Comparison of modified sleeper stretch with and without taping on glenohumeral internal rotation deficit in overhead throwers- A randomized clinical trial

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ABSTRACT

As GIRD and posterior shoulder tightness is interrelated with each other and well documented in overhead athletes. Many studies have been reported to evaluate the acute effects of sleeper stretch in overhead throwers but no studies till now have been reported to evaluate the long-term effect in overhead throwers. And many studies also have shown that kinesiology tape also improving IR ROM of dominant shoulder to check the long-term effect of kinesiology tape. The present study is to compare the effect of sleeper stretch with and without Kinesio tape to improve the GIRD in overhead throwers. Methodology: 60 overhead throwers, no age limitation (male and female) were recruited from Nehru ground and Mangala stadium (Mangalore), and cricket academy in Vadodara (Gujarat) and SAI (sports authority of India) in Gandhinagar (Gujarat). 60 overhead throwers randomly divided into two groups. Group 1 (n=30) was received only sleeper stretch and group 2 (n=30) was received sleeper stretch and kinesiology tape. The modified sleeper stretch, performed with the patient inside lying on the throwing side to stabilize the scapula against the table and both the shoulder and elbow flexed to 90°. In this position, passive IR is applied to the dominant arm by using the opposite hand. The immediate effects of the sleeper stretch, performed 3 times for 30 seconds, found an increase IR ROM of the shoulder joint. Taping is done in sitting position. The first piece of the tape was applied from the anterior aspect of the humeral head, just lateral to the acromion process to finish at the inferior angle of the scapula. The second piece of tape commenced on the anterior aspect of the humeral head over the acromion. The opposite hand lifted the humeral head up and back during the application of the tape. Result: GIRD in overhead throwers between the groups was analyzed using unpaired t-test comparison between the grips.by using the unpaired t-test. The mean diff between the 1st day to 1st week is 1.70 and t value is3.668, the mean diff between the 1st day to 2nd week is 4.56 and t value is 6.757, the mean diff between 1st day to 3rd week is 6.60 and t value is 7.51, the mean diff between 1st day to4th week is 6.96 and t value is 6.99,the mean diff between 1st week to 2nd week is 2.86 and t value is 7.05, the mean diff between 1st week to 3rd week is 4.90 and t value is 7.92,the mean diff between 1week to 4th week is 5.26 and t value is 6.69, the mean diff between 2nd week to 3rd week is 2.03 and t value is 4.92, the mean diff between 2nd week to 4th week is 2.40 and t value is 3.35, all above p<0.001means this is highly significant but the mean diff between 3rd week to 4th week is 0.367 and t value is 0.609,p<0.545 which is not highly significant. Conclusion: We concluded that the long-term effect of modified sleeper stretch showed improvement in IR ROM of the shoulder in the dominant side which is beneficial for athletes' regular rehabilitation to prevent the injuries. The immediate effect of Kinesiology taping is better than long-term effect.

Keywords: *GIRD, Modified sleeper stretch, Kinesiology taping*

1. INTRODUCTION

The shoulder is an elegant piece of machinery. It has the greatest ROM of any joint in the body. The important structures of the shoulder can be divided into several categories. These include bones and joints, ligaments and tendons, muscles, nerves, blood vessels, bursae. There are actually four joints that make up the shoulder. The main shoulder joint, called the GH (Glenohumeral) joint, is formed where the ball of the humerus fits into a shallow socket on the scapula. This shallow socket is called the glenoid.[1]

The overhead throwing motion is a highly skilled movement performed at extremely high velocity, which requires flexibility, muscular strength, coordination, synchronicity, and neuromuscular control. The throwing motion generates extraordinary demands on the shoulder joint. It is because of these high forces, which are repetitively applied.[2] However, this large range of motion can lead to joint problems.[1]

Shoulder injuries can be carrier changing or even carrier ending events, especially for overhead athletes such as baseball pitchers football quarterbacks, tennis player and swimmers. Efficient throwing requires a coordinated effort that progresses from the toes to

the fingertips. The sequence of body segment motion begins with the lower body and moves to the upper body and arm. Energy is generated in the legs and trunk and is then transferred through the shoulder to the arm, which delivers the force to the ball.[3]

Overhead throwing athletes have been found to have greater external and lesser internal rotation strength ratios in their dominant arm when compared to their non-dominant arm.[4] The forceful and repetitive nature of overhead activities is hypothesized to cause microtrauma to the anterior capsule, causing an anterior shift of the humeral head, changing the rotational arc of the shoulder, increasing ER and decreasing IR ratio.[5]

The throwing shoulder typically exhibits increased ER and decreased IR when compared to the non-throwing shoulder. This loss of internal rotation in the throwing shoulder is defined as the glenohumeral internal rotation deficit (GIRD).[6]
There are three grades of GIRD:
- GRADE 1: If the difference between the internal rotation of the non-throwing shoulder versus throwing shoulder was greater than 20 degrees.
- GRADE 2: The difference between the internal rotation of the throwing shoulder and the non-throwing shoulder was greater than 10% of the TROM (IR + ER) of the non-throwing shoulder.
- GRADE 3: The difference between the internal rotation of the throwing shoulder and the non-throwing shoulder was greater than 20% of the internal rotation of the non-throwing shoulder.[6]

Overhead athletes require a delicate balance of shoulder mobility and stability in order to meet the functional demands of their respective sport. Altered shoulder mobility has been reported in overhead athletes and is thought to develop secondary to adaptive structural changes to the joint resulting from the extreme physiological demands of overhead activity.[7]

These proposed causes include osseous adaptations, posterior capsular tightness at the GH joint. Measurement of passive humeral rotation in overhead athletes (especially throwing athletes) is a common clinical practice to identify contracture and tightness present in the posterior shoulder capsule and musculature. This tightness is commonly assessed by evaluating the presence of decreased IR, total humeral rotation, and horizontal adduction in the dominant limb compared with the non-dominant limb.[8] posterior shoulder tightness with subsequent loss of humeral internal rotation range of motion has been linked to upper extremity lesions in overhead athletes.[9] Passive GH joint rotation was measured using a universal goniometer.[10]

Stretching techniques for the posterior shoulder are commonly incorporated into the maintenance and prevention program of the overhead athlete to minimize risk of injury.[11] Routine stretching programs can be effective means of improving the ROM of joints. GIRD involves restricted shoulder ROM due to muscular and capsular tightness.[12]

GIRD may be a primary cause of shoulder pain and shoulder disability in the overhead thrower and encouraged the use of a stretching program for the posterior shoulder structures, particularly the sleeper stretch, to restore IR ROM.[11] in overhead athletes, significant gains in ROM, suggesting a universal, beneficial effect of the Sleeper Stretch.[13]

As shoulder tape is increasingly being used for athletes for both therapeutic and prophylactic reasons, and as both excessive and restricted shoulder ER ROM.[5] it has recently been reported that taping can influence joint kinematics in the knee. Given the relatively limited osseous stability of the GH joint, it is possible that tape may have a similar impact on shoulder kinematics.[10] The Aim of this study is a comparison of modified sleeper stretch with and without taping on GIRD in overhead throwers.

2. AIM & OBJECTIVES
Aim: The aim of the study is to evaluate a modified sleeper stretch with and without taping on GIRD in overhead throwers.

Objectives:
1) To evaluate the effects of modified sleeper stretch in improving GIRD in overhead athlete.
2) To evaluate the effects of modified sleeper stretch with taping in improving GIRD in overhead athlete.
3) To compare the effects of modified sleeper stretch and modified sleeper stretch with taping to improve GIRD in the overhead athlete

3. METHODOLOGY
Study design: randomized clinical trial.
Source of the data: In this study total 60 asymptomatic overhead athlete participated. The overhead athletes were taken from,
- Mangla stadium Mangalore
- Nehru Cricket Ground Mangalore
- Cricket academy in Vadodara (Gujarat)
- Sports Authority of India (SAI) Gandhinagar (Gujarat)

Subject present with GIRD. Both male and female candidates were included after they signed an informed consent form.
Sample size: 60
Sample design: Convenient sampling
Selection Criteria: Subjects for the study were selected based on the following criteria.

Inclusion criteria:
1) Overhead athlete with GIRD.
2) Bilateral comparison of TROM showing asymmetry of 5°.
3) Athletes one year of regular practice.
4) Males and females

Exclusion criteria:
  1) Non-players.
  2) Players with h/o shoulder pain or fracture or dislocation in less than twelve months.
  3) Any nerve lesions of the upper limb.
  4) Allergy to tape.
  5) Fragile skin around the shoulder joint.

Materials to be used:
  - Goniometer
  - Kinesio Tapes
  - Pre-Post assessment form

Procedure
The study was approved by the Institution's Ethics and Scientific review committee. All the participants who had fulfilled the eligibility criteria were explained about the purpose and procedure of the study and an informed written consent was obtained from each of the subjects in which the subject agreed to participate in the study subject with present of GIRD both male and female candidates were included after they signed for informed consent form.

4. MODIFIED SLEEPER STRETCH
The modified sleeper stretch, performed with the patient inside lying on the throwing side to stabilize the scapula against the table and both the shoulder and elbow flexed to 90°. In this position, passive IR is applied to the dominant arm by using the opposite hand. The immediate effects of the sleeper stretch, performed 3 times for 30 seconds, found an increase IR ROM of shoulder joint[11].

4.1 Kinesio-Taping
Taping is done in sitting position. The first piece of the tape was applied from the anterior aspect of the humeral head, just lateral to the acromion process to finish at the inferior angle of the scapula. The second piece of tape commenced on the anterior aspect of the humeral head over the acromion. The opposite hand lifted the humeral head up and back during the application of the tape.[22]

Methods of collection of data
All subjects were asked to sign the written consent form, stating the voluntary acceptance in this study. Subjects who fulfilled inclusion criteria were allotted in to subject group based on block randomization.

Baseline Data
The first day of the assessment checks the GIRD if it is present then the only subject was included in this study. Ask the patient to lie down on the couch and check the internal rotation of the shoulder joint both dominant and non-dominant side using universal goniometer.

Total 60 asymptomatic overhead throwers they were randomly divided into two groups. (Group 1 and group 2)Each group has 30 subjects. Group1 received only sleeper stretch and another group 2 received kinesio tape with sleeper stretch.

The duration of sleeper stretch is 3 times, 30-second hold and 30-second rest in between, every week 5 session and follow up for one month.For group 2 first applied Kinesio tape and then received sleeper stretch 3 times, 30-second hold and 30-second rest in between, every week 5 session and follow up for one month. Every alternate day the tape was changed.

Treatment protocol for group 1:
After checking the baseline data. Group 1 received a modified sleeper stretch. 3 times in one session, 30 sec hold, 30 sec rest in between. And this was done every session, weekly 5 sessions till 4th week. After that comparison between 1st-day baseline data and to 4th-week data.

Treatment protocol for group 2:
After checking baseline data. Group 2 received kinesiology tape. The tape has to be changed on an alternate day. Then received a modified sleeper stretch. 3 times in one session, 30 sec hold, 30 sec rest in between. And this was done every session, weekly 5 sessions till 4th week. After that comparison between 1st-day baseline data to 4th-week data.

After this, received both the groups' data, then the comparison between the groups is done.

Fig. 1: ROM Measurement for IR of Shoulder   **Fig. 2: Middle trapezius strengthening**

Fig. 3: Sleeper Stretch

Fig. 4: Modified sleeper stretch with Kinesio Tape

4. RESULT

The data analysis was done by using the statistical software SPSS (version 16) for windows. Among the 60 participants, in group 1 there were 30 participants and in group 2 there were 30 participants. Many studies have shown that it is no difference between male and female. Descriptive analysis was done for both the groups. Group 1 mean is 32.20±8.9 and for group 2 is 24.96 ±4.9.

To examine the difference within the group 1 after the treatment repeated measures ANOVA was used. Bonferroni test was done to determine improvement within the weeks for group 1. To examine the difference within the group 2 after the treatment repeated measure ANOVA was used. Bonferroni test was done to determine improvement within the weeks for group 2. To examine the difference between the groups before the treatment unpaired t-test was used.

Table 1: Showing results of improvement in IR ROM after the treatment, within group 1, by using repeated measures ANOVA

Group 1

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		Repeated measures ANOVA F value	p value
				Lower Bound	Upper Bound		
1st Day	30	44.77	3.63	43.41	46.12	2761.087	.000
1st Week	30	51.30	3.95	49.83	52.77		<0.001, HS
2nd Week	30	60.10	4.18	58.54	61.66		
3rd week	30	69.37	4.60	67.65	71.09		
4thweek	30	79.20	4.47	77.53	80.87		

This result shows that improvement in IR ROM within the group 1. The mean of 1st day is 44.77, 1st week is 51.30, 2nd week is 60.10, 3rd week is 69.37, 4th week is 79.20.by using repeated measures ANOVA f value is 2761.08 and p<0.001. So it clearly states that there is an improvement every week.

Table 2: Showing day and week wise comparison within the group 1
Post hoc analyis by Bonferroni test

Group: Group 1

		Mean Difference	Std. Error	p	
@1stDay	@1stWeek	-6.533	.266	.000	<0.001, HS
	@2ndWeek	-15.333	.353	.000	<0.001, HS
	@3rdweek	-24.600	.444	.000	<0.001, HS
	@4thweek	-34.433	.535	.000	<0.001, HS
@1stWeek	@2ndWeek	-8.800	.260	.000	<0.001, HS
	@3rdweek	-18.067	.355	.000	<0.001, HS
	@4thweek	-27.900	.446	.000	<0.001, HS
@2ndWeek	@3rdweek	-9.267	.253	.000	<0.001, HS
	@4thweek	-19.100	.379	.000	<0.001, HS
@3rdweek	@4thweek	-9.833	.311	.000	<0.001, HS

This table is showing that comparison between the day and week. the mean diff between 1stday to 1st week is -6.533, to 2nd week is -15.33, to 3rd week is - a 24.60,4^{th} week is -34.43. And the mean diff between a 1st week to 2nd week is -8.80, to 3rd week is -18.06, to 4th week is -27.90. And mean diff between a 2nd week to 3rd week is -9.267, to 4th week is -19.100. And the mean diff between a 3rd week to 4th week is -9.833. This is done by the Bonferroni test. p<0.001 means it is highly significant.

Table 3: Showing results of improvement in IR ROM after the treatment, within group 2, by using repeated measures ANOVA

Group 2

	N	Mean	Std. Deviation	95% Confidence Interval for Mean		Repeated measures ANOVA F value	p value
				Lower Bound	Upper Bound		
1st Day	30	47.93	3.43	46.65	49.22	1714.281	.000
1st Week	30	56.17	3.81	54.75	57.59		<0.001, HS
2nd Week	30	67.83	4.44	66.17	69.49		
3rd week	30	79.13	4.55	77.44	80.83		
4thweek	30	89.33	4.20	87.77	90.90		

This table is showing that improvement of IR ROM within the group 2. The mean of 1st day is 47.93, 1st week is 56.17, 2nd week is 67.83, 3rd week is 79.13, 4th week is 89.33. By using repeated measures ANOVA f value is 1714.28 and p<0.001. So it clearly states that there is an improvement every week.

Table 4: Showing day and week wise comparison within the group 2
Post hoc analyis by Bonferroni test

Group: Group 2

		Mean Difference	Std. Error	p	
@1stDay	@1stWeek	-8.233	.380	.000	<0.001, HS
	@2ndWeek	-19.900	.576	.000	<0.001, HS
	@3rdweek	-31.200	.759	.000	<0.001, HS
	@4thweek	-41.400	.840	.000	<0.001, HS
@1stWeek	@2ndWeek	-11.667	.312	.000	<0.001, HS
	@3rdweek	-22.967	.506	.000	<0.001, HS
	@4thweek	-33.167	.649	.000	<0.001, HS
@2ndWeek	@3rdweek	-11.300	.326	.000	<0.001, HS
	@4thweek	-21.500	.608	.000	<0.001, HS
@3rdweek	@4thweek	-10.200	.515	.000	<0.001, HS

This table is showing that comparison between the day and week in GRP 2. The mean diff between 1stday to 1st week is -8.233, to 2nd week is -19.90, to 3rd week is -31.20,4th week is -41.40. And the mean diff between 1st week to 2nd week is -11.66, to 3rd week is -22.96, to 4th week is -33.16. And mean diff between 2nd week to 3rd week is -11.30, to 4th week is -21.50. And the mean diff between 3rd week to 4th week is -10.20. This is done by Bonferroni test.p<0.001 means it is highly significant.

Table 5: Comparison between groups

		Mean Difference	Std. Error	Mean Difference	Std. Error Difference	t	p	95% Confidence Interval of the Difference	
								Lower	Upper
Change 1st day - 1st week	Group 1	-6.533	.266	1.700	.463	3.668	.001	.772	2.628
	Group 2	-8.233	.380				HS	.770	2.630
Change 1st day - 2nd week	Group 1	-15.333	.353	4.567	.676	6.757	.000	3.214	5.919
	Group 2	-19.900	.576				HS	3.208	5.925
Change 1st day - 3rd week	Group 1	-24.600	.444	6.600	.879	7.510	.000	4.841	8.359
	Group 2	-31.200	.759				HS	4.832	8.368
Change 1st day - 4th week	Group 1	-34.433	.535	6.967	.996	6.997	.000	4.974	8.960
	Group 2	-41.400	.840				HS	4.966	8.967
Change 1st - 2nd week	Group 1	-8.800	.260	2.867	.406	7.059	.000	2.054	3.680
	Group 2	-11.667	.312				HS	2.053	3.680
Change 1st - 3rdweek	Group 1	-18.067	.355	4.900	.619	7.922	.000	3.662	6.138
	Group 2	-22.967	.506				HS	3.659	6.141
Change 1st - 4thweek	Group 1	-27.900	.446	5.267	.787	6.692	.000	3.691	6.842
	Group 2	-33.167	.649				HS	3.687	6.846
Change 2nd - 3rd week	Group 1	-9.267	.253	2.033	.413	4.927	.000	1.207	2.859
	Group 2	-11.300	.326				HS	1.206	2.860
Change 2nd - 4th week	Group 1	-19.100	.379	2.400	.716	3.351	.001	.966	3.834
	Group 2	-21.500	.608				HS	.961	3.839
Change 3rd week - 4th week	Group 1	-9.833	.311	.367	.602	.609	.545	-.838	1.571
	Group 2	-10.200	.515				NS	-.843	1.577

This table is showing comparison between the groups. By using unpaired t test. The mean diff between the 1st day to 1st week is 1.70 and t value is3.668,the mean diff between the 1st day to 2nd week is 4.56 and t value is 6.757, the mean diff between 1st day to

3rd week is 6.60 and t value is 7.51, the mean diff between 1st day to4th week is 6.96 and t value is 6.99,the mean diff between 1st week to 2nd week is 2.86 and t value is 7.05, the mean diff between 1st week to 3rd week is 4.90 and t value is 7.92,the mean diff between 1week to 4th week is 5.26 and t value is 6.69, the mean diff between 2nd week to 3rd week is 2.03 and t value is 4.92, the mean diff between 2nd week to 4th week is 2.40 and t value is 3.35, all above p<0.001means this is highly significant but the mean diff between 3rd week to 4th week is 0.367 and t value is 0.609,p<0.545 which is not highly significant.

5. CONCLUSION

The major clinical findings were:

1. There was significant improvement in IR of ROM in dominant side of shoulder after applying sleeper stretch
2. There was significant improvement in IR of ROM in dominant side of shoulder after applying kinesiology tape we concluded that short term effect of kinesiology taping and modified sleeper stretch showed improvement in IR ROM of shoulder joint which is beneficial for athletes regular rehabilitation to prevent the injuries. However, the effectiveness of kinesiology taping on long term effect was less as compared to 1st day and there was no significant difference between groups on 3rd week to 4th week.

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