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EFFECTIVENESS OF RESISTANCE TRAINING USING THERABANDS AND DUMBBELLS ON THE STRENGTH OF INTERNAL AND EXTERNAL ROTATORS OF SHOULDER IN MALE VOLLEY BALL PLAYERS

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ABSTRACT

INTRODUCTION: *Volleyball players repetitively use their shoulders for overhead serving, spiking and blocking, which commonly leads to shoulder pain. Overuse of the rotator cuff muscles can lead to rotator cuff tendinitis or tears, which is more commonly seen in adults than in young athletes. More often, pain from shoulder instability and resulting impingement is seen in young athletes. In addition to the rotator cuff muscles, there are also ligaments that help to stabilize the shoulder joint during movement. In volleyball, the player's arm typically goes into extreme positions and rotations for hitting. When these muscles and ligaments are over worked and unable to restrain excessive movement of the shoulder may lead to occurrence of injuries. Resistance training (RT) can improve players' maximal force and power production, reduce the incidence of injury, and contribute to faster injury recovery times, thereby minimizing the number of missed practice sessions and competitions. There are specific forms in which overload may be introduced during resistance training.*

Aim: *To determine the effectiveness of resistance training using therabands and dumbbells on the strength of internal and external rotators of shoulder in male volley ball players.*

Objectives: *To compare the pre and post values of peak torque of internal and external rotators of shoulder in subjects who have undergone resistance training using therabands and resistance training using dumbbells.*

Methodology: *A total of 30 players were recruited in experimental and control group. The demographic data including age, height, weight were calculated through data calculation sheet. Initial evaluation of strength of shoulder internal and external rotators was done by using isokinetic analyzer. Results: After the analysis, the results revealed significant improvement of internal and external rotators P (<0.00) in experimental group than the control group.*

Conclusion: *To compare the pre and post value of peak torque of internal and external rotators on subjects who have made resistance training using therabands and dumbbells between the experimental group and control group.*

Keywords: Therabands, Dumbbells, Isokinetic Analyzer.

INTRODUCTION

Volleyball is a sport played by two teams consisting of 12 players each on a playing court, divided by a net in order to ground it on the opponent's court and to prevent the same effort by the opponent. The team has 3 hits or contacts to return the ball. (1).

Volley ball is a sportive modality that requires strength in the upper and lower extremities along with the trunk musculature. The improvement of muscular strength is very important along with agility and flexibility for a volley ball player. The ball is usually played with the hands or arms (2).

Mostly volley ball injuries are a result of over use and overtraining, playing on multiple teams during the year gives the young athlete less time for proper rest between practices and games. "Lack of strength and flexibility in the core, shoulder musculature and legs can lead to poor form in the athletes jump and volleys, resulting in injury (2).

Volleyball players repetitively use their shoulders for overhead serving, spiking and blocking, which commonly leads to shoulder pain. Overuse of the rotator cuff muscles can lead to rotator cuff tendinitis or tears, which is more commonly seen in adults than in young athletes. More often, pain from shoulder instability and resulting impingement is see in our young athletes. In addition to the rotator cuff muscles, there are also ligaments that help to stabilize the shoulder joint during movement (3).

In volleyball, the player's arm typically goes injury recovery times, thereby minimizing the number of missed practice sessions and competitions (4,5). There are specific forms in which overload may be introduced during resistance training (6).

Resistance training (RT) can be done by using various resistive devices such as weight cuffs, dumbbells, springs, therabands, barbells, sand bags. RT can improve players' maximal force and power production, reduce the incidence of injury, and contribute to faster into extreme positions and rotations for hitting.

Therabands are specific brand of resistance bands used for muscular strengthening. The versatility of a theraband

makes possible to exercise virtually any muscle in the body. The light weight, foldability of the therabands makes it convenient for us in carrying where ever we go.

Resistance level	*Colour code*	*Resistance In LBS*	*Resistance In Kgs*
Light	*Yellow*	*09.98*	*4.5*
Medium	*Red*	*11.86*	*5.4*
Strong	*Green*	*13.73*	*6.2*

Volley ball is a game that can be played by all ages and both sexes indoors and outdoors. It can be highly competitive, requiring a high level fitness agility and co-ordination, or it can be a relaxing and highly enjoyable recreation. Volley ball requires a variety of physical attributes and specific playing skills therefore participants need to train and prepare to meet at least a minimum set of physical, physiological and psychological requirements to cope with the demands of the game and to reduce the risk the injuries (7).Volley ball playing largely involves jumping, stretching, twisting, diving, spiking and turning movements, that place the players to greater risk of injuries (8).

Lightweight dumbbells are frequently used as the primary method of therapeutic exercise in the prevention of shoulder injury and in the strengthening of the external rotator muscles (9).

Dumbbells are graduated weights that are either held or applied to the extremities, and help strengthen the external rotator muscles during rehabilitation following rotator cuff repair (10).

Isokinetic strength testing can play an important part in the comprehensive evaluation and rehabilitation of a patient with a shoulder injury (11). Of all the muscle groups of the shoulder, external rotators (ERs) and internal rotators (IRs) are most important because those muscle groups are responsible for maintaing dynamic stabilization of the glenohumeral joint (12). One possible mechanism leading to shoulder injury may be strength imbalance between these muscles (13), which can be assessed by using isokinetic analyzer.

Difference in IR and ER strength ratios appears to be related to injury in almost all players whose sport involves overhead throwing activites such as baseball (14), tennis, handball and volley ball (15).

In volley ball, strength of the ERs and IRs is related to either serving or spiking performance, which are both important elements of success in volley ball. IR concentric strength correlates well with volley ball spike velocity (16). An asymptomatic overhead athlete should have IRs that are 3% to 9% stronger in the dominant shoulder than in the nondominant shoulder, whereas ER strength may be weaker in the range of 0% to 14% compared with the nondominant side(17). **NEED OF THE STUDY**:

Isolated studies were done on the effect of resistance training using therabands and resistance training using dumbbells on strength of internal and external rotators of shoulder in volley ball players.

Majority of the studies were done on the volley ball players, basket ball players and athletes related to the proximal joint muscles strength and power.

AIM OF THE STUDY:

To determine the effectiveness of resistance training using therabands and dumbbells on the strength of internal and external rotators of shoulder in male volley ball players.

OBJECTIVES:

1. To evaluate pre and post values of resistance training using therabands on the strength of shoulder internal and external rotators (peak torque) by using isokinetic analyzer.
2. To evaluate pre and post values of resistance training using dumb-bells on the strength of shoulder internal and external rotators (peak torque) by using isokinetic analyzer.
3. To compare the pre and post value of peak torque of internal and external rotators of shoulder in subjects who have undergone resistance training using therabands and resistance training dumbbells.

HYPOTHESIS:

Null hypothesis: There is no significant effect of resistance training using therabands and dumbbells on the strength of internal and external rotators of shoulder in male volleyball players.

Alternate hypothesis: There is significant effect of resistance training using therabands and dumbbells on the strength of internal and external rotators of shoulder in male volleyball players.

MATERIALS AND METHODOLOGY

- Isokinetic analyzer to evaluate the peak torque of internal and external rotators of shoulder.
- Therabands to strengthen internal and external rotators of shoulder
- Dumbbells to strengthen internal and external rotators of shoulder
- **Source of data**: Primary data was collected from S.V. University volley ball players at Tirupati, A.P.
- **Duration of the study:** 6-weeks 5-days/week, one session per day.
- **Study design:** The study design was two way experimental study.
- **Sample design:** simple random sampling
- **Sample size:** the sample size for this research study is 30 male volley ball players.

Inclusion criteria:

Age group: 18 -25 years, male volley ball players

Exclusion criteria:

- Female volley ball players
- Age below 18 and above 25
- Previous trauma
- Musculoskeletal injuries
- Any recent shoulder surgery

Outcome measures:

Muscle strength of internal and external rotators of shoulder is measured by using isokinetic analyzer.

METHODOLOGY

30 male volleyball players who have fulfilled the inclusion criteria were assigned into two group experimental & control groups each consisting of 15 subjects.

The purpose of the study was explained to all the subjects written informed consent documents were signed by the subjects voluntarily.

At baseline, recruited players will underwent a detailed clinical examination as per the attached proforma. A detailed anthropometric assessment including measurement of weight (weighing machine), height (stadiometer) will be taken. The strength of IR&ER of shoulder will be assessed by using isokinetic analyzer through peak torque.

Protocol for Experimental Group: The subjects of the experimental group undergone resistance training by using thebands.

Warm up period conducted for 10mins which include jogging, arm circle .General mobility exercises.

Theraband resistance training conducted for 25mins.

1st and 2nd week –Yellow theraband weekly 5days, 3sets 10 repetitions per set 1min rest

3rd and 4th week – Red theraband same protocol given

5th and 6th – Blue theraband same protocol given

Cool down period conducted for 5mins.

Procedure for internal rotators: Position of the player: Standing position on the floor.

Position of therapist: The therapist stands beside the player and corrects the faulty movements.

Procedure: One end of theraband is attached to a secure objects left side of the body and other end of theraband is hold by the subjects hand, the shoulder is adduction position and asked player to do internal rotation maintain for 5 seconds or 5sets in this position.

Procedure for external rotators: Position of the player: Standing position on the floor.

Position of therapist: The therapist stands beside the player and corrects the faulty movements.

Procedure: One end of theraband is attached to a secure objects same side of the body and other end of theraband is hold by the subjects hand, the shoulder is adduction position and asked player to do external rotation maintain for 5 seconds or 5sets in this position

Protocol for control group: The subjects of the control group undergone resistance training by using dumbbells.

Warm up period conducted for 10mins which include jogging, arm circle general mobility exercises.

Dumbbells resistance training conducted for 25 mins

1st and 2nd week weightage of the dumbbells used was decided by after calculating 1 repetition maximum of the players. is given weekly 5days, 3sets 10 repetitions per set 1min rest

3nd and 4th week conducted dumbbells is given same protocol

5th and 6th week conducted dumbbells is given same protocol.

Cool down period conducted for 5mins.

Procedure for internal rotators: Position of the player: Sitting position in the chair

Position of therapist: The therapist stands beside the player and corrects the faulty movements.

Procedure: player is sitting comfortable position dumbbell is held in the hand shoulder is adduction position and asked player to do internal rotation.

Procedure for external rotators:

Position of the player: Sitting position on the chair

Position of therapist: The therapist stands beside the player and corrects the faulty movements.

Procedure: player is sitting comfortable position dumbbell is held in the hand shoulder is adduction position and asked player to do external rotation.

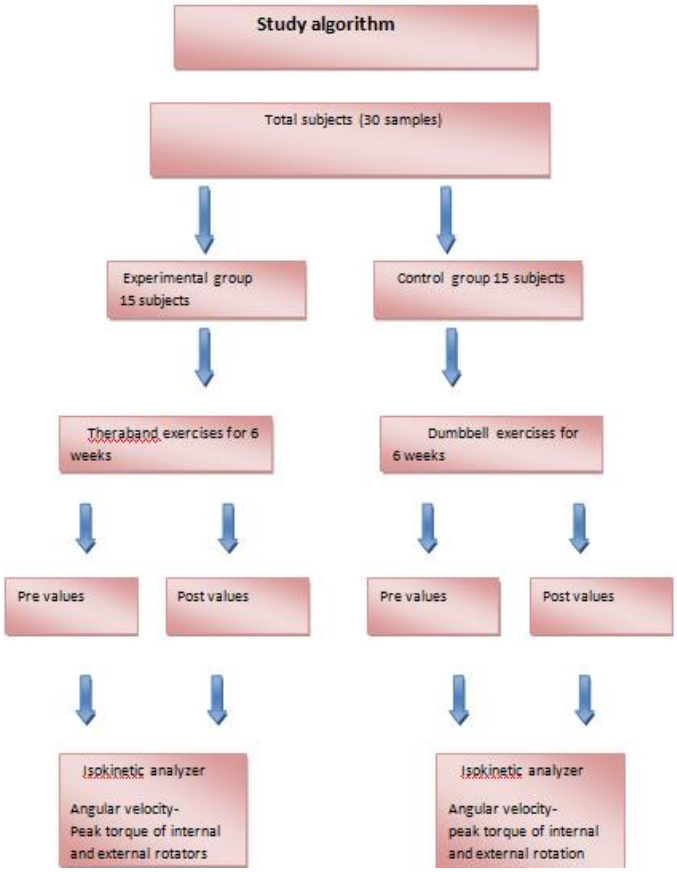


Figure.1,2: Measurement of peak torque of shoulder internal and external rotators by using isokinetic analyzer.

Figure. 3,4: Strength of shoulder internal and external rotators strengthening exercises through theraband.

Figure.5,6: Strength of shoulder internal and external rotators strengthening exercises through dumbbells.

STATISTICAL ANALYSIS :

Statistical analysis has been carried out to analyze the significant impact of the protocol used by the players of the experimental group by using IBM SPSS Inc.20.0 version All 30 players completed the entire study protocol as defined by 6 weeks in the training session. Statistical tools such as independent sample t-test and paired sample t-test has been appiled to the outcome measures –peak torque for internal and external rotators of shoulder 120◦, 150◦, 180◦. Descriptive measures like mean, standard deviation have been reported along with p-value.

Table.1: Pre and post values of strength (peak torque) of internal rotators at 120^0 angular velocity in both the groups

Group		*N*	*Mean*	*SD*	*T-value*	*P-value*
Internal rotators 120◦ (experimental)	*Pre*	*15*	*18.47*	*5.246*	*15.512*	*0.000*
	Post	*15*	*21.96*	*4.963*		
Internal rotators 120◦ (Control)	*Pre*	*15*	*18.31*	*3.868*	*7.917*	*0.000*
	Post	*15*	*19.83*	*3.833*		

RESULTS: Pre and post values of peak torque of internal rotators at 120◦ of angular velocity mean and SD are 18.47±5.246 and 21.96±4.963 for experimental where as for control group is 18.31±3.868 and 19.83±3.833.

Inference: On performing the paired t-test, it was observed that there is a statistical significance ($p<0.00$) values of strength of internal and external rotators. The t-test values are 15.512 in experimental where as 7.917 in control group. It shows that post intervention had shown significant impact on the players.

Fig.1: Graphical representation of pre & post values of peak torques of shoulder internal rotators at 120⁰ angular velocity

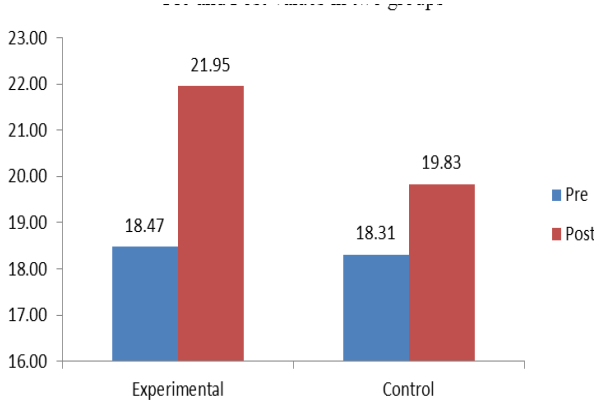


Table.2: Pre and post values of strength (peak torque) of internal rotators at 150⁰ angular velocity in both the group.

Group		N	Mean	SD	T-value	P-value
Internal rotators 150◦ (Experimental)	Pre	15	15.75	3.081	4.536	0.000
	Post	15	23.08	6.091		
Internal rotators 150◦ (Control)	Pre	15	14.25	3.259	20.965	0.000
	Post	15	18.13	3.196		

RESULTS: Pre and post values of peak torque of internal rotators at 150◦ of angular velocity mean and SD are 15.75 ± 3.081 and 23.08± 6.091 for experimental where as for control group is 14.25± 3.259and 18.13± 3.196.

Inference: On performing the paired t-test, it was observed that there is a statistical significance (p<0.00) values of strength of internal and external rotators. The t-test values are 4.536 in experimental where as 20.965 in control group. It shows that post intervention had shown significant impact on the players.

Fig.2: Graphical representation of pre & post values of peak torques of shoulder internal rotators at 150⁰ angular velocity.

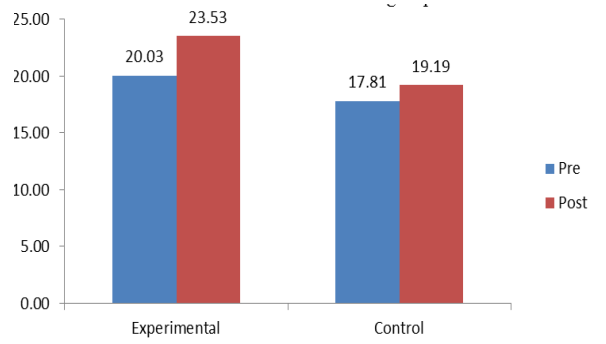


Table: 3 pre and post values of strength (peak torque) of internal rotators 180⁰ angular velocity in both the groups

Group		N	Mean	SD	T-value	P-value
Internal rotators 180◦ (experimental)	Pre	15	18.14	5355	8.973	0.000
	Post	15	21.28	5.145		
Internal rotators 180◦ (Control)	Pre	15	16.10	6.069	16.664	0.000
	Post	15	20.30	6.351		

RESULTS: Pre and post values of peak torque of internal rotators at 180◦ of angular velocity mean and SD are 18.14 ± 5.355 and 21.28 ± 5.145 for experimental where as for control group is 16.10 ± 6.609 and 20.30 ± 6.351.

Inference: On performing the paired t-test, it was observed that there is a statistical significance (p<0.00) values of strength of internal and external rotators. The t-test values are 8.973 in experimental where as 16.664 in control group. It shows that post intervention had shown significant impact on the players

Fig 3: Graphical representation of pre & post values of peak torques of shoulder internal rotators at 180⁰ angular velocity.

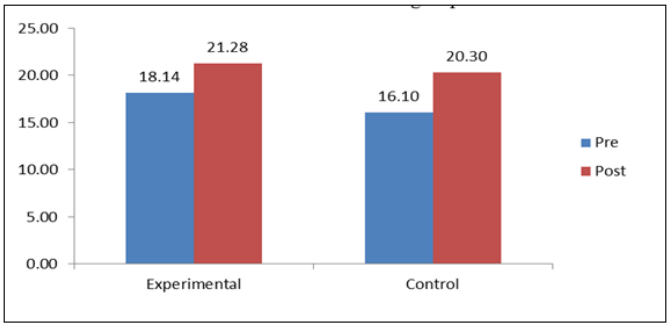


Table: 4 pre and post values of strength (peak torque) of external rotators 120⁰ angular velocity in both the groups

Group		N	Mean	SD	T-value	P-value
External rotators 120◦ (experimental)	Pre	15	18.25	2.836	4.795	0.000
	Post	15	24.07	4.990		
External rotators 120◦ (Control)	Pre	15	13.56	3.434	8.776	0.000
	Post	15	14.99	3.369		

RESULTS: Pre and post values of peak torque of external rotators at 120◦ of angular velocity mean and SD are 18.25 ± 2.836 and 24.07 ± 4.990 for experimental whereas for control group is 13.56 ± 3.434 and 14.99 ± 3.369.

Inference: On performing the paired t-test, it was observed that there is a statistical significance (p<0.00) values of strength of internal and external rotators. The t-test values are 4.795 in experimental where as 8.776 in control group. It shows that post intervention had shown significant impact on the players.

Fig 4: Graphical representation of pre & post values of peak torques of should external rotators at 120⁰ angular velocity

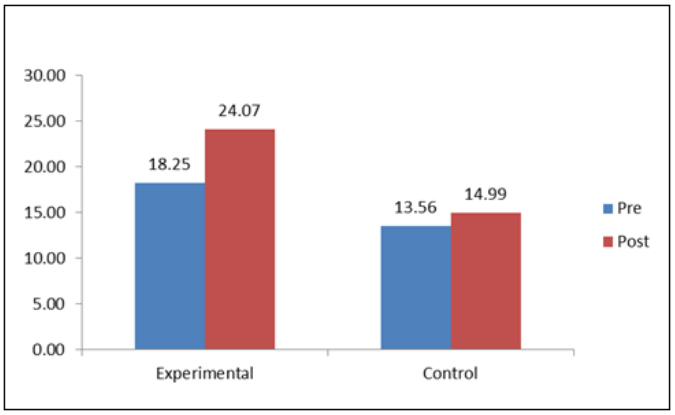


Table: 5 pre and post values of strength (peak torque) of external rotators 150⁰ angular velocity in both the groups

Group		*N*	*Mean*	*SD*	*T-value*	*P-value*
External rotators 150◦ (experimental)	*Pre*	*15*	*15.75*	*3.081*	*4.536*	*0.000*
	Post	*15*	*23.08*	*6.091*		
External rotators 150◦ (Control)	*Pre*	*15*	*14.25*	*3.259*	*20.965*	*0.000*
	Post	*15*	*18.13*	*3.196*		

RESULTS: Pre and post values of peak torque of external rotators at 150◦ of angular velocity mean and SD are 15.75 ± 3.081 and 23.08 ± 6.091 for experimental whereas for control group is 14.25 ± 3.259 and 18.13 ± 3.196.

Inference: On performing the paired t-test, it was observed that there is a statistical significance (p<0.00) values of strength of internal and external rotators. The t-test values are 4.536 in experimental where as 20.965 in control group. It shows that post intervention had shown significant impact on the players.

Fig5: Graphical representation of pre & post values of peak torques of should external rotators at 150⁰ angular velocity.

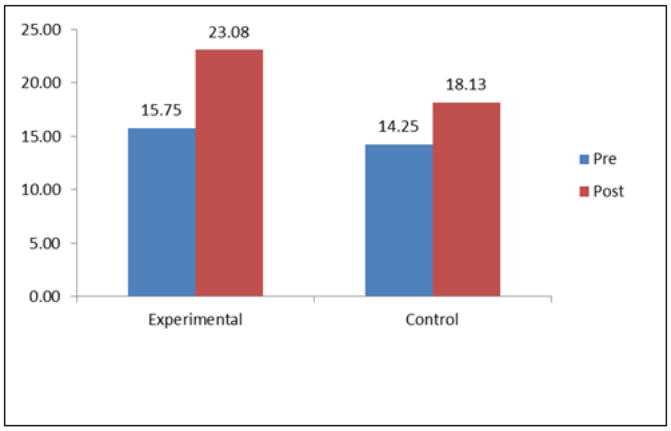


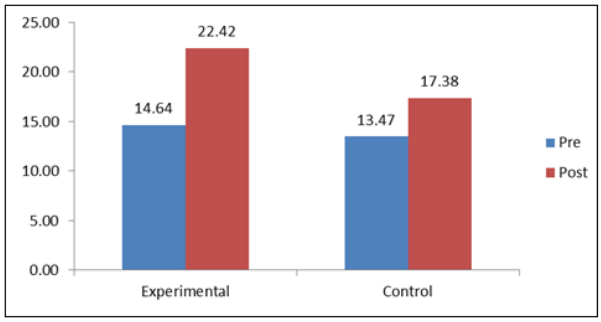
Table: 6 pre and post values of strength (peak torque) of external rotators 180⁰ angular velocity in both the groups

Group		*N*	*Mean*	*SD*	*T-value*	*P-value*
External rotators 180◦ (experimental)	*Pre*	*15*	*14.64*	*2.924*	*5.735*	*0.000*
	Post	*15*	*22.42*	*5.520*		
External rotators 180◦ (Control)	*Pre*	*15*	*13.47*	*2.959*	*22.021*	*0.000*
	Post	*15*	*17.38*	*3.100*		

RESULTS: Pre and post values of peak torque external rotators at 180◦ of angular velocity of mean and SD are 14.64 ± 2.924 and 22.42 ± 5.520 for experimental whereas for control group is 13.47 ± 2.959 and 17.38 ± 3.100.

Inference: On performing the paired t-test, it was observed that there is a statistical significance (p<0.00) values of strength of internal and external rotators. The t-test values are 5.735 in experimental where as 22.021 in control group. It shows that post intervention had shown significant impact on the players.

Fig 6: Graphical representation of pre & post values of peak torques of should external rotators at 180⁰ angular velocity



DISCUSSION

In the present study out of 30 male volleyball players, 15 players were selected for resistance training using therabands and 15 players were selected for resistance training using dumbbells resistance training. The strength of shoulder internal and external rotators showed significant improvement after 6 weeks of resistance training with therabands and dumbbells ($p<0.00$).

The improvement of muscle strength due to resistance training may be due to changes induced in the central nervous system which can increase number of motor units recruited to alter motor neuron firing rate. This will enhance motor unit synchronization during particular movement's pattern and results in the removal of neural inhibition.

The results in the table 1,2,3 shows that strength of internal rotators at 120◦, 150◦ , 180◦ angular velocity of the experimental group has significantly improved after 6 weeks ($p<0.000$) compared with the control group. Page et al. conducted a 6 week (3days per week) intervention using theraband elastic bands and observed a 19.6% increase in eccentric external rotation torque in a group of baseball pitcher.

The experimental group exhibited significantly greater improvement in peak torque for both internal and external rotators of shoulder. The results in the table 4,5,6 shows that strength of external rotators at 120◦, 150◦, 180◦ angular velocity of the experimental group has significantly improved after 6 weeks ($p<0.000$) compared with the control group. Treiber et. al, assessed concentric strength of the external rotator muscles and did not result in a decrease of shoulder rotator muscle imbalance, there was no evidence to support the effectiveness of rotator cuff exercises for shoulder injury prevention (10,15). Gozlan and Witvrouw et.al, reported no differences in ER or IR strength of the D and ND shoulders at 60°/s and 180°/s in male volleyball players

Chung et al. (1987) compared the external and internal rotation muscle strengths of healthy Korean adults and found that the muscles responsible for internal rotation had higher strength than those responsible for external rotation.One of the major benefits of theraband is that than free weights, it does not rely on gravity provided resistance. It increases potential for use in more functional movement pattern that mimic both day to day activities and various sport specific activities. Because free weights rely on gravity to provide resistance, this can only provide resistance in vertical plane.

CONCLUSION:

There was improvement of strength of internal rotators and external rotators in both the groups. But the subjects who have undergone RT using therabands have more improvement of strength of IR and ER than the subjects who undergone RT using dumbbells. Hence, the null hypothesis is rejected and the alternate hypothesis is accepted.

LIMITATIONS:

- Sample size is small.
- Study duration is shorter.
- Only male volleyball players.
- Long term effects were not monitored in this study.

RECOMMENDATIONS

- Long term effects can be monitored in further studies.
- Large sample size is recommended.
- E.M.G recommended for secondary outcome measure, to measure the peak muscle strength.
- Core muscle strengthening training can be studied in volley ball players.
- Measurement of limb length can be recommended for further studies.

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