.34, p>0.005). The data suggested that Group A shows more post significant result than Group B.

**Fig 3:** Comparison between Group A and Group B on Range of Motion of Internal rotation in baseball players having Glenohumeral Internal Rotation Deficit (GIRD)

Discussion

Due to the prevalence of single sport specialization and increase in the throwing demand of overhead athlete, the prevalence of GIRD is increases because of repetitive movements of shoulder in cocking phase due to which the rotator cuff muscles and posterior capsule tightness is seen. As the prevalence of GIRD increases, more researches is needed for management of GIRD because it actually decreases the internal range of motion as well as increase the external range of motion and also decrease the performance of the players as well strength of shoulder is also reduced. GIRD is basically due to increased retro-torsion (decreased anteversion) of the humerus, which shifts the arc of motion more posteriorly Because of this the rotator cuff muscle and posterior muscle tightness it is important to strengthen the rotator cuff muscles in a proper way.

In the present study, to compare the 6 week effect of Rotator Cuff Strengthening Exercise along with Sleeper Stretch Vs Traditional Exercise Program in baseball player having Glenohumeral Internal Rotation Deficit (GIRD). N=60 baseball player having GIRD is selected, n=30 players were selected for strengthening exercise with resistive band with sleeper stretch and n=30 players were selected for strengthening exercise with weight cuff and triceps stretch. The outcome measures for the measurements of GIRD and muscular strength is goniometer (intrarater reliability 0.87 and sphygmomanometer (0.90-0.97) which has a very good reliability and validity.

In the present study the post comparison between Group A and Group B on IR, ROM is illustrated on table 5.7 and fig

7. The Mean \pm S.D. of both the groups for right side group A (post=64.13 \pm 7.99) and group B (post=56.40 \pm 9.19) and for left side group A (post=58.93 \pm 6.92) group B (post= 52.90 \pm 7.06). For right side IR ROM (t= 3.66, p > 0.0005) and for left side (t = 3.34, p>0.005). The data suggested that Group A shows more post significant result than Group B. whereas in the study of Noonan *et al.*, (2015) demonstrated that increase humeral retro-torsion may put more stress on the posterior shoulder of pitchers, which may result in ROM deficit. 16 ROM, strength and neuromuscular control are key factor in preventing injuries. The body must be able to go through its necessary rom to perform properly. The surrounding musculature must also be strong enough to tolerate the forces demanded by the body's tasks. Trakis and colleagues (2008) suggested that proper stretching of the posterior capsule and strengthening of the posterior shoulder musculature may aid in preventing injury. Similarly, Lorenz (2005) and Sauer *et al.* (2007) suggested that stretching the posterior capsule will prevent injury.

6. Conclusion

This study concluded that there was significant effect of Rotator Cuff Strengthening Exercise along with Sleeper Stretch in baseball player having Glenohumeral Internal Rotation Deficit (GIRD). The statistical analysis suggested that the measurements value of ROM, strength and GIRD were significantly improved.

7. Limitations

1. Sample size was small.
2. Both male and female players are not equally participated in this study.
3. Only those players are included in the study who do not have any kind of pain.
4. In addition, the players were asked to perform exercises under each training program for a period of 6 weeks and then their performance was evaluated. The training regime did not include any sports prop such as low loads, heavy loads, bodyweights, etc. besides, the long term benefits of these training programs were not addressed.
5. The present study was limited to players from one of the cities of Madhya Pradesh, India, thus generalization of the study to players from other cities should be cautioned. It is possible that training practiced by players from other cities may have different characteristics.
6. Besides, the primary outcome were muscular strength and range of motion. Secondary outcome such as student's perspective on the training program, its severity and benefits on fitness component were not tested.

8. Suggestion and further recommendations

1. In further studies, it may be suggested that the training course could be more than 6 weeks, so that proper results would be evaluated.
2. For further studies, it may be suggested that the number of players should be more for better result.
3. Future studies should include equal weightage of male and female baseball players for which the result should not be bias.
4. In a further study, secondary outcomes measuring student's perspective on different training program, severity and difficulty of training programs, and satisfaction with physical benefits should be measured.
5. The baseball players are also subjected to high risk of injury. Effect of these training on the prevention of injuries remains to be tested.

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