



“ADDED EFFECTS OF PROPRIOCEPTIVE TRAINING ON DYNAMIC POSTURAL STABILITY IN MALE KHO-KHO PLAYERS (AMATEURS) USING STAR EXCURSION BALANCE TEST”

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ABSTRACT

Background: Kho-Kho is a traditional, active Indian team sport which is heavily based on athletic training requiring optimum use of all the sensorimotor skills in their possession like agility, speed, postural stability, strength, quick reaction time, proper peripheral vision, endurance and neuromuscular coordination. Proprioception is defined as awareness of posture, movement, position and changes in equilibrium, tension, and resistance and is relayed by the proprioceptors. Dynamic postural stability plays the most important role in the player's performance and is affected by the accurate functioning of Proprioceptors. Inaccurate proprioception functioning leads to reduction in dynamic postural stability and increases the risk of injuries in the players. Proper assessment of the dynamic postural stability in Kho-Kho players is a necessity for prevention of injuries.

Aim: The aim of the study is to see the added effects of Proprioceptive Training on Dynamic Postural Stability in male Kho-Kho players (amateurs) using Star Excursion Balance Test.

Method: Thirty (30) male, amateur Kho-Kho players of age ranging from 17-24 will be selected for the purpose of study. Subjects will be randomly categorized into Group A (Control) and Group B (Experimental) with 15 in each group. Pre-interventional assessment will be done using the SEBT on both the legs. Group A will undergo conventional balance exercises and Group B will perform agility-based proprioceptive training along with conventional balance exercises alternatively. Post-interventional assessment will be taken after 4 weeks using the SEBT.

Outcome measures: Star excursion balance test is the outcome measure used to measure the prior and after intervention differences.

Result: Out of 30 participants taken, the 15 participants present the Experimental group (Group B) which performed the combination of proprioceptive exercises and conventional balance exercises, showed clinical and Statistical significance in terms of SEBT outcome with higher mean difference values resulting in [p=0.001]

Conclusion: It is concluded that a treatment protocol comprising the combination of agility-based Proprioceptive balance exercises and the conventional balance exercises has a good reliability in terms of rehabilitation and balance. The exercise training protocol will eventually lead to a significant overall improvement in sports performance of the player.

Key words: Kho-Kho, Amateurs, Proprioception, Dynamic postural stability, Star excursion balance test (SEBT)

I. INTRODUCTION

Throughout history, there has been a greater emphasis on maintaining one's physical health to lead a healthier life. The younger generation is understanding the value of playing a sport in order to achieve physical fitness and are starting to play sports while laying proper emphasis on the skillsets required as well.

Kho-Kho is a traditional, active Indian team sport which is heavily based on athletic training. The nature of the game is such that it forces the player to persistently use all the skills in their possession in the most optimal way. Being constantly on the move requires skills like speed, agility, higher neuromuscular coordination, dynamic postural stability, good vision and perception, and overall greater muscular strength.^[7] The game lasts for a total game time of 36 mins having 4 halves of 9 minutes each. The runner's job is to consistently save themselves from getting tagged by the chaser for as long as they can within the boundaries of ground.^[7] Hence, if a player possesses these highly developed skills, the player is said to be of a greater caliber than others.^[1]

Postural control is defined as the ability to maintain a certain posture for a given amount of time without any external assistance. It is an essential body function which helps in maintaining the equilibrium and the balance of the body. It is of 2 types, Static and Dynamic Postural Control.^[1]

Dynamic Postural Control is defined as maintaining a certain body posture while in motion or performing any particular task. It is the ability of the body to maintain equilibrium of muscular forces while in motion and perform smoother and effective body movements.^[6] Both Static and Dynamic Postural Control of the body are important aspect regarding effective performance of an individual in sports.

Proprioception is defined as awareness of posture, movement, position and changes in equilibrium, tension, and resistance. It has a direct connection with the central nervous system through mechanoreceptors present in the joint, muscles and tendons. Proprioceptors are the special sense organs which relay signals regarding proprioception and provide information responsible for countering any external forces or tension produced in the muscles while maintaining the stability of muscle tone.^[1] Various types of proprioceptors are Muscle spindle, Golgi Tendon Organ (GTO) and joint receptors.^[9]

The Dynamic postural control is mainly achieved by accurate working of the proprioceptors. The accuracy of proprioceptive signals passed on can further be developed and improved by training them. It is an important aspect regarding effective performance of an individual in sports and hence its assessment is equally necessary for the identification and prevention of injury and plan a training regime to improve the balance. If due to any physiological condition or any injury/trauma, functioning of the proprioceptors becomes inaccurate, the dynamic postural control is going to be affected as well. So as to train the dynamic balance of the body, proprioception training is deemed significant and effective. The proprioception of the anti-gravity muscles like Gluteus Maximus, Quadriceps, Hamstrings, Gastrocnemius, Soleus and Tibialis Anterior is significant.

The SEBT (Star excursion Balance Test) is a functional test used to assess the dynamic postural control in clinical practice and various research settings. Studies were done previously, proving that SEBT is a very reliable test with having intra-rater reliability ranging from 0.88 to 0.96 with very little standard error of measurement (2.41 to 3.30).^[4]

It requires the subject to stand in a single legged stance in the center of a grid formed by pair of 4 straight lines which are at 45-degree angle of each other. The subject then achieves a single legged stance and then uses the non-stance leg to reach out maximally on each of the 8 directions and tap on the line with the foot. This activity requires good lower limb muscular strength, neuromuscular coordination, proprioception, and adequate range of motion for lower limb. The pre-treatment values and the post-treatment values are recorded. Based on the difference in the values that we obtain, SEBT will help analyze the performance of the individual and infer a conclusion.^[4]

II. AIM

To see the added effects of Proprioceptive Training on Dynamic Postural Stability in male Kho-Kho players (amateurs) using Star Excursion Balance Test.

III. OBJECTIVES

- To see the added effects of Proprioceptive Training on Dynamic Postural Stability in male Kho-Kho players (amateurs) using Star Excursion Balance Test adjunct with Daily conventional training.
- To see the effects of conventional balance training in male Kho-Kho players (amateurs) using Star Excursion Balance Test.

IV. METHODOLOGY

- TYPE OF STUDY: Comparative study
- STUDY SETTING: Bhanu Talim Sanstha, Miraj
- STUDY DURATION: 6 months
- STUDY DESIGN: Randomized Control trial
- TYPE OF SAMPLING: Simple Random Sampling
- SAMPLE SIZE: 30 [15 each]

V. MATERIALS

- Weight machine
- Inch tape
- Sticking tape
- Pen marker
- Cones/Markers

VI. INCLUSION CRITERIA

- Subjects of age 17-24 years.
- Gender – Male
- BMI: According to Asia Pacific 17.50 - 22.90 (Normal)
- Newly joined players (< 1 months)
- Return to sport (minimum 2 months of inactivity)

VII. EXCLUSION CRITERIA

- Deformities of lower limb (Coxa Vara, Genu Valgum, Genu Varus)
- Recent lower limb Soft Tissue Injuries (sprain, strain, bursitis or tendonitis)
- Recent Surgeries of lower limb
- Cardiovascular conditions
- Obesity
- Denial of consent

VIII. PROCEDURE

Ethical clearance will be obtained from the Institutional Ethical Committee. Screening of the subjects will be done and selected according to the inclusion criteria. Prior to the study, procedure will be explained to the subjects and written informed consent will be taken from them. Pre-intervention and post-intervention assessment will be done using the Star Excursion Balance Test. The selected subjects then will randomly be divided into two groups comprising of 15 in each. Group A is the control group and will be given Conventional Balance Exercises whereas Group B is the experimental group and will be given agility-based Proprioceptive balance exercises along with Conventional balance exercises, alternatively.

Both groups will perform the respective exercises for 1 session/day for 5 days/week with 2 days of rest in between.

INTERVENTION

GROUP A (CONTROL)

This group consists of players who will undergo only the conventional balance exercisettraining for 1 session/day for 5 days/week with 2 days of rest in between.

The conventional balance exercises includes^[3] –

1. Stretching (15 seconds hold 5 repetitions)

- Quadriceps
- Hamstrings
- Calf muscles
- Hip abductors
- Hip adductors

2. Strength training (10-15 repetitions)

- Abdominal curl ups
- Squats (weighted)
- Lunges
- Planks (1 minute hold)

3. Postural control (eyes open/close)

- Single legged stance
- Leg reach outs
- Tandem walking
- Toe / Heel raise exercise
- Walking on soft/uneven path



GROUP B (EXPERIMENTAL)

This is the experimental group and consists of players who will perform the conventional balance exercises, and the proprioceptive balance exercises alternatively, for 1 session/day for 5 days/week with 2 days of rest in between.

The proprioceptive balance exercises will be done for 3 days a week and it will help improve the speed, agility, and neuromuscular coordination of the player.

The other days players will perform the regular conventional balance exercises which are performed as usual by the players themselves.

The Proprioception training includes exercises^[1] –

1. Side jumping (10-15 repetitions)

- A line is created, and the player is asked to jump over it in sideways direction alternatively.



2. Side running (10-15 repetitions)

- 4-5 parallel markers are placed on the ground and the player is asked to run over it insideways direction.
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figure 2 – side running

3. Squat Jumps (10-15 repetitions)



figure 3 – squat jumps

4. Diagonal running (3-4 repetitions)

- Cones or markers are kept in straight parallel lines and the player is asked to run towards each marker in a diagonal manner.



figure 4 – diagonal running

5. Plyometric Lunges with alternating the legs (10-15 reps)



figure 5 - plyometric lunges

6. Mountain climbers (10-15 Repetitions)



figure 6 – mountain climbers

7. Functional Reach-outs in 4 directions.

- Player stands in center and is asked to reach out in any of the 4 direction using hands or legs as commanded.
- The randomness of direction callouts is also introduced to challenge the player further.



figure 7 – functional reachouts

table 1 – intervention table

Day	Control Group	Experimental Group
1	Conventional Balance Training	Proprioceptive Balance Training
2	Conventional Balance Training	Conventional Balance Training
3	Conventional Balance Training	Proprioceptive Balance Training
4	Rest	Rest
5	Conventional Balance Training	Proprioceptive Balance Training
6	Conventional Balance Training	Conventional Balance Training
7	Rest	Rest

IX. STATISTICAL ANALYSIS

The Statistical analysis was done using Statistical Package for Social Sciences [SPSS] software version 23. Both Right and Left leg were assessed in the 8 directional components of the Star Excursion Balance Test. The level of significance for PRE and POST assessment for Star Excursion Balance Test between the groups was calculated using Unpaired T-test. The level of significance within the groups was calculated using Paired T-test. The level of significance was defined as $[p < 0.05]$.

X. RESULTS

The Data analysis was done using Statistical Package for Social Sciences [SPSS] software version 23. Both Right and Left leg were assessed in the 8 directional components of the StarExcursion Balance Test.

table no 2: shows Mean, Standard deviation, t-value and p-value between groups independent sample t test for left side

Variable	Time frame	Group	Mean	SD	t-value	p-value
SEBT_ANT	Pre	Grp-A	120.73	17.88	0.081	0.936
		Grp-B	121.20	13.51		
	Post	Grp-A	126.53	17.47	2.255	0.032*
		Grp-B	138.93	12.18		
SEBT_AM	Pre	Grp-A	125.27	19.59	0.075	0.941
		Grp-B	124.80	14.11		
	Post	Grp-A	131.53	18.53	1.618	0.117
		Grp-B	140.80	12.20		
SEBT_MED	Pre	Grp-A	120.53	19.99	0.459	0.650
		Grp-B	117.47	16.45		
	Post	Grp-A	127.33	19.38	1.075	0.291
		Grp-B	134.13	14.97		
SEBT_PM	Pre	Grp-A	111.33	16.11	0.991	0.330
		Grp-B	116.13	9.61		
	Post	Grp-A	118.33	15.36	3.222	0.003*
		Grp-B	133.33	9.45		
SEBT_POST	Pre	Grp-A	110.67	13.25	1.272	0.214
		Grp-B	116.33	11.04		
	Post	Grp-A	118.00	13.35	3.539	0.001*
		Grp-B	133.47	10.41		
SEBT_PL	Pre	Grp-A	114.87	12.45	1.100	0.281
		Grp-B	119.60	11.07		
	Post	Grp-A	121.73	12.67	3.359	0.002*
		Grp-B	136.13	10.72		
SEBT_LAT	Pre	Grp-A	118.13	13.64	0.190	0.851
		Grp-B	119.13	15.14		
	Post	Grp-A	124.67	12.23	2.300	0.029*
		Grp-B	136.07	14.80		
SEBT_AL	Pre	Grp-A	119.27	12.57	0.770	0.448
		Grp-B	122.87	13.03		
	Post	Grp-A	125.73	12.80	2.887	0.007*
		Grp-B	138.80	11.98		

graph no. 1: between groups independent sample t test for left side.

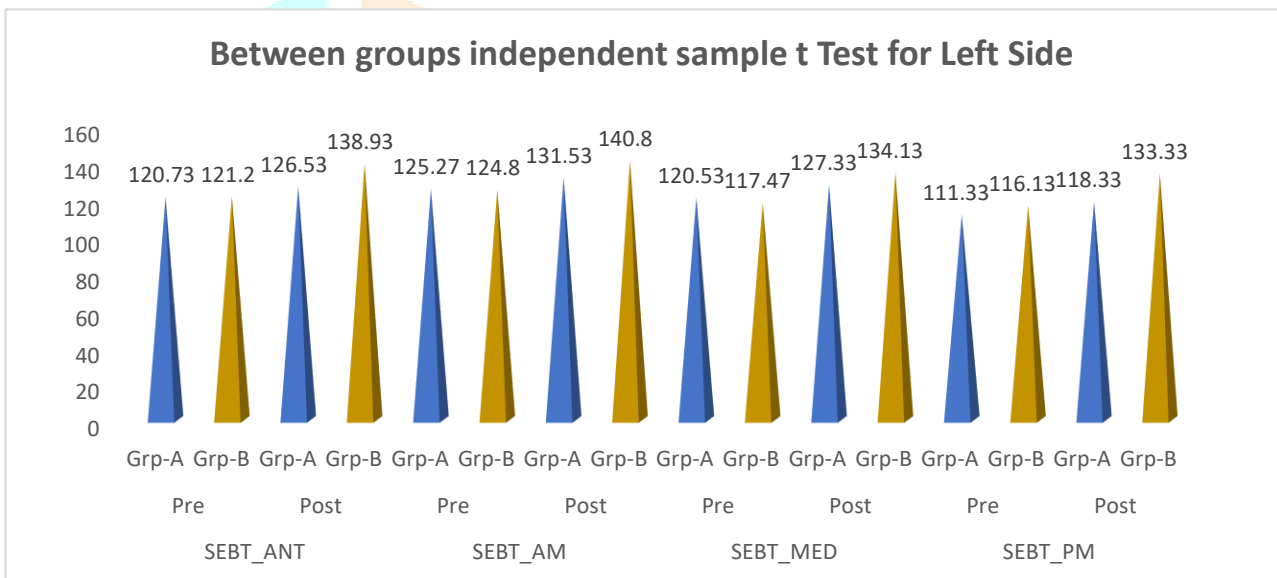
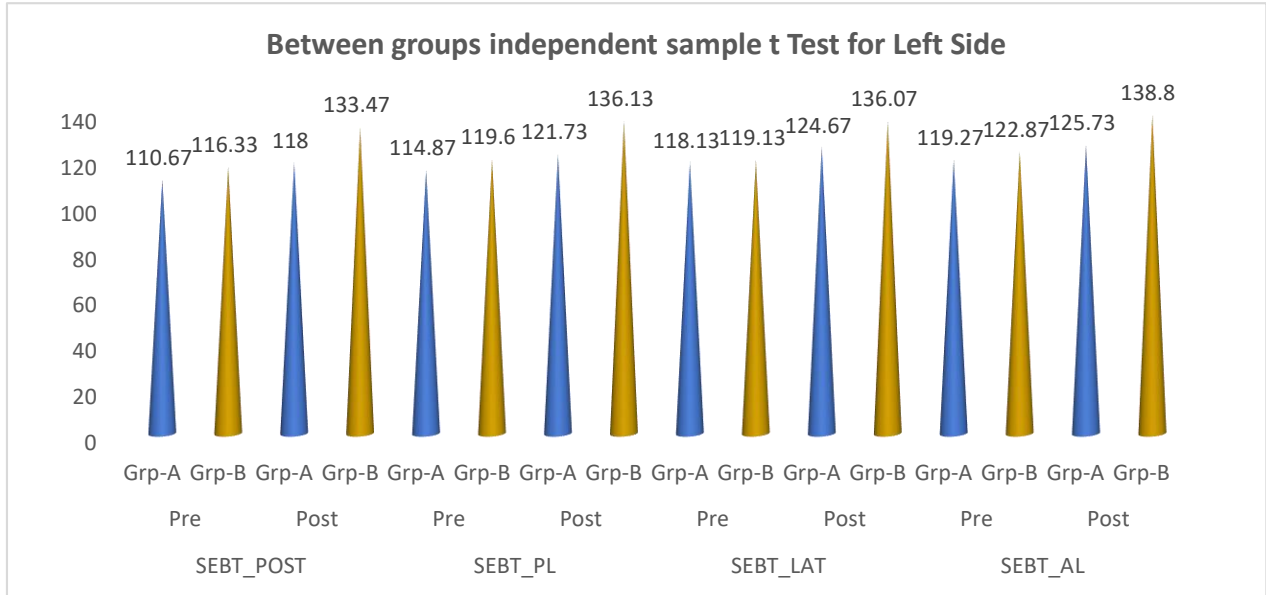
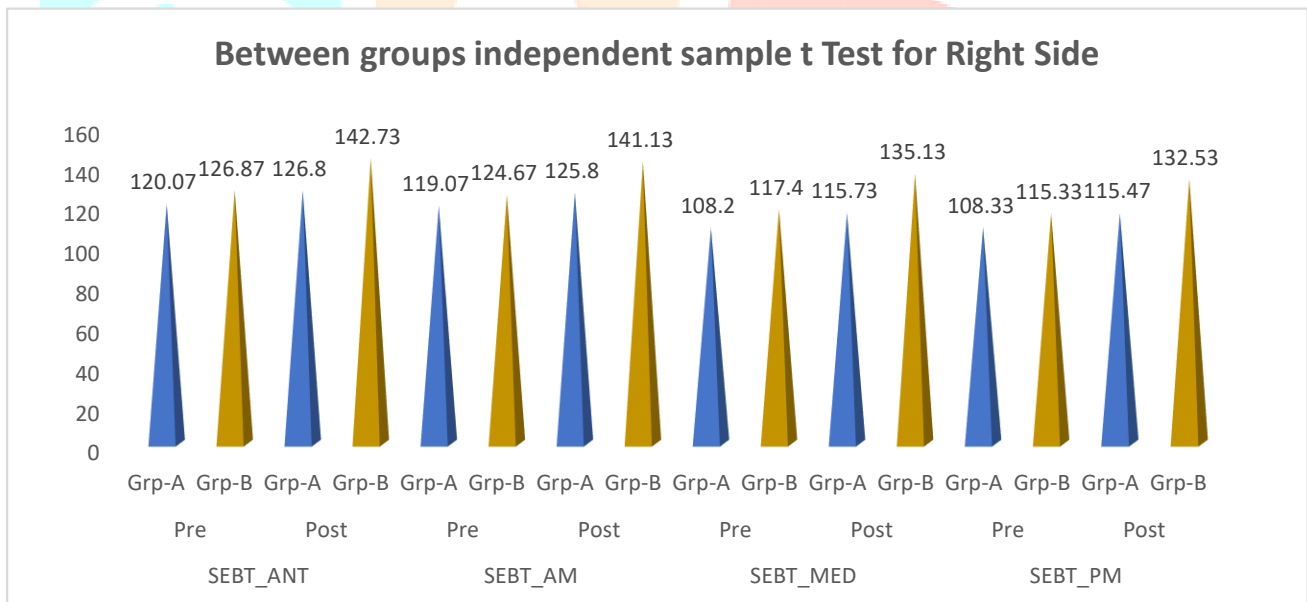


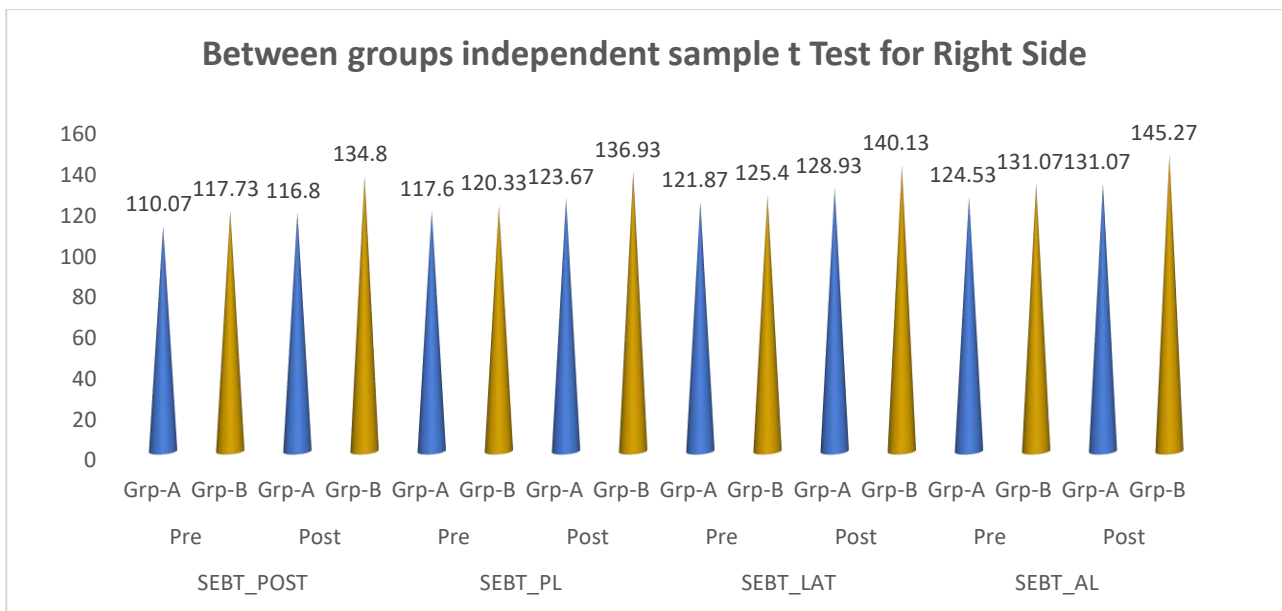
Table no. 3: shows Mean, Standard deviation, t-value and p-value between groups independent sample t test for right side

Variable	Time frame	Group	Mean	SD	t-value	p-value
SEBT_ANT	Pre	Grp-A	120.07	14.46	1.356	0.186
		Grp-B	126.87	12.97		
	Post	Grp-A	126.80	13.18	3.642	0.001*
		Grp-B	142.73	10.65		
SEBT_AM	Pre	Grp-A	119.07	18.00	0.969	0.341
		Grp-B	124.67	13.30		
	Post	Grp-A	125.80	17.15	2.850	0.008*
		Grp-B	141.13	11.83		
SEBT_MED	Pre	Grp-A	108.20	16.77	1.660	0.108
		Grp-B	117.40	13.40		
	Post	Grp-A	115.73	16.93	3.507	0.002*
		Grp-B	135.13	13.13		
	Pre	Grp-A	108.33	16.14	1.471	0.153
		Grp-B	115.33	8.92		

SEBT_PM	Post	Grp-A	115.47	15.92	3.581	0.001*
		Grp-B	132.53	9.34		
SEBT_POST	Pre	Grp-A	110.07	16.54	1.549	0.133
		Grp-B	117.73	9.70		
	Post	Grp-A	116.80	16.47	3.649	0.001*
		Grp-B	134.80	9.69		
SEBT_PL	Pre	Grp-A	117.60	15.83	0.531	0.600
		Grp-B	120.33	12.13		
	Post	Grp-A	123.67	15.84	2.655	0.013*
		Grp-B	136.93	11.12		
SEBT_LAT	Pre	Grp-A	121.87	14.42	0.695	0.493
		Grp-B	125.40	13.42		
	Post	Grp-A	128.93	13.97	2.350	0.026*
		Grp-B	140.13	12.06		
SEBT_AL	Pre	Grp-A	124.53	12.36	1.425	0.165
		Grp-B	131.07	12.75		
	Post	Grp-A	131.07	12.10	3.588	0.001*
		Grp-B	145.27	9.41		

graph no. 2: shows Mean, Standard deviation, t-value and p-value between groups independent sample t test for right side.





Results from analysis

- The final analysis proves that the Group B is clinically as well as statistically highly significant than the Group A.
- When the components of the SEBT were compared to the Group A, Group B recorded significantly higher mean values for post intervention and mean value difference shows significant improvement in excursion post intervention. The standard deviation showed consistency with post intervention value which is lesser than pre value.
- Thus, reference to the results of the paired t test analysis at 5% significance level, there is significant statistical reliable difference between pre and post intervention values with p-value less than the 5% significance level ($0.001 < 0.05$) in all the 8 directions and therefore it justifies the improvement in health outcomes post intervention.
- This states that Proprioceptive balance exercises along with the conventional balance exercises have good reliability in terms of rehabilitation and exercise training and it will eventually lead to a significant overall improvement in sports performance of the player.

XI. DISCUSSION

Sports play a significant part in the life of an individual and being in the most optimum health is a necessity for any sports player. Kho-Kho is a traditional Indian sport where the player must have ideal sensorimotor skills, musculoskeletal and cardiorespiratory system functioning. The skills focused are speed, agility, high neuromuscular coordination, postural stability, strength, quick reaction time and peripheral vision.

Postural control is the ability to maintain a certain posture for a given amount of time without any external assistance and is an essential body function in maintaining the body's equilibrium and the balance. It is of two types, Static Postural Control and Dynamic Postural Control.^[1] Dynamic Postural Control is the body's ability to maintain a certain posture while in motion or performing any task. It is the ability to maintain equilibrium of muscular forces while performing smoother and effective body movements.^[6]

Proprioception is a mechanism present in the body which has direct connection with the central nervous system through proprioceptors present in the joint, muscles and tendons. It signals the body how to counter any external forces or tension produced in the muscles. Proprioceptors are the special sense organs which send signals regarding the resistance and provide information responsible for smoothly handling all the changes in movement while maintaining the stability of body and muscle tone.^[1] Different types of proprioceptors are Muscle spindle, Golgi Tendon Organ (GTO) and joint receptors. If due to any physiological condition or any injury/trauma, functioning of the proprioceptors becomes inaccurate, the dynamic postural control is going to be affected as well.

Dynamic Postural Control of the body is an important aspect regarding effective performance of an individual in sports and hence its assessment is equally necessary for the identification and prevention of risk of injury and plan an effective training regime to improve the balance. The accuracy of proprioceptive signals passed on can further be developed and improved by training them.

The purpose of the present study was to evaluate the added effects of the proprioceptive balance exercises along with conventional balance exercises on the amateur Kho-Kho players. The subjects in the experimental group underwent an experimental speed-agility based exercise protocol which aimed to improve the proprioceptive functioning of the lower limbs and subsequently improving the balance of the player.

The final result of the study demonstrated that compared to the control group, the subjects in the experimental group showed marked improvements in the dynamic postural stability of the individual players. The Comparison of post intervention statistical data (mean difference values) of both the Groups proved that Group B (experimental) was better than the Group A (control).

The Dynamic postural control is mainly achieved by accurate working of the proprioceptors of the antigravity muscles. Due to the proprioceptive training, the proprioceptor functioning of the lower limb muscles showed effective and improved performance. Since the protocol was based on speed and agility, the muscles were able to effectively counteract the gravity, stress and tension acting on muscles for a longer period of time before reaching the fatigue stage since the endurance of the muscles was challenged. The consistent stimulus on the proprioceptors improved the accurate relaying of information between the muscle belly, its tendon and the joint through the muscle spindle fibers, GTO and joint receptors.

Previous studies have proven that strength-based training is effective in improving the balance of the individual. But after analyzing the data obtained from the present study, it is proven that agility-based proprioception training is significantly effective in improving the dynamic postural stability and balance of the sports player.

Ashutosh Pandey et.al (2018) conducted a study to find out the effect of proprioceptive training on dynamic postural stability in National level kho-kho players. The non-dominant leg of the players was assessed using the SEBT. The result showed significant improvement in SEBT on non-dominant leg which led to improvement in Dynamic postural stability. It showed 44% improvement in dynamic postural stability and a positive improvement after 8 weeks of proprioceptive training.

MOHAMMADI, et.al. (2012) conducted a study to examine the effects of strength training on static and dynamic balance in young male athletes. The purpose of this study was to evaluate the added benefits of proprioception training along with the conventional balance exercises on the dynamic postural stability of an amateur kho-kho player using the SEBT and the results showed significant improvement in static and dynamic balance. The possible reason for such improvement was assumed to be increased muscular strength and stimulation of muscle spindles, increased muscle coordination.

Dr. SS Biju (2019) performed a study which was done to determine the effect of plyometric training on dynamic balance on kho-kho players age ranging from 16-18 years. The experimental group underwent intervention for 12 weeks, 3 days per week and 1 session per day. The results showed significant improvement in dynamic balance after the plyometric training. The author found that improving the strength of the muscle resulted in improved muscle functioning and hence resulted in improved balance of the players.

In Hyouk Hyong et.al. (2014) conducted a study to examine the reliability and validity of the Star Excursion Balance Test (SEBT) and understanding its efficient utilisation. The author found that SEBT had an intrarater ICC value ranging from 0.88 to 0.96 and standard error of margin was 2.41 to 3.30. This concluded that SEBT is a very reliable and significantly effective outcome measure to be used in clinical trials and research settings.

XII. CONCLUSION

Previous studies highlight that Conventional balance exercises have been a traditional and an ineffective way to improve the balance of an individual. Studies have also proven that strength-based exercise protocols are effective in improving balance of an individual.

This study emphasizes that Proprioceptive exercises which are agility-based; are responsible for improving the postural stability and balance of the individual as well. The evaluation of the result proves that individuals undergoing proprioceptive balance exercises along with the conventional balance exercises showed more significant improvements in dynamic postural stability.

Hence, it is concluded that a treatment protocol comprising the combination of Proprioceptive balance exercises and the conventional balance exercises has a good reliability in terms of rehabilitation and the exercises training will eventually lead to a significant overall improvement in sports performance of the player.

XIII. LIMITATIONS AND SUGGESTIONS

● Limitations:

1. Only male population was selected.
2. Normal BMI population was selected.

● Suggestions:

1. Study can be done in female population and compared with male population
2. Study can be done on underweight or overweight population.
3. Study can be done on larger population.
4. Study can be done for longer duration.

XIV. REFERENCES

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