



EFFECTIVENESS OF PROPRIOCEPTIVE EXERCISES ON BALANCE, AGILITY AND LOWER LIMB EXPLOSIVE STRENGTH IN AMATEUR VOLLEYBALL PLAYERS

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Abstract

Introduction:- Volleyball has become one of the most widely played participant sports in the world. In Volleyball balance, agility and lower limb explosive strength plays important role. In the absence of optimal balance, sport performance can be negatively influenced in repetitive jumping, sprint and in activities involving agility. For this reason, balance and jumping should be considered together in athletes. The purpose of proprioceptive training is to advance the complex activity of the neuromuscular system. Effect of proprioceptive training on sports performance is minimally studied so it is importance to check where Proprioceptive exercise training can improve the balance, agility and lower limb explosive strength in amateur volleyball players.

Method:- 32 male amateur volleyball players in age group of 18-25 years were included and divided into two groups. Players having lower limb injury, Musculoskeletal problems and any medical condition that would impair their playing activities were excluded. Intervention group (Group A) followed Proprioceptive training programme for 5 weeks and control group (Group B) does not perform any exercise they continue to do their daily activities. Proprioceptive exercise training consist of five weeks (3 days / week , 10 reps / exercise) . After 5 weeks star excursion balance test, T- test of agility, vertical jump test was performed again and paired t -test and Unpaired t-test is performed to compare results in intragroup and intergroup respectively.

Results :- Both groups improved significantly at the end of 5th week but intervention group showed highly significant difference for balance, agility and lower limb explosive strength as compared to Control group ($p < 0.05$).

Conclusion:- Proprioceptive exercise training is effective in improving dynamic balance, agility and lower limb explosive strength in amateur volleyball players.

Index Terms :- Balance, Agility, Lower limb explosive strength, Proprioception

I. INTRODUCTION

Volleyball is an Olympic sport that is played in more than 200 countries in the world.⁽¹⁾ There are many dynamic skills and movements needed to Play the game .⁽²⁾ Volleyball uses several complex movements in offense and defence. However, the spike typically finalises the offensive action and is one of the most important and basic techniques.⁽¹⁾ In Volleyball balance, agility and Vertical jump plays important role.

Proprioception relates primarily to the position sense of mechanoreceptives . It encompasses two aspects of position sense, static and dynamic. Static sense is thought to provide conscious orientation of one body part to another, while dynamic sense facilitates neuromuscular feedback system related to the rate and direction of Movement.⁽³⁾ The purpose of proprioceptive training is to advance the complex activity of the neuromuscular system.⁽⁴⁾

Balance is defined as the ability of the Center of the body to remain in maximal stability with minimal slide. Balance is controlled by central nervous system, and it is performed with the combination of data coming from vestibular, somatosensory and visual systems. There are two types of balance- static and dynamic balance.⁽⁵⁾ Static balance is defined as attaining the balance in a stable position with minimal movement. The dynamic balance is the ability to remain standing and stable while performing movements or actions that require displacing or moving.⁽⁵⁾

Dynamic balance requires moving a stable postural set over the base of support. Volleyball involves rapid postural movements around the court which include quick and repetitive movements like jumping and squatting.

Agility is often described as the ability of a quick and efficient transfer of a body in space conditioned by the change of direction and sudden stop. ⁽⁴⁾ In volleyball , agility is needed to reach the approaching ball as well as for rapid changes in directions within small duration of time that are needed during the process of game .

Explosive jumping strength represents the ability of maximum muscle activity that enables the acceleration of one's own body in the activities such as vertical and horizontal jumps (Milanović, 2005; Željaskov, 2004). Vertical jumps are the jumps made in a vertical plane.⁽⁴⁾ Jumping is utilized during the jump set, jump serve, blocking and spiking.⁽⁷⁾

Dynamic balance, agility and lower limb explosive strength is measured by star excursion balance test, T-test of agility and vertical jump test respectively.

None of the previous studies till date have studied the effect of Proprioceptive training on various parameters of physical fitness required in volleyball players. Most of the studies have studied effect of Proprioceptive training on ankle sprain prevention . Very few studies have focused on the Effect of Proprioceptive training exercises in sports that require excellent strength, agility and balance.

The research hypothesis , says there would be a significant difference between Proprioceptive training exercise group and control group. The aim is to study the effectiveness of proprioceptive exercises on balance, agility and lower limb explosive strength in young amateur volleyball players. The objective is to study effect of proprioceptive exercises on balance using star excursion balance test , on agility using T – test of Agility, on Lower limb explosive strength using vertical jump test and to compare intervention group with control group.

II. METHODOLOGY

The study was carried out at LSFPEFS COP Nigdi. Ethical committee clearance was obtained and permission was taken from the department. Written consent was taken from the subjects who fulfil the inclusion criteria and exclusion criteria. A sample size of 32 was calculated using winpepi 11:65 software. Power of the study is 0.95. Participants were divided into two groups by simple random sampling intervention group (Group A, n=16) and control group (Group B, n=16). Details like name, age, height, weight, BMI, limb length, number of playing years, history of any Previous injuries, and any medical condition of the player was Recorded in the evaluation performa. Star excursion balance test, T- test of agility, vertical jump test was Performed before intervention and scores were noted. Training programme was explained to intervention group. Intervention group followed training programme for 5 weeks and control group does not perform any exercise they continue to do their daily activities. 5 weeks star excursion balance test, T- test of agility, vertical jump test Was performed again and score was taken.

II.A INCLUSION CRITERIA

- Age 18-25 Years
- Male Players
- Amature players having minimum 1 year of experience
- Willing for participation

II.B EXCLUSION CRITERIA

- Players having lower limb injury
- Musculoskeletal problem that decreased the compliance of the players to participate in the study.
- Any medical condition that would impair their playing activities.

II.C OUTCOME MEASURES

1. Star Excursion Balance Test (SEBT) :-

- The Star Excursion Balance Test (SEBT) is a dynamic test that requires strength, flexibility, and proprioception.
- The SEBT can also be used to compare balance ability among different sports and to assess physical performance.
- Before the SEBT can be performed, a small amount of setup is required. Four strips of athletic tape will need to be cut to a length of 6-8 feet each.
- Two pieces will be used to form a '+', with the other two being placed over top to form an 'x' so that a star shape is formed.
- It is important that all lines are separated from each other by a 45° angle.
- The person performing the test must maintain a their balance on one leg, while using the other leg to reach as far as possible in 8 different directions.
- Once in each of the following directions: anterior, anteromedial, medial, posteromedial, posterior, posterolateral, lateral and anterolateral.
- Scoring System :- With the test complete and all performances measured and recorded, the test administrator can then calculate the athlete's SEBT performance scores using the following simple equations:
- Average distance in each direction (cm) = $\text{Reach 1} + \text{Reach 2} + \text{Reach 3} / 3$

- Relative (normalised) distance in each direction (%) = Average distance in each direction / leg length *100

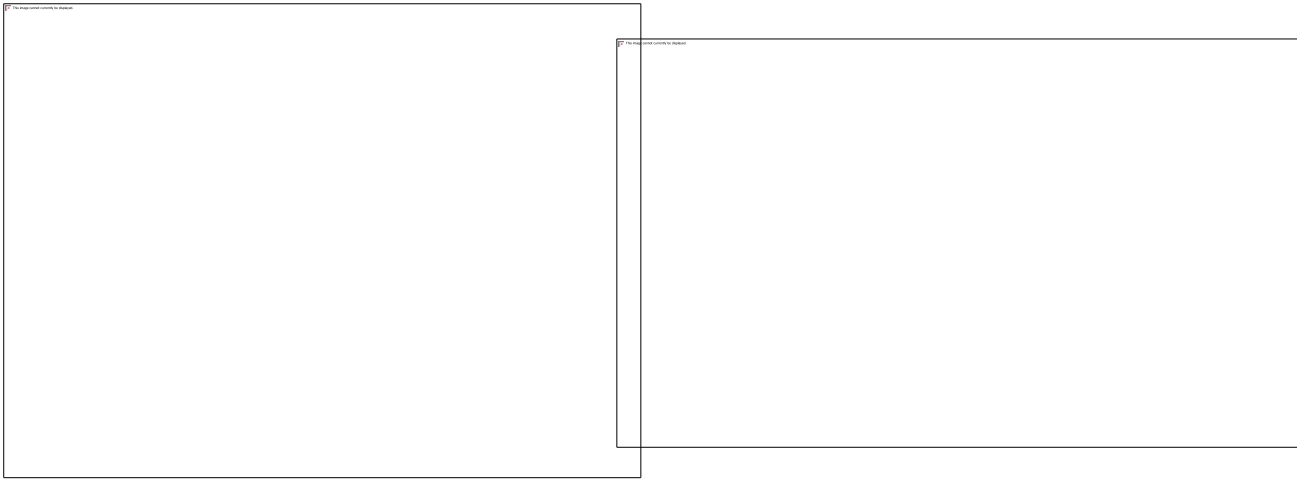


Fig.1 star excursion balance test

2 . T – TEST OF AGILITY :-

- Purpose: The T-Test is a test of agility for athletes, and includes forward, lateral, and Backwards running.
- Equipment required: Tape measure, Marking cones, Stopwatch.
- Test setup :- Set out four cones as illustrated in the diagram above (5 yards = 4.57 m, 10 Yards = 9.14 m).
- Procedure: The subject starts at cone A. On the command of the timer, the subject sprints To cone B and touches the base of the cone with their right hand. They then turn left and Shuffle sideways to cone C, and also touches its base, this time with their left hand. Then Shuffling sideways to the right to cone D and touching the base with the right hand. They Then shuffle back to cone B touching with the left hand, and run backwards to cone A. The Stopwatch is stopped as they pass cone A.
- Scoring :- The trial will not be counted if the subject crosses one foot in front of the other While shuffling, fails to touch the base of the cones, or fails to face forward throughout the test. Take the best time of three successful trials to the nearest 0.1 seconds.



Fig. 2 T- Test of agility

3) VERTICAL JUMP TEST :-

- This test is designed to measure lower limb explosive power by measuring the height a client is able to jump.
- Equipment required :- measuring tape or marked wall, chalk for marking wall.

Procedure :- the person stands side on to a wall and reaches up with the hand closest to the Wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach. The person puts chalk on their finger tips to mark the wall at the height of their jump. The person then stands away from the wall, and jumps vertically As high as possible using both

arms and legs to assist in projecting the body upwards. 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 best of three attempts is recorded.

- Scoring :- The jump height is usually recorded as a distance score.

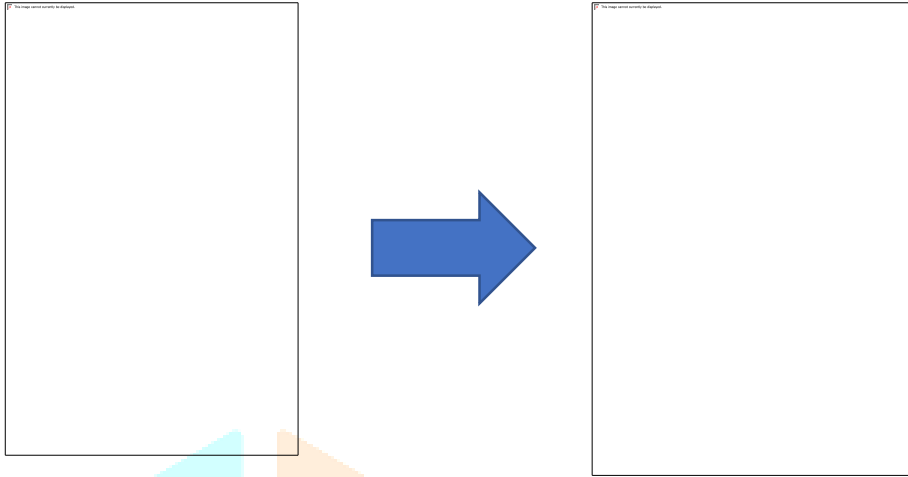


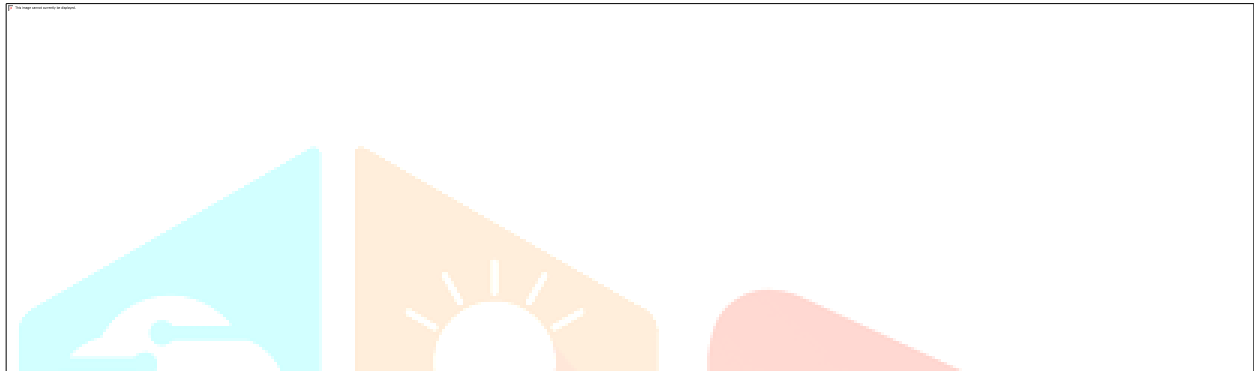
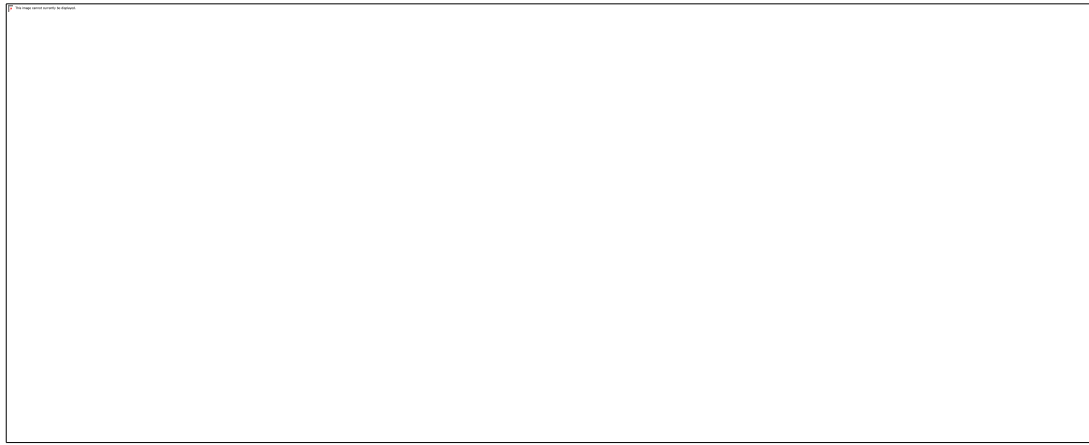
Fig . 3 VERTICAL JUMP TEST

II.D INTERVENTION PROTOCOL

- The intervention programme consisted of an five-week proprioceptive training.
- The frequency of exercising was consistent throughout the full five weeks (Three training sessions per week)
- Participants were encouraged to perform the exercises and gradual increase of training load, that is, exercises became more difficult after several sessions.
- 10 reps of exercise was performed.



Fig. 4 PROPRIOCEPTIVE EXERCISE TRAINING



III. STATISTICAL ANALYSIS

Data was collected and analysed by appropriate statistical test. Paired t-test and Unpaired t-test is performed to compare results in intragroup and intergroup respectively.

IV. RESULTS

Mean comparison of age, height, weight and BMI was done for Players in both the groups. Between group analysis showed that there was no significant difference in means of age, height, Weight, And BMI of the players in both group $p > 0.05$.



Table:1 Mean comparison of Age, Weight, Height and BMI

A) INTERVENTION GROUP :-

1) Star excursion test :-

The result of study revealed that dynamic balance for both lower extremities (dominant and non dominant) in all eight components (Anterior, Anteromedial, Anterolateral, Medial, Posterior, Posteromedial, Posterolateral, Lateral) as measured by star excursion balance test showed that there was a highly significant improvement seen in intervention group, $p < 0.05$.



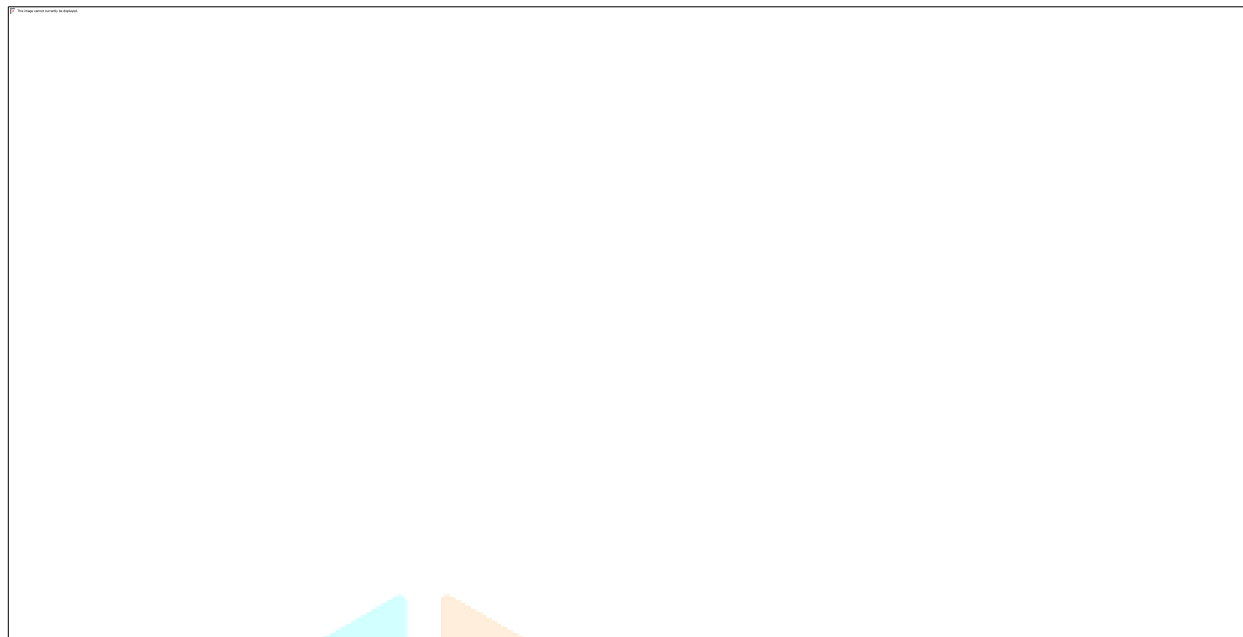
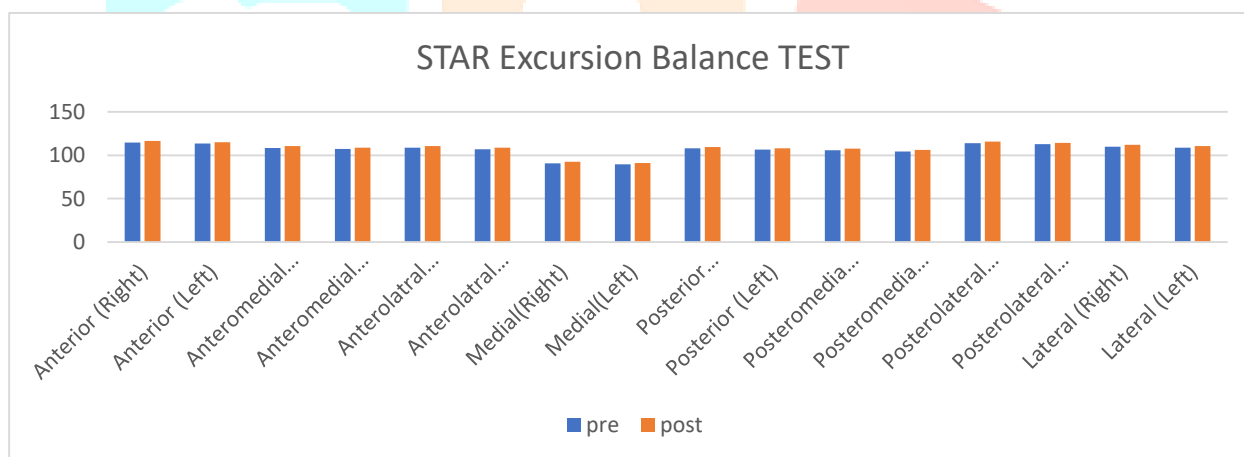


Table:2 Mean comparison of dynamic balance between Pre intervention and Post intervention.



2) T- test of agility :-

The result of study revealed that agility as measured by T- test of agility showed that there was a highly significant improvement seen in intervention group, $p < 0.05$ (Table :3).

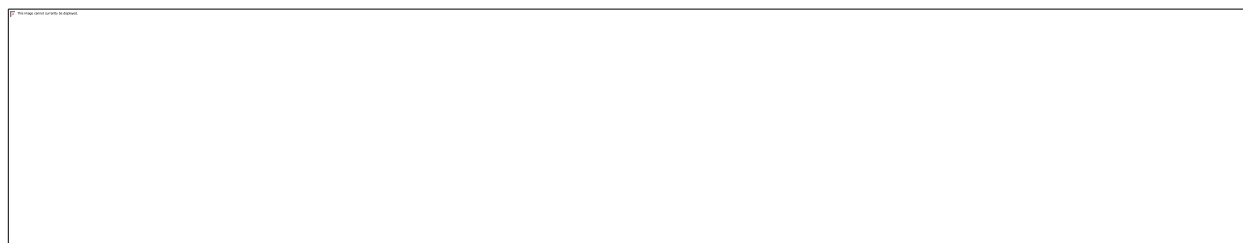
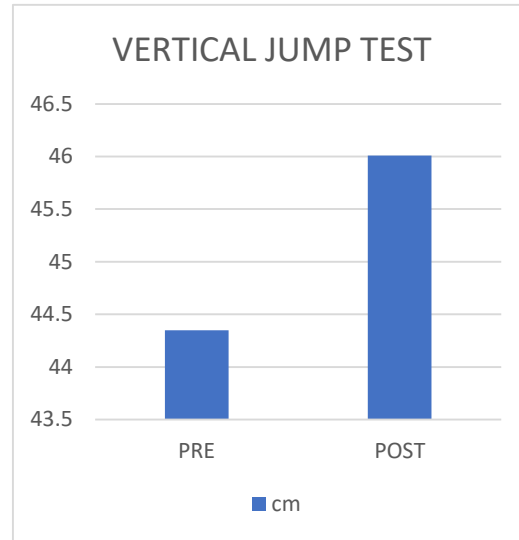
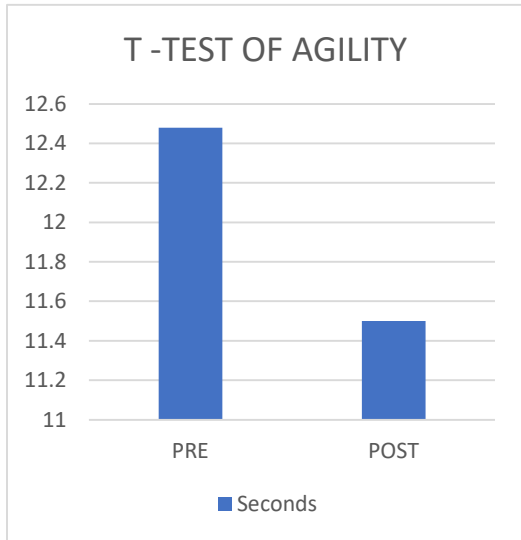


Table:3 Mean comparison of Agility between Pre intervention and Post intervention.



3) vertical jump test:-

The result of study revealed that vertical jump as measured by vertical jump test showed that there was a highly significant improvement seen in intervention group, $p < 0.0001$ (Table :4).

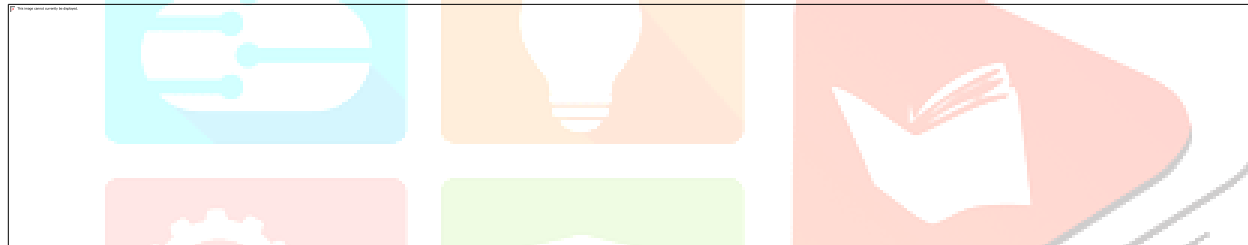


Table: 4 Mean comparison of vertical jump between Pre intervention and Post intervention.

CONTROL GROUP :-

1)Star excursion test :-

The result of study revealed that dynamic balance for Anteromedial (left) , Posteromedial (right and left), Posterolateral (right and left) as measured by star Excursion balance test showed that there was a significant improvement seen in Control group. , $P < 0.05$ or 0.001 (Table :5).

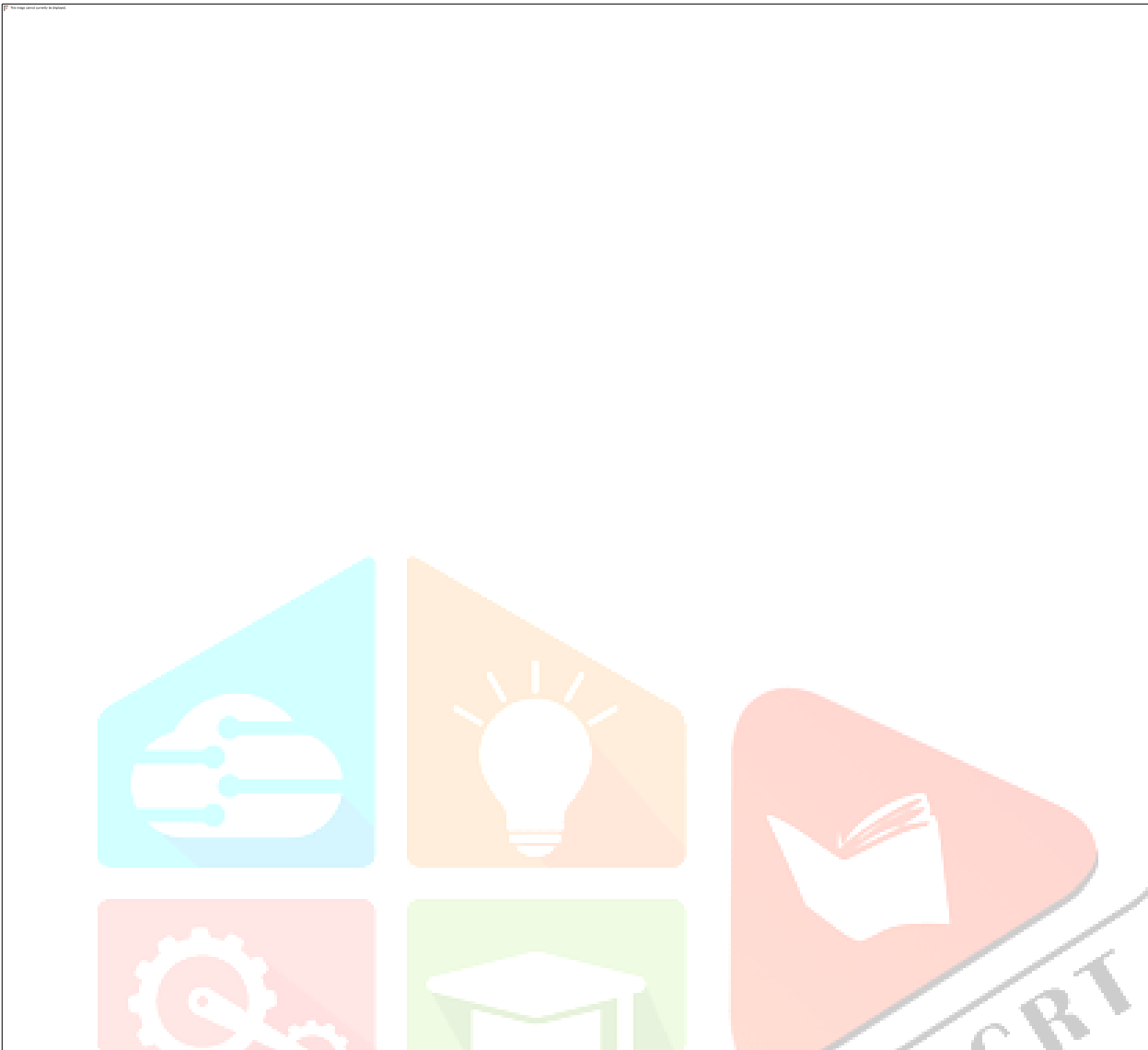
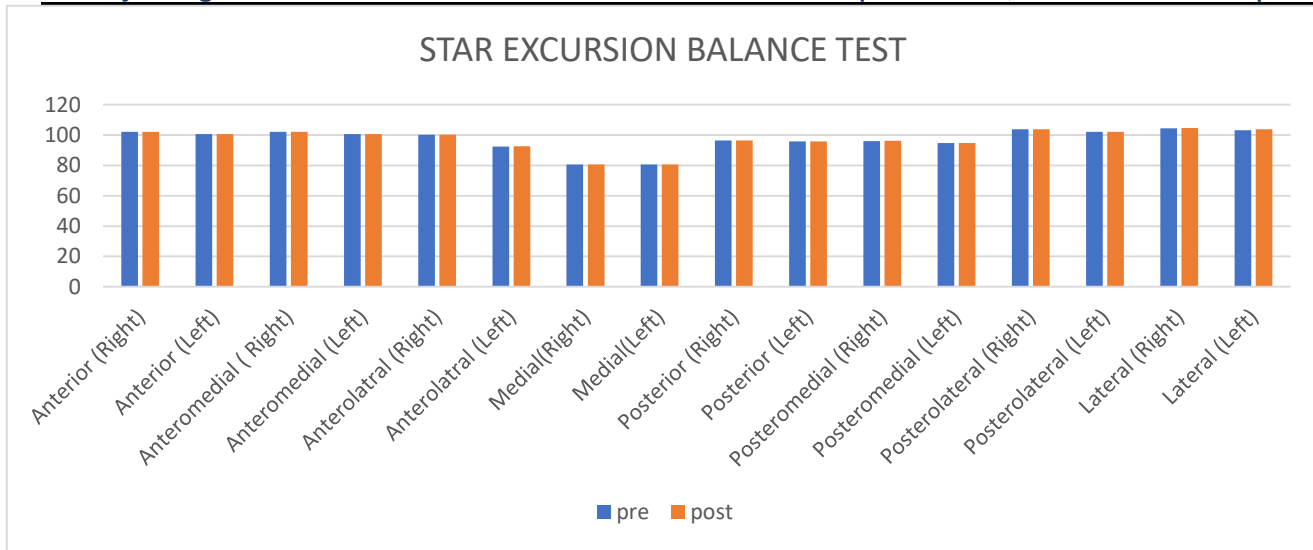




Table: 5 Mean comparison of dynamic balance in control group between Pre



2)T -test of agility :-

The result of study revealed that agility as measured by T- test of agility showed that there was a significant improvement seen in control group, $p < 0.05$ (Table :6)

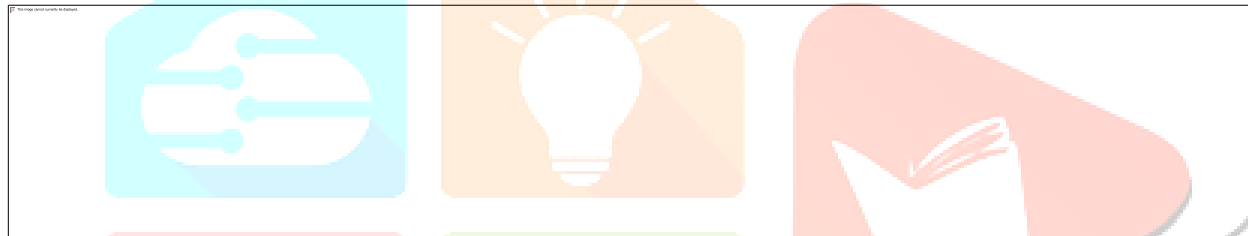
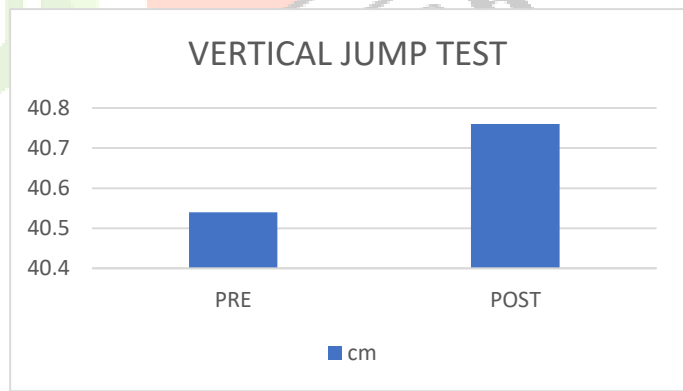
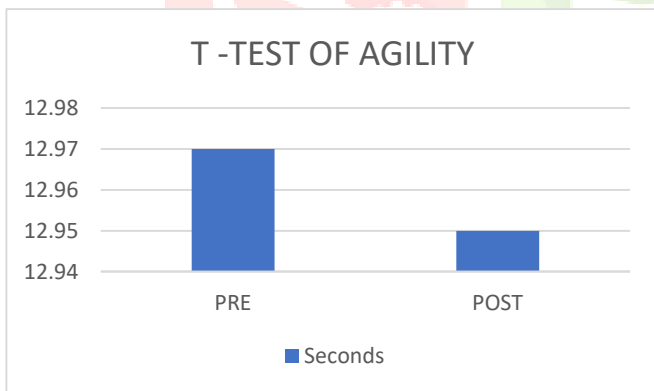


Table:6 Mean comparison of Agility in control group between Pre and Post Study.



3)Vertical jump test :-

The result of study revealed that vertical jump as measured by vertical jump test Showed that there was a significant improvement seen in Control group, $P < 0.05$ (Table :7).

Table: 7 Mean comparison of vertical jump in control group Pre and Post Study.

To compare the intervention group with control group Unpaired t-test is performed. The between group analysis for balance, agility and vertical jump using Unpaired t-test showed that there was significant difference between both the groups after 5 weeks of intervention.

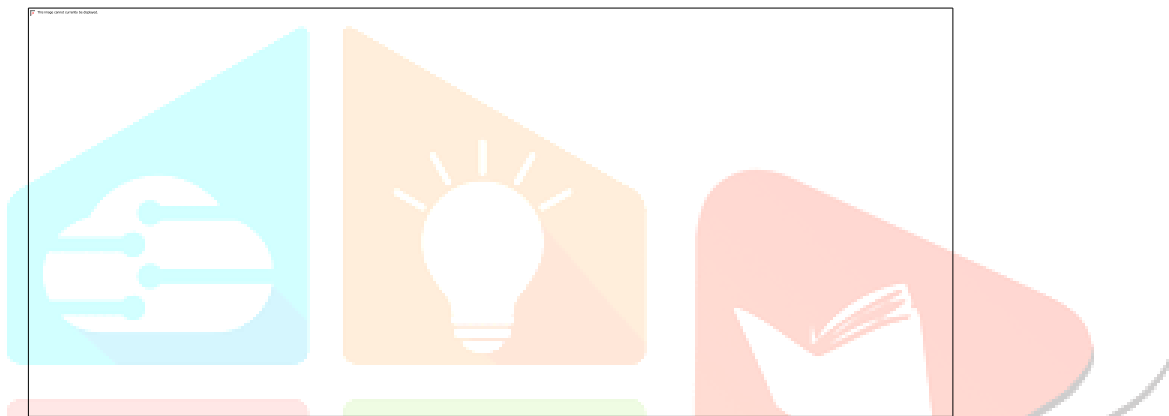


Table: 8 Unpaired t-test between Intervention group and control group

Unpaired t-test showed that balance is improved significantly In intervention group in Anterior (Right, Left) , Anterolateral (Left), Medial (Right, Left), Posterior (Right, Left) , Posteromedial (Right) , Posterolateral(Right , Left) compared to control group. There are non significant changes seen in Anteromedial (Right, Left) , Anterolateral (Right), Posteromedial(-Left), Lateral (Right, Left).

Unpaired t-test showed that agility is improved in intervention group compared to control group ,($P < 0.05$).

Table:9 Unpaired t-test between Intervention group and control group

Unpaired t-test showed that vertical jump is improved in intervention group Compared to control group.($P < 0.05$).

Table:10 Unpaired t-test between Intervention group and control group

V. DISCUSSION

This study aimed to find effectiveness of proprioceptive exercise on balance, agility and vertical jump in amateur volleyball players. The players in this study had Similar baseline values for age, Height, weight and BMI.

One participant from intervention group was drop out at 2nd week of Intervention due to lower Limb injury. At the end of 5 weeks number of participants in intervention group (n=15) and Control group (n=16).

The results of study revealed that both groups improved significantly at the end of 5th week but Intervention group which performed Proprioceptive exercise programme showed highly significant difference for dynamic balance, agility and lower limb explosive strength as measured by star excursion balance test , T- test of agility, Vertical jump test as compared to Control group which does not perform any exercise programme they continue with their daily activities for 5 weeks.

Intervention Group has improvement in all 8 components of star excursion balance test (Anterior, Anteromedial, Anterolateral, Medial, Posterior, Posteromedial, posterolateral, Posterior)for both the lower extremities as measured by star excursion balance test. Agility and Vertical jump is improved highly significant in intervention group as measured by T- test of Agility and vertical jump test respectively.

The result of study revealed that dynamic balance for Anteromedial (left) , Posteromedial (right And left), Posterolateral (right and left) as measured by star excursion balance test showed that there was a significant improvement seen in control group. Other components of star excursion Balance test does not showed any significant changes . Agility and vertical jump is significantly improved in control group. The reason for this can be that participants where involved in other sporting activities during that 5 weeks of period.

Balance is improved in maximum components of star excursion balance test, agility and vertical jump is significantly improved in intervention group compared to the control group after 5 weeks Of Proprioceptive exercise training.

The effects of proprioceptive training on the central and peripheral level that can be related to the development of motor skills. Central effects include greater body awareness due to the improved sense of the position and movement of joints (Palma, 2005; Eils & Rosenbaum, 2001; Gruber & Gollhofer, 2004). Body posture and balance are also improved. So balance is improved due to improvement in sense of position and movement of joint.

There is an increase of rate of force development during voluntary muscular contraction (Gruber & Gollhofer, 2004). This suggests the possibility of proprioceptive training influence on the neuromuscular system due to the initiation of the generated force, i.e. an improvement of explosive strength and neuromuscular activation at the start of a voluntary muscular activity. The improvement of proprioception can have a positive impact on neural activation – excitation of the motor-neural system, especially concerning the stretch-shortening cycle. The proprioceptive training affects the increase in strength of the flexor and extensor muscles of the foot . It also affects the increase in strength of the muscles on the back side of the thigh. The increase in strength of leg extensor muscles along With the inhibition of stretch reflex and the co-contraction mechanism can be the reasons for the improvement in vertical jumping performance.

Based on the influence of proprioceptive training on the rate of force development and neural activation of individual muscles found in several studies (Bruhn and associates, 2004; Gruber & Gollhofer, 2004) we hypothesized that proprioceptive training could have positive effects an the activity with an explosive character. The analysis of body acceleration and running as well as the results of the research showed that the proprioceptive training could improve the results in the T-test of agility , and that it could considerably contribute to the acceleration of the body after a turn the acceleration depends, before all, on the rate of force development.

Proprioceptive exercise training programme can be incorporated in training programme of volleyball players in addition to the conventional training programme to improve dynamic balance, agility and lower limb explosive strength.

VI. CONCLUSION

Proprioceptive exercise training is effective in improving dynamic balance, agility and lower limb explosive strength in amateur volleyball players.

VII. LIMITATION

- The limitation of the study is limited age group because of which results cannot be generalised
- Female volleyball players were not included in the study, so any gender specific differences in the results and associated factors could not be studied.
- The sample population was composed of random college students who were not necessarily athletes. Research indicates that well-trained athletes respond differently than the general Population ⁽¹⁰⁾. As a result, the findings of this study would apply more toward the general Population than specifically athletes.

VIII. RECOMMENDATION AND FUTURE SCOPE OF STUDY

- Study can be done on a larger sample size and long term effects Of Proprioceptive training on dynamic balance, agility, vertical jump can be studied.
- Same Training programme can be given to professional volleyball players to improve their balance, agility and vertical jump.

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