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EFFECTIVENESS OF THERABAND EXERCISES ON STRENGTH OF ANKLE AND SUBTALAR MUSCLES AND JUMP PERFORMANCE IN MALE VOLLEY BALL PLAYERS

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Abstract: Background: In volley ball sports, jumping and landing movements are typical activities. During these activities, the lower limb muscles play a key role mainly the muscles of ankle complex. The aim of the study is to determine the effectiveness of Thera band exercises on strength of ankle and subtalar muscles and jump performance in male volley ball players. Objectives of this study are to find out the pre and post values of peak torque of ankle and subtalar musculature and jump performance in volley ball players after theraband resistance training. **Methodology:** A total of 36 players were recruited in a single group. The demographic data including age, gender, height, weight, and BMI were calculated through data calculation sheet. Initial evaluation of the ankle and subtalar muscle strength is done by using Isokinetic analyser and vertical jump performance was measured using sergeant jump test. **Results:** After the analysis, the results revealed significant improvement of ankle and subtalar muscle strength $p (<0.00)$ and jump performance. **Conclusion:** The study showed beneficial results in muscular strength and jump performance.

Keywords: Theraband, isokinetic analyser, jump test.



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INTRODUCTION

Volley ball was invented by the American “William Morgan” in 1895 ¹. Based on the report given by international volley ball federation there are more than 800 million people who play the game at least weekly once ². Jumping and landing movements are typical activities in volley ball sport. During these activities lower limb muscles play a key role mainly the muscles of ankle complex. Ankle joint stability is maintained by both static and dynamic mechanisms. Dynamic joint stability relies on proper functioning of neuromuscular network. Disruption in the pathway may predispose the ankle to further injury and future instability³. Dynamic joint stabilization is achieved by co-contraction of the muscles surrounding a joint. Eccentric control, to minimize forces between the ground and the ankle foot complex⁴. As a result, players who have muscular imbalance are susceptible to injury due to their inability in dissipating the forces acting on the joint in coordinated manner. The excessive stress on the surrounding joint tissues often predispose to ankle joint injury⁵.

Measurement of vertical jump height was first proposed as a test of muscular power by Sergeant in 1921. During volley ball game vertical jump is divided into 3 phases down phase, a up phase and a flight phase. During down phase ankle in dorsi flexion, knee in flexion, hip in flexion, and shoulder hyper extended position. During up phase opposite motions occur at each joint such as ankle in plantar flexion, knee and hip in extension shoulders in flexion position⁶. During down phase ankle joint motion is doris flexion but the muscle contraction is eccentric, so the ankle plantar flexors are the active muscle group. During up phase the contraction of the active muscles at each of the joint is concentric. Ankle plantar flexors are active in this phase. At the end of the preparatory phase and the beginning of propulsive phase the body is accelerated upward rapidly, so strength is required in the ankle plantar flexors⁶.

Theraband products are the original system of progressive exercise. It was used from more than 30 years ⁷. Evidence based exercise programs utilizing theraband and tubing rehabilitate injuries improve the functional ability of older adults, improve athletic performance and aid in treating many chronic diseases ⁷. Theraband resistance bands and tubing are low-cost, easily portable and versatile. They are made of natural rubber latex and are easily recognized by the trademark. The available colours are yellow, red, green, blue, black and silver, as well as other colours such as tan and gold ⁷. Elastic resistance is a unique type of resistance training compared to other types of resistances, such as isotonic or isokinetic resistances. The resistance provided by elastic bands or tubing is based on the amount of band or tubing is stretched. The theraband resistance measured in pounds of force depending on the percentage the band or tubing is stretched from its resting length; this is known as “force-elongation”. Regardless of how long the band or tubing is stretched, the force produced at its stretched length depends on the percent elongation ⁷.

In 1950's Hettinger dynamometer was the first isometric measurement used. "Hislop and Perrin" first described the concept of isokinetics in 1967. Constant angular devices have been used to determine muscle function, testing and rehabilitation⁸. Isokinetic commonly referred for multi joint systems (MJS) are truly multi mode dynamometers capable of evaluating isokinetic, isometric, isotonic and reactive- eccentric methods and analysis of open and closed kinematic chain⁸. A task analysis survey of the sports physical therapy section of the American physical therapy section association in 1980 concluded that such equipment is essential in the practice of sports physiotherapy⁹. Isokinetic testing and exercise as established a major place in the assessment and rehabilitation of sports injuries⁹. Advanced technology allows clinicians to progress the patients form the acute phase of rehabilitation to the more functional movement patterns faster and safer than ever. To take advantage of the MJS, first we must understand the terminology used⁸.

Need of the study the lack of muscular ability of invertors, evertors, plantar flexors and dorsi flexors lead to ankle instability which alter the jump performance 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. Hence the main purpose of this study is to evaluate the effectiveness of theraband exercise on strength of ankle and subtalar muscles and jump performance in male volley ball players.

Aim of the study to determine the effectiveness of theraband exercises on strength of ankle and subtalar muscles and jump performance in male volley ball players.

MATERIALS AND METHODOLOGY

Materials: Isokinetic analyser to evaluate the peak torque of ankle and subtalar muscles.

Sergeant jump test to evaluate jump performance.

Theraband (blue colour) to strengthen the ankle plantar flexors, dorsi flexors, invertors and evertors.

Methodology:

Study design: Experimental study design

Sampling: Simple random sampling

Setting: Sri Venkateswara arts and Science College & Sri Venkateswara institute of medical sciences, Tirupati, A.P

Sample size: 36 subjects

Study duration: 5 weeks, 5days/week.

CRITERIA OF THE STUDY

Inclusion criteria: Age group: 18 – 24 years, Professional male volley ball players and BMI=18 – 25.

Exclusion criteria: Previous trauma, musculoskeletal injuries, any recent ankle & subtalar surgery, flat foot, BMI above 25.

Outcome measures: Measurement of ankle & subtalar muscle strength by using isokinetic dynamometer. Each players performs a practice trial consisting of three sub maximal ankle plantar flexion, dorsi flexon, inversion and eversion at 60⁰/s, angular velocity before recording the data. The evaluation of strength training involved the measurement of peak torque of ankle plantar flexors, dorsi flexors, invertors and evertors by using the Isokinetic analyser (Biodex System 4 pro) with angular velocities at 60⁰/s.

Measuring jump performance by using sergeant jump test. The player stands side on to a wall and reached up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. The player then stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. The jump technique can use a counter movement. Attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the score. The player repeat the test 3 times is recorded. A prior informed consent was obtained from all the participants after fully explaining the research protocol.

Procedure: A total of 36 players who have fulfilled the inclusion criteria were assigned in a single group. The demographic data were collected from each subject and the purpose of the study was explained to all the players.

INTERVENTION

The protocol consist of 60 minutes which including warming up for 10 minutes strengthening exercise protocol with theraband (blue colour) for 45 minutes and cool down for 5 minutes.

Protocol: Warm up period conducted for 10 minutes, which include Jogging, Arm circles, General Mobility exercises and stretching exercises.

1st week:-10 rep. each set, 5 seconds hold of 5sets, between each exercise, 30 seconds rest.

2nd and 3rd weeks: - 20 rep. each set 5 seconds hold of 5sets, between each exercise, 30 seconds rest.

4th and 5th weeks: - 30 rep. each set 10 seconds hold of 5sets between each exercise, 30 seconds rest. One session/day, weekly 5 days theraband exercises 5weeks. Cool down period of 5 minutes which includes relaxation exercises for lower extremity muscles and relaxed breathing exercises.

STATISTICAL ANALYSIS

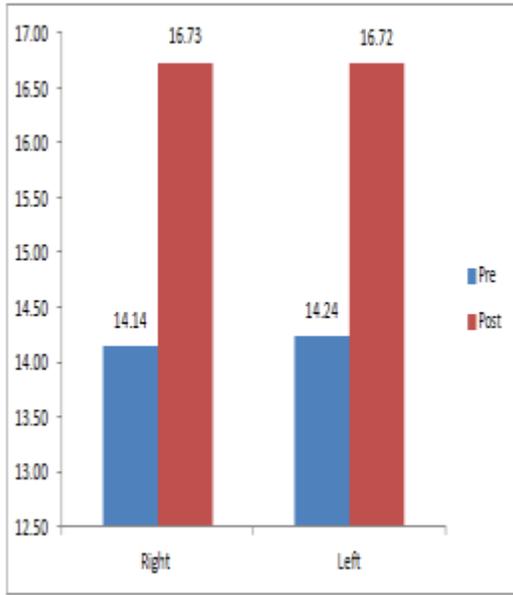
Statistical analysis has been carried out to analyze the significant impact of the protocol used by the players of experimental group by using IBM SPSS Inc.20.0 version. All 33 players completed the entire study protocol as defined by 5-weeks in the training sessions and 3 drop outs. Statistical tools such as independent sample t-test and paired sample t-test has been applied to the outcome measures – peak torque for ankle plantar flexors and dorsi flexors at 60°/s, and invertors and evertors at 60°/s and jump performance (height in meters).Descriptive measures like mean, standard deviation have been reported along with p- value.

Results: After the analysis, the results revealed significant improvement of ankle and subtalar muscle strength p (<0.00) and jump performance.

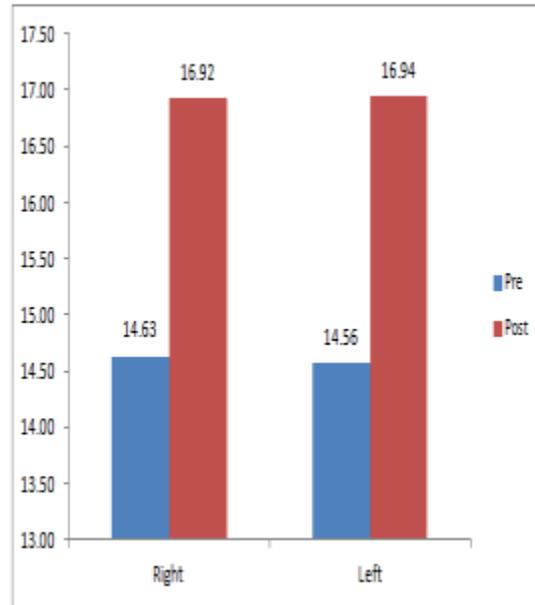
Comparison between pre and post values using paired t-test:

		N	Mean	SD	t-value	p-value	Remarks
Plantar flexors Right	Pre	33	14.14	3.322	11.976	0.000	As p < 0.05, there is significant difference between the pre and post within Plantar flexors Right
	Post	33	16.73	2.686			
Plantar flexors Left	Pre	33	14.24	3.242	14.001	0.000	As p < 0.05, there is significant difference between the pre and post within Plantar flexors Left
	Post	33	16.72	2.808			
Dorsi flexors Right	Pre	33	14.63	2.886	15.048	0.000	As p < 0.05, there is significant difference between the pre and post within Dorsi flexors Right
	Post	33	16.92	2.544			
Dorsi flexors Left	Pre	33	14.56	2.954	14.406	0.000	As p < 0.05, there is significant difference between the pre and post within Dorsi flexors Left
	Post	33	16.94	2.663			
Invertors Right	Pre	33	14.64	3.248	15.075	0.000	As p < 0.05, there is significant difference between the pre and post within Invertors flexors Right
	Post	33	17.12	2.920			
Invertors Left	Pre	33	14.59	3.202	14.888	0.000	As p < 0.05, there is significant difference between the pre and post within Invertors flexors Left
	Post	33	17.07	2.967			
Evertors Right	Pre	33	14.84	3.091	15.020	0.000	As p < 0.05, there is significant difference between the pre and post within Evertors flexors Right
	Post	33	17.29	2.964			

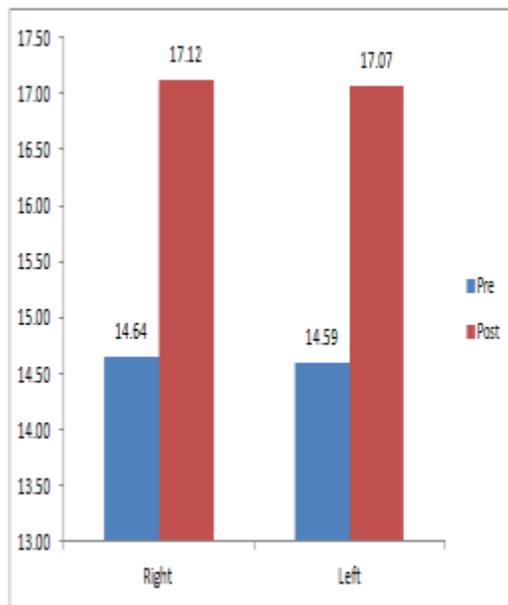
Evertors Left	Pre	33	14.91	3.186	15.859	0.000	As p < 0.05, there is significant difference between the pre and post within Evertors flexors Left
	Post	33	17.25	3.052			
Jump performance	Pre	33	2.57	0.087	20.223	0.000	As p < 0.05, there is significant difference between the pre and post within Jump performance
	Post	33	2.71	0.089			



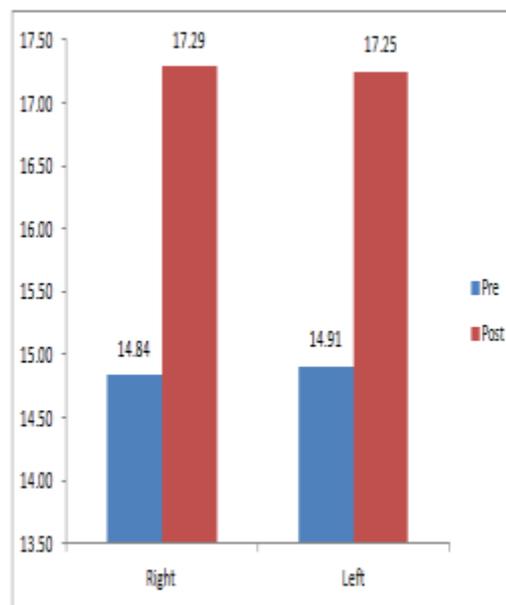
Pre and post values of ankle plantor flexors



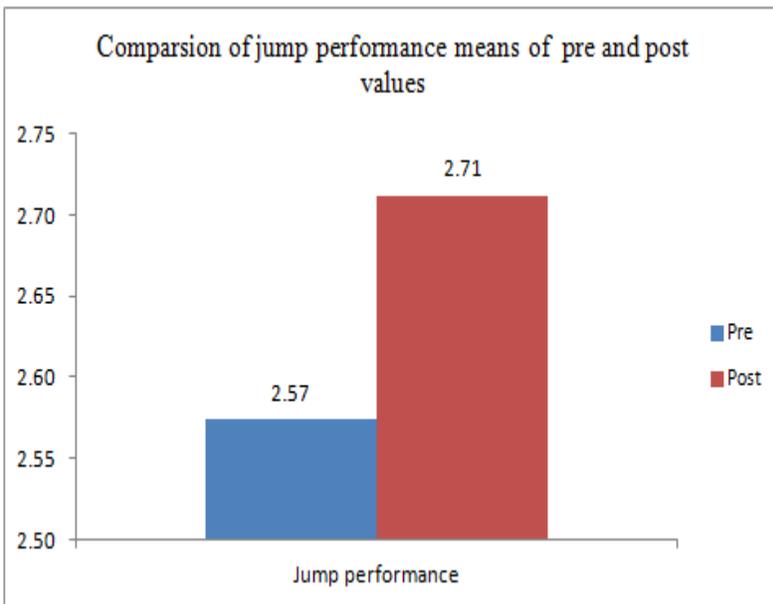
Pre and post values of ankle dorsi flexors



Pre and post values of ankle invertors



Pre and post values of ankle evertors



DISCUSSION

In the present study 36 male volley ball players were selected for theraband resistance training, there was three drop out in the study. The players mean age group 21.21 ± 1.317 . They have completed the protocol of resistance training (5weeks) as per the prescribed protocol. The strength of ankle and subtalar muscles showed significant improvement after 5 weeks of resistance training with theraband ($p < 0.05$). After the data analysis reveals, a significant difference between the pre and post values of ankle and subtalar muscles strength ($p < 0.05$), and jump performance.

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 pattern and results in the removal of neural inhibition¹⁰.

The muscle is able to adapt by increasing the size and amount of contractile proteins, which comprise the myofibrils within each muscle fiber, leading to an increase in the size of the individual muscle fibers and their consequent force production¹¹.

Theraband exercise, such as the use of elastic tubing equipment, has been used for almost a century. Originally therabands used as a fitness technique, but eventually progressed to be used as rehabilitation device. Currently it is used commonly in both fitness and rehabilitation around the world¹².

Theraband and free-weight resistance have several similar properties such as resistance, range of motion (ROM), variable speed of movement, progressive resistance. Therabands have various advantages rather than free weights such as resistance in multiple directions, provide variable resistance, provide constant tension, and prevent cheating¹².

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. Theraband exercise can perform in various directions such as twisting body from side to side, side kicks and punches, and major advantage is less risk for injury¹².

Theraband resistance training programs using elastic tubing, elastic bands and similar devices increase muscle strength and muscle size and decrease body fat in a similar manner to free weight training programs¹².

The results on the statistical analysis showed significant improvement in the post values of peak torque of ankle dorsi flexors and plantar flexors strength for right and left sides (table 1 and 2). A Similar studies are done by Fernando ribeiro (2009) concluded by the low cost strength training of dorsi flexors and plantar flexors improve the strength, balance and functional mobility in elderly people. The improvement in plantor flexor strength was associated with the improvement in balance¹³.

The results on the stastical analysis showed significant improvement in the post values of peak torque of ankle invertors and evertors strength for right and left sides (table 3 and 4). A Similar studies are done by Nasim Mohajerani (2013) concluded that muscle weakness can be a predictor of chronic functional ankle instability and that progressive resistance exercises can increase muscle strength in the functionally unstable ankle¹⁴.

The sergeant jump test performance increased by recruiting greater muscle mass and therefore generating significantly greater power. Additionally greater muscular strength improved by the theraband exercise have increased the ATP supply which lead to enhanced peak torque in the initial phase of any power activity including jumping.

The table 5 showed a significant improvement in sergeant jump test of the male volley ball players. A similar study are done by Alekhya a Tirumala et al(2014) concluded that the two weeks resistance tube exercise program was found to have an effect on kicking accuracy, vertical jump height and 40-yard technical test performance in competitive foot ball players. Resistance tube exercise thus is included as a component of a regular strength training program for such athletes¹⁵.

Conclusion: The present study concluded that there is improvement in ankle and subtalar muscle peak torque and jump performance in volley ball players. The theraband exercise effectively improves ankle and subtalar muscle strength and jump performance.

Limitations: Sample size is small, study duration is shorter and resistance training selected only male volleyball players.

Recommendations: Studies can be done both in men women and long term effects can be monitored in further studies.

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